Integrated National Energy and Climate Plan

Pursuant to the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the governance of the energy union and climate action, amending Directive 94/22/EC, Directive 98/70/EC, Directive 2009/31/EC, Regulation (EC) No 663/2009, Regulation (EC) No 715/2009, Directive 2009/73/EC, Council Directive 2009/119/EC, Directive 2010/31/EU, Directive 2012/27/EU, Directive 2013/30/EU and Council Directive (EU) 2015/652 and repealing Regulation (EU) No 525/2013

Contents

List of acronyms

ACER	Agency for the Cooperation of Energy Regulators
ACOMES	Annual Coordinating Meeting of Entity Stockholders
ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
AGEB	Arbeitsgemeinschaft Energiebilanzen e. V. [Working Group on Energy Balances]
AGEE-Stat	Arbeitsgruppe Erneuerbare Energien-Statistik [Working Group on Renewable Energy Statistics]
APEE	Anreizprogramm Energieeffizienz [Energy Efficiency Incentive Programme]
BAFA	Bundesamt für Wirtschaft und Ausfuhrkontrolle [Federal Office for Economic Affairs and Export Control]
BBPlG	Bundesbedarfsplangesetz [Federal Requirements Planning Act]
BDS	Bürgerdialog Stromnetz [Citizens' Dialogue on the Electricity Grid]
BEG	Bundesförderung für energieeffiziente Gebäude [Federal subsidy for efficient buildings]
BEHG	Brennstoffemissionshandelsgesetz [Fuel Emissions Trading Act]
BEMIP	Baltic Energy Market Interconnection Plan
BfEE	Bundesstelle für Energieeffizienz [Federal Office for Energy Efficiency]
BHKW	Blockheizkraftwerk [cogeneration plant]
BIP	Bruttoinlandsprodukt [gross domestic product, GDP]
BMBF	Bundesministerium für Bildung und Forschung [Federal Ministry of Education and Research]
BMEL	Bundesministerium für Ernährung und Landwirtschaft [Federal Ministry of Food and Agriculture]
BMU	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit [Federal Ministry of the Environment, Nature Conservation and Nuclear Safety]
BMWi	Bundesministerium für Wirtschaft und Energie [Federal Ministry of Economic Affairs and Energy]
BNetzA	Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen [Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways]
BKV	Bilanzkreisverantwortlicher [balancing group manager]
BSI	Bundesamt für Sicherheit in der Informationstechnik [Federal Office for Information Security]
CAP	Common Agricultural Policy [Gemeinsame Agrarpolitik, GAP]
CA-RES	Concerted Action on the Renewable Energy Sources Directive
CCU	Carbon Capture and Utilisation
CCS	Carbon Dioxide Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CDU	Christlich Demokratische Union [Christian Democratic Union]
CEER	Council of European Energy Regulators
CEF	Connecting Europe Facility
CNG	Compressed natural gas
CO_2	Carbon dioxide
$CO_{2äq}$	CO_2eq, carbon dioxide equivalent
CORE	zentral-und osteuropäische Kapazitätsberechnungsregion [Central and Eastern European Capacity Calculation Region]
CSU	Christlich Soziale Union [Christian Social Union]
ct	cent
DEHST	Deutsche Emissionshandelsstelle [German Emissions Trading Authority]
dena	Deutsche Energieagentur [German Energy Agency]
DFBEW	Deutsch-Französisches Büro für die Energiewende [German/French Office for the Energy Transition]
DGE	Deutsche Gesellschaft für Ernährung [German Society for Nutrition]
DIHK	Deutsche Industrie und Handelskammertag [Association of German Chambers of Commerce and Industry]
DK	Denmark
DPMA	Deutsches Patent-und Markenamt [German Patent and Trade Mark Office]
EBK	Bundesförderung für Energieberatung für Nichtwohngebäude von Kommunen/gemeinnützigen Organisationen [federal funding for energy consulting for non-residential buildings owned by municipalities/charitable organisations]
EBM	Energieberatung im Mittelstand [energy consulting for SMEs]
EBV	Erdölbevorratungsverband [Petroleum Stockholding Association]
EBW	Bundesförderung für Energieberatung für Wohngebäude (Vor-Ort-Beratung, individueller Sanierungsfahrplan) [federal funding for energy consulting for residential buildings (on-site

	consulting, individual renovation roadmap)]
EDL-G	Gesetz über Energiedienstleistungen und andere Energieeffizienzmaßnahmen [Act on Energy Services and Other Energy Efficiency Measures]
EE	Erneuerbare Energien [renewable energies]
EED	Energy Efficiency Directive
EEG	Erneuerbare-Energien-Gesetz [Renewable Energy Sources Act]
EEV	Endenergieverbrauch [final energy consumption]
EEWärmeG	Erneuerbare-Energien-Wärmegesetz [Renewable Energies Heat Act]
EffSTRA	Energy Efficiency Strategy 2050
EHS	Emissionshandelssystem [emissions trading system]
EKF	Energie-und Klimafonds [Energy and Climate Fund]
EltLastV	Elektrizitätslastverteilungs-Verordnung [Electricity Effort Sharing Regulation]
EltLastVwV	Allgemeine Verwaltungsvorschrift zur Elektrizitätslastverteilungs-Verordnung [General Administrative Provisions on the Electricity Effort Sharing Regulation]
EltSV	Elektrizitätssicherungsverordnung [Regulation on the Security of the Electricity Supply]
EnEV	Energieeinsparverordnung [Energy Conservation Regulation]
EnergieStG	Energiesteuergesetz [Energy Tax Act]
EnLAG	Energieleitungsausbaugesetz [Energy Line Expansion Act]
EnSiG	Energiesicherungsgesetz [Energy Security Act] 1975
EnWG	Energiewirtschaftsgesetzt [Energy Industry Act]
EPBD	Energy Performance of Buildings Directive (EU Buildings Directive)
ERA-Net	European Research Area
ErdölBevG	Erdölbevorratungsgesetz [Petroleum Stockholding Act]
ESG	Energieeffizienzstrategie Gebäude [Energy Efficiency Strategy for Buildings]
ESR	Effort Sharing Regulation (EU)
EStG	Einkommensteuergesetz [Income Tax Act]
ETS	Emissions Trading System
EU	European Union
EUKI	European Climate Initiative
EUR	euro
EU-SET-Plan	European Strategic Energy Technology Plan
FNB	Fernleitungsnetzbetreiber [transmission system operator]
GAEC	Good Agricultural and Environmental Conditions (GAECs)
GasSV	Gassicherungsverordnung [Regulation on the Security of the Gas Supply]
GasNZV	Gasnetzzugangsverordnung [Gas Network Access Regulation]
GEG	Gebäudeenergiegesetz [Buildings Energy Act]
GemAV	Verordnung zu den gemeinsamen Ausschreibungen für Windenergieanlagen an Land und Solaranlagen [Regulation on joint calls for tenders for onshore wind energy and solar PV]
GewStG	Gewerbesteuergesetz [Trade Tax Act]
GHD	Gewerbe, Handel, Dienstleistungen [commerce, trade, services]
GIZ	Gesellschaft für Internationale Zusammenarbeit GmbH [Corporation for International Cooperation]
GVFG	Gemeindeverkehrsfinanzierungsgesetz [Municipal Transport Financing Act]
GW	gigawatt
GWS	Gesellschaft für wirtschaftliche Strukturforschung [Institute of Economic Structures Research]
HeizölLBV	Heizöllieferbeschränkungsverordnung [Fuel Oil Supply Restrictions Regulation]
HEL	leichtflüssiges Heizöl [light fuel oil]
HGÜ	Hochspannungs-Gleichstrom-Übertragung [high-voltage direct-current transmission]
HVO	hydrotreated vegetable oil
IEA	International Energy Agency
IFFS	Inefficient Fossil Fuel Subsidies
IKT	Informations-und Kommunikationstechnik [information and communication technologies]
IKzB	Informations-und Kompetenzzentrum für zukunftsgerechtes Bauen [Information and Competency Centre for Future-Oriented Construction]
IPC	International Patent Classification
iSFP	individueller Sanierungsfahrplan [individual renovation roadmap]
ISI	Fraunhofer-Institut für System-und Innovationsforschung [Fraunhofer Institute for System and Innovation Research]
KfW	Kreditanstalt für den Wiederaufbau

KGV	Koordinierungsgruppe Versorgung [Supply Coordination Group]
km	kilometre
KMU	kleine und mittlere Unternehmen [small and medium-sized enterprises]
KOM	Europäische Kommission [European Commission]
KraftstoffLBV	Kraftstofflieferbeschränkungsverordnung [Fuel Supply Restrictions Regulation]
KSB	Klimaschutzbericht [climate protection report]
KSP	Klimaschutzplan [Climate Action Plan]
KSP2050	Klimaschutzplan 2050 [Climate Action Plan 2050]
KStG	Körperschaftssteuergesetz [Corporation Tax Act]
kW	kilowatt
kWh	Kilowattstunde [kilowatt hour]
KWK	Kraft-Wärme-Kopplung [cogeneration]
KWKG	Kraft-Wärme-Kopplungsgesetz [Cogeneration Act]
LEK	Liegenschaftskonzepte [real estate concepts]
Lkw	Lastkraftwagen [heavy goods vehicle]
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land-Use Change and Forestry
MAP	Marktanreizprogramm [Market Incentive Programme]
MGV	Marktgebietsverantwortlicher [market area coordinator]
Mrd.	Milliarden [billions]
MinölAV	Mineralölausgleichsverordnung [Petroleum Equalisation Regulation]
MinölBewV	Mineralölbewirtschaftungsverordnung [Petroleum Management Regulation]
MinÖlDatG	Mineralöldatengesetz [Petroleum Data Act]
Mio.	million
MKS	Mobilitäts-und Kraftstoffstrategie [Mobility and Fuels Strategy]
MSR	Market Stability Reserve
MsbG	Messstellenbetriebsgesetz [Smart Meters Operation Act]
MW	megawatt
MWh	Megawattstunde [megawatt hour]
MwSt.	Mehrwertsteuer [VAT]
NABEG	Netzausbaubeschleunigungsgesetz Übertragungsnetz [Transmission System Expansion Acceleration Act]
NAPE	Nationaler Aktionsplan Energieeffizienz [National Energy Efficiency Action Plan, NEEAP]
NECP	National Energy and Climate Plan
NEP	Netzentwicklungsplan [Network Development Plan]
NESO	National Emergency Strategy Organization
NGO	Non-Governmental Organisation
NIP	Nationales Innovationsprogramm Wasserstoff und Brennstoffzellentechnologie [National Innovation Programme for Hydrogen and Fuel Cell Technology]
NKI	Nationale Klimaschutzinitiative [National Climate Initiative]
NL	The Netherlands
NOW	Nationale Organisation Wasserstoff GmbH
NOR	Norway
NPM	National Platform ‘Future of Mobility’
NSBTF	North Sea Basin Task Force
NSR	Nationaler Strategierahmen über den Aufbau der Infrastruktur für alternative Kraftstoffe [National Strategic Framework for the Expansion of Alternative Fuel Infrastructures]
NSI	North-South Electricity Interconnections in Central Eastern and South Eastern Europe
NSOG	North Sea Offshore Grid
NTRI	National Top Runner Initiative
ÖPNV	Öffentlicher Personennahverkehr [local public transport]
PCI	Projects of Common Interest
PEV	Primärenergieverbrauch [primary energy consumption]
PJ	petajoule
Pkm	person-kilometre
Pkw	Personenkraftwagen [car]
PL	Poland
PtH	Power to Heat

PV	photovoltaics
RED II	Renewable Energy Directive (recast version)
RL	Richtlinie [directive]
SET Plan	European Strategic Energy Technology Plan
SGB	Sozialgesetzbuch [Social Code]
SINTEG	Schaufenster intelligente Energie – Digitale Agenda für die Energiewende [Smart Energy Showcases – Digital Agenda for the Energy Transition]
SOEC	Solid Oxide Electrolysis Cells
SPD	Sozialdemokratische Partei Deutschlands [Social Democratic Party of Germany]
StBA	Statistisches Bundesamt [Federal Statistical Office]
t	tonnes
tkm	tonne-kilometre
TEHG	Treibhausgasemissionshandelsgesetz [Greenhouse Gas Emissions Trading Act]
TEN-E	Trans-European Networks for Energy
THG	Treibhausgas [greenhouse gas]
Tsd.	thousand
TWh	terawatt hours
UBA	Umweltbundesamt [Federal Environment Agency]
UGS	Untergrundspeicher [underground storage reservoir]
UGSB	Untergrundspeicherbetreiber [underground storage reservoir operator]
ÜNB	Übertragungsnetzbetreiber [transmission system operator]
VerkLG	Verkehrsleistungsgesetz [Transport Services Act]
VET-Berichte	Berichte über die emissionshandelspflichtigen Treibhausgasemissionen von stationären Anlagen und Luftverkehr in Deutschland [Reports on greenhouse gas emissions (covered by emissions trading schemes) from stationary facilities and air transport in Germany]
VgV	Vergabeverordnung [Regulation on the Award of Public Contracts]
VOL/A	Vergabe-und Vertragsordnung für Bauleistungen, Teil A [Public Procurement Rules for Construction Services, Part A]
VSVgV	Vergabeordnung Verteidigung und Sicherheit [Public Procurement Rules for Defence and Security]
vzbv	Verbraucherzentrale Bundesverband e. V. [Federation of German Consumer Organisations]
VNB	Verteilernetzbetreiber [distribution system operator]
WEG	Wohnungseigentümergemeinschaft [commonholders' association]
WindSeeG	Windenergie-auf-See-Gesetz [Offshore Wind Energy Act]
WIPO	World Intellectual Property Organisation
WTZ	wissenschatlich-technologische Zusammenarbeit [scientific and technological cooperation]
ZdH	Zentralverband des Deutschen Handwerks [German Confederation of Skilled Crafts]

Section A: National Plan

1. Overview and process for establishing the plan

1.1. Summary

1.1.i. Political, economic, environmental and social context of the plan

Germany's integrated National Energy and Climate Plan (NECP) provides an overview of the country's energy and climate policy as well as the current status of plans in these areas. Energy and climate policy is continuously evolving.

On 9 October 2019, the Federal Government passed the Climate Action Programme 2030 through which it intends to achieve Germany's climate goals between now and 2030. It contains measures for all sectors (energy, buildings, transport, industry, agriculture, land use, land-use change, forestry and waste management) and introduces a national emissions trading system for the heating and transport sectors, which are not covered by the European emissions trading system. The measures contained in the Climate Action Programme 2030 will shape Germany's energy and climate policy up to 2030 and beyond. They are taken into consideration in this NECP. The Federal Government is working tirelessly on the implementation and, where applicable, the necessary detailed specification of the chosen measures and, as such, has set various legislative procedures in motion and even completed some of them already, for example the Fuel Emissions Trading Act [BEHG] and the Federal Climate Protection Act. The Federal Climate Protection Act also contains the Federal Republic of Germany's commitment, made at the UN Climate Action Summit on 23 September 2019 in New York, to pursue the long-term goal of reducing greenhouse gas emissions to net zero emissions by 2050.

The contents of the Energy Efficiency Strategy 2050 with Germany's energy efficiency goal for 2030 as a contribution to the achievement of the EU's energy efficiency goal as well as the Federal Government's long-term renovation strategy pursuant to the EU Energy Performance of Buildings Directive are also taken into consideration in this NECP. The applicable federal budgetary and financial planning principles and approaches to the Energy and Climate Fund form the necessary foundation for all measures that have a financial impact in this area.

The topic of energy and climate policy is of vital importance for an industrial nation like Germany, and also affects other fields of policy, in particular economic, environmental and social policy. The triad of energy policy goals (reliability of supply, environmental soundness and affordability) therefore is and will remain a key benchmark for Germany's energy policy.

Figure A1: Triad of goals for the energy transition:

Bezahlbarkeit	Affordability
Energiewende	Energy transition
Versorgungssicherheit	Reliability of supply
Umweltverträglichkeit	Environmental soundness

Germany wishes to establish an environmentally sound supply of energy through improved energy efficiency and increased use of renewable energy sources. The Federal Government's actions are therefore guided by the principle of 'Efficiency First'. Conflicts with other environmental, nature conservation and species protection targets must be resolved appropriately and sustainably. Reliability of supply must be guaranteed to the maximum extent possible. Cost efficiency is a vital factor in ensuring that energy remains affordable. It therefore plays a significant role in advancing

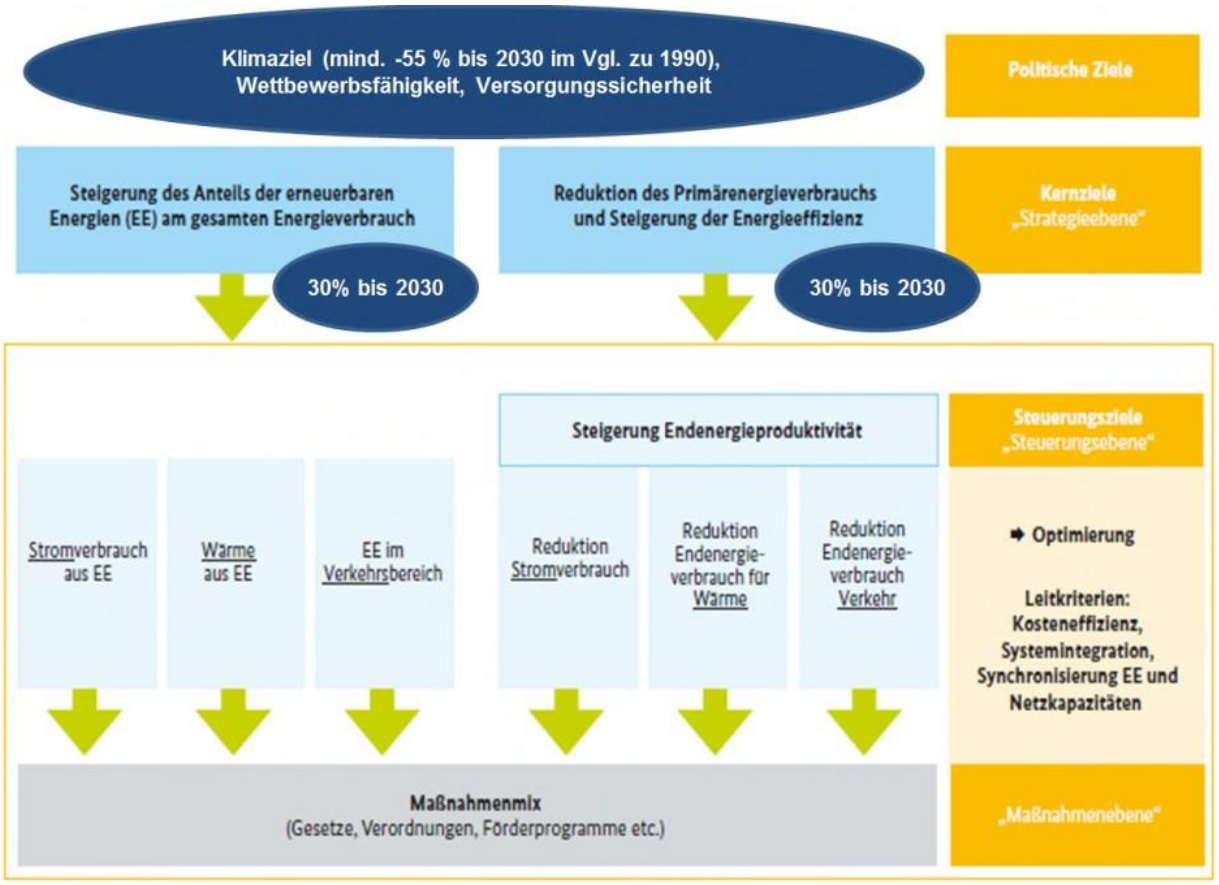
social justice. The transformation of energy supply structures is also intended to boost Germany's status as a competitive place to do business. Supplying power in an environmentally sound manner is a vital prerequisite for safeguarding the very basis of human existence.

The energy transition is a programme of modernisation and investment. It represents a huge economic opportunity for innovative companies – not only within the German and European markets, but also around the world. Many countries are currently expanding their energy supply structures to incorporate renewable energy sources and making increased use of energy-efficient technologies. At the same time, the energy transition will mean a far-reaching structural shift in certain regions and certain sectors of the economy. Policies are needed to support and accompany this shift, resulting in a fundamental transformation in the way we live and do business.

1.1.ii. Strategy relating to the five dimensions of the energy union

The general policy guidelines derived from the triad of energy transition goals are put into concrete form in the Federal Government's 2010 Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply, as well as in supplementary decisions by the Bundestag and the Federal Government and in EU legislation. These documents contain many different goals which serve as a **guiding compass for the German energy transition**. In order to structure and prioritise these individual energy transition goals, the Federal Government has established an architecture of goals. It is based on **three different levels of goals**, i.e. policy goals, core goals and steering goals:

Figure A2: 2030 goal-based architecture



Klimaziele (mind. -55% bis 2030, weitgehend THG-neutral -80 bis -95% bis 2050), Kernenergieausstieg (bis 2022), Wettbewerbsfähigkeit, Versorgungssicherheit	Climate goals (at least -55% by 2030, largely greenhouse gas neutral -80 to -95% by 2050), nuclear phase-out (by 2022), competitiveness, reliability of supply
Steigerung des Anteils der erneuerbaren Energien (EE) am gesamten Energieverbrauch	Increase in the share of renewable energies in total energy consumption
Reduktion des Primärenergieverbrauchs und Steigerung der Energieeffizienz	Reduction in primary energy consumption and increase in energy efficiency
30% bis 2030	30% by 2030

60% bis 2050	60% by 2050
50% bis 205	50% by 2050
Politische Ziele	Policy objectives
Kernziele „Strategieebene“	Core goals (‘strategy level’)
Steigerung Endenergieproduktivität	Increase in final energy productivity
Steuerungsziele „Steuerungsebene“	Steering goals (‘steering level’)
Stromverbrauch aus EE	Consumption of electricity from renewable energies
Wärme aus EE	Heat from renewable energies
EE im Verkehrsbereich	Renewable energies in the transport sector
Reduktion Stromverbrauch	Reduction in electricity consumption
Reduktion Endenergie verbrauch für Wärme	Reduction in final energy consumption (heating)
Reduktion Endenergie verbrauch Verkehr	Reduction in final energy consumption (transport)
Optimierung	Optimisation
Leitkriterien: Kostenefizienz, Systemintegration, Synchronisierung EE und Netzkapazitäten	Guiding criteria: cost efficiency, system integration, synchronisation of renewable energies and grid capacities
Maßnahmenmix (Gesetze, Verordnungen, Förderprogramme etc.)	Mix of measures (acts, regulations, funding programmes, etc.)
„Maßnahmenebene“	‘Action level’

The **policy goals** serve as a framework for transformation of the energy supply. The **core goals** include the reduction of primary energy consumption with a corresponding increase in energy efficiency and the expansion of renewable energy sources. They represent the central strategies that will be used to drive forward the energy transition. Both of these core goals are fleshed out in **steering goals** relating to action in the areas of electricity, heat and transport. The steering goals and the associated measures are coordinated with a view to ensuring that the overarching goals can be achieved as reliably and cost-effectively as possible through an integrated approach.

1.1.iii. Overview table with key objectives, policies and measures of the plan

The tables show the central goals, strategies and measures that will apply under the Federal Government’s National Energy and Climate Plan between now and 2030. They include central national goals (Table A1) and central strategies and measures which are currently being implemented, have already been implemented, have been adopted or are planned in keeping with Article 2(1)-(4) of the EU Regulation on the governance of the energy union (Governance Regulation) (Table A2). The extent to which funds will be provided for them from the federal budget is a matter for the relevant budgeting process.

Table A1: Central goals for 2030 along the dimensions of the energy union

Units	Central goals
1. Decarbonisation	

1.1. GHG emissions and removals	• National climate goal: at least -55 % by 2030 compared to 1990
	• EU climate goal: at least -40% by 2030 compared to 2005, subdivided into
	  ○ ETS: EU-wide goal of -43% by 2030 compared to 2005
	  ○ ESR: -38 % by 2030 compared to 2005
	• LULUCF: no debit rule

1.2. Renewable energy	• Share of renewable energies in gross final energy consumption: 30% in 2030 (German contribution to the EU 2030 goal)
2. Energy efficiency	• The Energy Efficiency Strategy 2050 sets out a reduction in primary energy consumption of 30% compared to 2008 in 2030 (German contribution to the EU 2030 goal).

3. Energy security	• Coverage of Germany's energy demand at all times • Continued resilience to supply crises • Further reduction in the likelihood of supply crises • Preparedness for a potential deterioration in the supply situation
4. Internal energy market	• Achievement of the level of interconnectivity provided for pursuant to Article 4(d) of the Governance Regulation • Needs-based grid expansion and modernisation • Joint examination of energy infrastructures • Sectoral coupling for electricity, heating and transport • Gradual reduction and phase-out of coal-fired power generation by 2038 at the latest • Continuing functionality of the Electricity Market 2.0 and guaranteed energy system flexibility: • Further coupling of the electricity markets
5. Research, innovation, competitiveness	• The Federal Government is striving to ramp up energy research in the period between 2020 and 2030. It has therefore set itself the goal of providing approximately EUR 1.3 billion of funds per annum in the years 2020-2022 for energy research. • Promotion of pioneering innovations relating to transformation of the power supply • Maintenance and expansion of Germany's status as a competitive location for industry, commerce and SMEs and the jobs they offer, and establishment of a solid foundation for sustainable prosperity and quality of life

Table A2: Central strategies and measures along the dimensions of the energy union

Units	Central strategies and measures
1. Decarbonisation	
1.1. GHG emissions and removals	• Implementation of the Climate Action Plan 2050 and the Climate Action Programme 2030 (key measures from the programme are explained in the following dimensions)

1.2. Renewable energy	• Renewable Energy Sources Act • Offshore Wind Energy Act • Expediting of planning and licensing procedures for the expansion of onshore wind energy • Closer synchronisation between the expansion of renewable energy sources and grid expansion • Better regionalisation of growth of renewable energies • Further developments in the field of cogeneration • Regional cooperation • Increase in the consumption of self-generated electricity • Funding programme 'Use of Biomass for the Generation of Energy' • Subsidies for electrically powered vehicles (environmental bonus) Boosting Germany's status as a location for battery cell production • Energy conservation legislation for buildings, Renewable Energies Heat Act and Buildings Energy Act* • Energy Efficiency Strategy for Buildings* • Amendment of the Heating Network Systems 4.0* funding programme • Market incentive programme for renewable energies in the heating market* • Federal funding for efficient buildings* • Expansion of funding programmes for heating networks, heat storage systems and multi-building investments ** Measures from the buildings sector (see 2. 'Energy efficiency') which also make a significant contribution to Dimension 1 'Reduction in CO_2 emissions'.*
2. Energy efficiency	• Energy Efficiency Strategy 2050 • National Energy Efficiency Action Plan 2.0 (NEEAP) • Long-Term Renovation Strategy • Energy Efficiency Strategy for Buildings • Buildings Energy Act • Federal Government's CO_2 Building Modernisation Programme • Market incentive programme for renewable energies in the heating market • Federal funding for efficient buildings • Tax incentives for energy-related building renovations • Expansion of funding programmes for heating networks • Carbon pricing in the heating and transport sectors
3. Energy security	• Act on the Security of the Electricity and Gas Supply (Energy Industry Act) • 1975 Energy Security Act • Regulation on the Security of the Gas Supply in a Crisis • National preventive action and emergency plans for natural gas pursuant to Regulation (EU) No 2017/1938 (previously Regulation (EU) No 994/2010) • Solidarity mechanism pursuant to Regulation (EU) No 2017/1938 • Increase in Germany's use of LNG • Petroleum Stockholding Act • Petroleum Data Act
4. Internal energy market	Achievement of the level of interconnectivity provided for pursuant to Article 4(d) of the Governance Regulation: • Increase in the number of cross-border electricity interconnectors • Stronger regional cooperation Needs-based grid expansion and modernisation: • Accelerated grid expansion • Optimisation of existing grids • Monitoring of grid expansion projects for electricity and gas • Fee-related incentives and Incentive Regulation Sectoral coupling for electricity, heating and transport

	• Removal of barriers to sectoral coupling (electricity, heat and transport) Gradual reduction and phase-out of coal-fired power generation by 2038 at the latest • Coal Phase-out Act • Structural policy supporting measures Continuing functionality of the Electricity Market 2.0 and guaranteed energy system flexibility: • Increased integration and flexibility of European electricity markets • Fair and system-focused network funding • Implementation of the 'Use It, Don't Curtail It' concept • Pilot projects for modernised cogeneration plants to increase their flexibility • Principle of re-dispatching: Optimisation measures relating to re-dispatching • National flexibility check to identify any barriers to flexibility and potential for flexibility Further coupling of the electricity markets: • Action plan for reducing grid congestion • Creation of a Central and Eastern European Capacity Calculation Region (CORE) • Optimisation of intra-day trading capacities
5. Research, innovation, competitiveness	• Seventh Energy Research Programme – Innovations for the Energy Transition • Real-world laboratories and increased technology transfer • Cross-system issues (e.g. sectoral coupling, digitalisation) • Greater involvement of start-ups • Stepping up of international cooperation

1.2. Overview of current policy situation

1.2.i. National and Union energy system and policy context of the national plan

Energy and climate policy must be formulated within a European context, since energy and climate policy decisions by one Member State unavoidably have an impact on other Member States. National energy and climate plans can be used to bring about greater convergence of national policies. Energy efficiency and the growth of renewables will be major building blocks of the European energy transition. This supports and fits well with Germany's strategy for transforming its energy supply (see Section 1.1.ii.).

Realisation of a single European energy market is a key prerequisite for the success of the energy transition in Germany and the EU. Open, flexible markets and fair competition are needed in order to achieve a cost-effective and reliable energy supply and integrate renewable energies into the market. The electricity markets need to be connected, and they need to send the necessary price signals. This establishes a solid foundation for the necessary investments and for increased flexibility of energy generation and consumption.

1.2.ii. Current energy and climate policies and measures relating to the five dimensions of the energy union

The following table includes all of the strategies and measures outlined in the Federal Government's integrated National Energy and Climate Plan along the five dimensions of the energy union. The measures marked with an asterisk * are new additions compared to the Federal Government's draft integrated National Energy and Climate Plan from the end of 2018. The individual policies and measures set out in the NECP reflect the provisions from existing national legal acts. The legislative arrangement and national binding nature result from the corresponding legal acts.

Table A3: Strategies and measures along the five dimensions of the energy union

1. Decarbonisation

1.1 GHG emissions and removals

Section 3.1.1.i.

Enshrining of climate goals into law
3.1.1.i.1. * Federal Climate Protection Act

Carbon pricing
3.1.1.i.2. *Carbon pricing in the heating and transport sectors

Agriculture
3.1.1.i.3. * Reduction of nitrogen surpluses including reduction of ammonia emissions and targeted reduction of nitrous oxide emissions as well as improvement in nitrogen efficiency
3.1.1.i.4. * Support for the fermentation of farmyard fertilisers derived from animals and agricultural residues
3.1.1.i.5. * Development of organic farming
3.1.1.i.6. * Reduction of greenhouse gas emissions in livestock farming
3.1.1.i.7. * Energy efficiency in agriculture

Land use, land-use change and forestry
3.1.1.i.8. * Preservation and accumulation of humus on arable land
3.1.1.i.9. * Conservation of permanent grassland
3.1.1.i.10. * Protection of bog soil including reduction in use of peat in growing media
3.1.1.i.11. * Conservation and sustainable management of forests and timber usage

Further measures for the removal of greenhouse gases
3.1.1.i.12. * Funding programme for the expansion of landfill aeration and the optimisation of gas collection
3.1.1.i.13. * 'Climate Action 2050' information campaign

Section 3.1.1.ii.

3.1.1.ii.1. * Minimum price in EU emissions trading
3.1.1.ii.2. * European Climate Initiative
3.1.1.ii.3. Meseberg Climate Working Group

Section 3.1.1.iii.

3.1.1.iii.1. National Climate Initiative
3.1.1.iii.2. * Development and implementation of a Sustainable Finance Strategy
3.1.1.iii.3. * Further development of the KfW into the transformative promotional bank for supporting the transformation of sectors of the economy and the financial market for a GHG-neutral future
3.1.1.iii.4. * 'Green' federal securities

1.2 Renewable energies

Section 3.1.2.i.

Electricity
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3. Energy security

Section 3.3.i.

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Measures to maintain and (where applicable) improve the reliability of Germany's gas supply

3.3.i.1. Guaranteeing security of supply for domestic customers
3.3.i.2. Provision of information
3.3.i.3. Capacity for gas to flow in both directions ('reverse flows')
3.3.i.4. Energy storage facilities
3.3.i.5. Preventive Action Plan for Gas
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Measures to eliminate or mitigate the potential impact of a disruption in the natural gas supply

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Electricity

Measures to maintain and (where applicable) improve the reliability of Germany's electricity supply

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3.3.i.23. Provision of information
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Measures to eliminate or mitigate the potential impact of a disruption in the electricity supply

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3.3.ii.1. Solidarity between EU Member States on the basis of the SoS Regulation (Regulation (EU) No 2017/1938)
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3.3.ii.3. Consultations on the preventive action plan and emergency plan
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3.3.ii.6. Cooperation in regional groups within the framework of the Trans-European Energy Networks (TEN-E Regional Groups) – gas

Petroleum

3.3.ii.7. Cooperation in regional groups within the framework of the Trans-European Energy Networks (TEN-E Regional Groups) – oil
3.3.ii.8. Annual Coordinating Meeting of Entity Stockholders (ACOMES)

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3.3.ii.9. Cross-border investigation of the security of supply with reference to the electricity market
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4. Internal energy market

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3.4.1.i.1. Network Development Plan (NDP) – Electricity
3.4.1.i.2. Interconnector expansion projects under the Energy Line Expansion Act and the Federal Requirements Planning Act

Section 3.4.2.i.

Electricity

3.4.2.i.1. Electricity Grid Action Plan
3.4.2.i.2. Monitoring of grid expansion projects for electricity
3.4.2.i.3. Controlling of grid expansion projects for electricity
3.4.2.i.4. Optimisation and modernisation of the existing grids
3.4.2.i.5. Accelerated grid expansion
3.4.2.i.6. Fee-related incentives and Incentive Regulation

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3.4.2.i.7. Network Development Plan (NDP) – gas
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3.4.3.i.1. *Gradual reduction and phase-out of coal-fired power generation based on the recommendations of the Commission on Growth, Structural Change and Employment
3.4.3.i.2. Sectoral coupling
3.4.3.i.3. Measures in the Action Plan for Reducing Grid Congestion
3.4.3.i.4. * Cross-border measures in the Action Plan for Reducing Grid Congestion

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Section 3.4.3.ii.

Measures to ensure adequacy
3.4.3.ii.1. Measures to ensure adequacy of the energy system
3.4.3.ii.2. Additional measures aimed at achieving a flexible and efficient power supply
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Measures to ensure flexibility
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3.4.3.ii.6. Fair and system-focused network funding
3.4.3.ii.7. Implementation of the 'Use It, Don't Curtail It' concept
3.4.3.ii.8. *Flexible cogeneration plants as a transition technology
3.4.3.ii.9. Optimisation measures relating to re-dispatching
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3.4.3.iv.2. Default and auxiliary supply concept
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3.4.3.iv.4. * Change in commuting allowance for long-distance commuters
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3.4.3.v.1. Control and system stabilisation through increased cooperation between transmission and distribution system operators and market players
3.4.3.v.2. Dynamic electricity price agreements and smart meters
3.4.3.v.3. Establishment of a core energy market data register
3.4.3.v.4. Smart Meters Operation Act

Section 3.4.3.vi.

3.4.3.vi.1. Pentalateral Energy Form – Internal Energy Market
3.4.3.vi.2. Electricity neighbours
3.4.3.vi.3. Cooperation in regional groups within the framework of the Trans-European Energy Networks (Trans-European Energy Networks – TEN-E Regional Groups) – Internal energy market
3.4.3.vi.4. German/French showcase project for cross-border energy system optimisation (Smart Border Initiative)

5. Research, innovation, competitiveness

Section 3.5.i.

Research
3.5.i.1. Seventh Energy Research Programme of the Federal Government
3.5.i.2. * Avoidance of Climate-Relevant Process Emissions in Industry research initiative
3.5.i.3. Financial industry and climate protection
3.5.i.4. Climate Protection in Agriculture and Forestry research initiative
3.5.i.5. New Bioeconomy Strategy
3.5.i.6. Future Building programme's model project for experimental building work
3.5.i.7. Funding initiative 'Solar Construction/Energy-Efficient City'
3.5.i.8. Research and observation of aerosols, clouds and trace gases as part of the European research infrastructure ACTRIS

Innovation and competitiveness
3.5.i.9. Further development of CCU/CCS options
3.5.i.10. * Carbon avoidance and utilisation in primary industries programme
3.5.i.11. * EU ETS Innovation Fund: further development of the NER300 programme
3.5.i.12. * National decarbonisation programme
3.5.i.13. 'Smart Energy Showcases – Digital Agenda for the Energy Transition' programme (SINTEG)
3.5.i.14. * Act on the Digitalisation of the Energy Transition
3.5.i.15. Research and innovation agenda on the material use of carbon
3.5.i.16. Greater involvement of start-ups in energy research
3.5.i.17. Battery research as part of the 'Battery Research Factory' umbrella concept
3.5.i.18. * Key areas of mobility: A) Urban mobility B) Systemic barriers to innovation in climate protection
3.5.i.19. * Digital Innovation Hub for Climate
3.5.i.20. * Green ICT: research and development for reducing the carbon footprint of digital technologies

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European energy research cooperation
3.5.ii.1. Strategic Energy Technology Plan (EU SET Plan)
3.5.ii.2. European Research Area (ERA-NET) Cofund

Regional/bilateral cooperation
3.5.ii.3. *Cooperation between the North Sea coastal states in the area of energy research
3.5.ii.4. Cooperation on CCUS with other North Sea coastal states
3.5.ii.5. *Greek/German Research Cooperation and Funding of Early-Stage Researchers
3.5.ii.6. French/German Fellowship Programme
3.5.ii.7. French/German research funding in the area of electricity networks/smart grids

Section 3.5.iii.

Research
3.5.iii.1. Seventh Energy Research Programme
3.5.iii.2. EU Framework Programme for Research and Innovation 'Horizon 2020'

Innovation and competitiveness
3.5.iii.3. Boosting Germany's status as a research location for energy storage technology
3.5.iii.4. New construction techniques and materials for a low-emission industry
3.5.iii.5.* 'SME-innovative' research funding initiative (energy efficiency and climate protection)

1.2.iii. Key issues of cross-border relevance

Dimension 1: Decarbonisation

1.1 GHG emissions and removals Germany's efforts contribute to the achievement of the EU's 2030 climate goal and the targets enshrined in the Paris Agreement. Experiences and best practices are exchanged with other Member States in particular with regard to national climate protection strategies and non-governmental or sub-national climate protection projects (run by NGOs and municipalities), allowing potential impacts on other Member States to be identified and discussed as soon as possible. The design and implementation of EU climate policy represents another central focus of exchanges with other Member States.

1.2 Renewable energy Germany's geographical location in the centre of Europe means that the expansion of renewable energies within its borders has multiple impacts on neighbouring states. The Federal Government accords high priority to the network and system integration of renewable energies (see Section 3.1.2.). Over the next few years, the Federal Government will focus on regional cooperation with other Member States as a significant driver for the market integration of renewable energies. The Federal Government is therefore opening up its tendering procedures for electricity generated from renewable energies to ensure that providers from other EU Member States are eligible. The Federal Government also plays an active role in the North Seas Energy Forum and participates in the working group on renewable energies within the framework of the Baltic Energy Market Interconnection Plan (BEMIP) (see Sections 1.4., 3.2., 3.4.3.). In addition, Germany has played an active role in the Concerted Action on the Renewable Energy Sources Directive (CA-RES) forum from its inception.

Dimension 2: Energy efficiency

This dimension does not as a basic principle give rise to any issues of immediate cross-border significance. Cross-border cooperation projects have, however, been set up with neighbouring EU Member States, as well as various initiatives for exchanging best practices relating to efficiency (see Section 3.2.).

Dimension 3: Energy security

Functioning energy markets are the best possible guarantee for energy supply security within the EU as a whole, and also lower the risk that disruptions in supply will lead to adverse consequences. If the security of any one Member State's energy supply is under threat, there is a risk that unilateral measures taken by this Member State will jeopardise the smooth functioning of the internal market and have a harmful impact on the supply situation in other Member States. Gas can be supplied to the German market via various import routes, and the neighbouring national markets also have a range of options available to them in this respect. This reduces the risk of supply disruptions not only for the gas market in Germany, but also for markets in neighbouring states. Germany's electricity market is also firmly integrated into the EU's internal electricity market. Electricity Market Regulation 2019/943 sets out key principles for monitoring security of supply on the electricity market, which are currently being further fleshed out by the EU Member States. These principles are already applied in Germany's Report on the Security of Supply. Preliminary cross-border collaboration between stakeholders in Germany and neighbouring third countries, if necessary with support from the competent authorities, is vitally important (and stipulated in Risk-Preparedness Regulation 2019/941) in order to ensure that cross-border measures can be taken to maintain security of supply in neighbouring Member States in the event of a crisis, i.e. a significant electricity demand-supply gap. Germany is involved in the drafting of a Regional Report on the Security of Supply within the framework of the Pentalateral Energy Forum.

Dimension 4: Internal energy market

The EU internal market forms the backbone of the European energy transition and is also a vital prerequisite for guaranteeing a safe, cost-efficient and environmentally sound supply of energy in Germany. With this in mind, exchanges of electricity between EU Member States are gaining in importance. Supra-regional synergies in respect of generation and consumption can be harnessed to make the electricity system even more flexible. The Federal Government therefore plays an active role in a number of different regional cooperation forums with a view to deepening the integration of Europe's internal electricity market. Particular mention should be made of the Pentalateral Energy Forum and the Baltic Energy Market Interconnection Plan (BEMIP) (see Sections 1.4., 3.2., 3.4.3.). The federal states are also committed to creating a European internal electricity market, for example by promoting cross-border citizen energy communities.

Dimension 5: Research, innovation, competitiveness

In common with many other European countries, Germany faces major challenges in the field of research and innovation in connection with its move towards greater use of clean and renewable energies within the framework of the energy transition. Areas where technical innovations are needed and where Member States

must work together include in particular the integration of increasing but fluctuating quantities of electricity fed in from wind and PV systems, digitalisation of the energy supply and sectoral coupling (including heat energy). Regional cooperation makes it possible to tackle these issues together successfully, to make effective use of cross-border infrastructures, and to deploy financial resources efficiently. Research cooperation takes place at international and more specifically EU level as a result of the Federal Government's involvement in Horizon 2020/Europe and its implementation of the goals enshrined in the Strategic Energy Technology (SET) Plan on the basis of common research projects and coordinated funding priorities. Regional and bilateral cooperation provides an opportunity to join forces and take more effective action in areas where similar challenges are faced (at either a geographical or thematic level). Last but not least, international cooperation is crucially important in ensuring Germany's research landscape remains at the top level worldwide across all technologies.

1.2.iv. Administrative structure of implementing national energy and climate policies

The Federal Government, the federal states and the municipalities all have a role to play in implementing the energy transition and climate protection measures. At Federal Government level, the Federal Ministry of Economic Affairs and Energy is responsible for energy policy. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety is responsible for climate policy.

Authorities at Federal Government and federal state level work together on an ongoing basis to implement the energy transition. The Federal Chancellor holds 6-monthly meetings with the heads of the federal state governments; these meetings are also attended by the competent federal ministers. Topics discussed at these meetings include progress made with the energy transition. The competent ministers at Federal Government and federal state level also discuss priorities and next steps for the energy transition on an annual basis within the framework of the Conference of Ministers for Economic Affairs and the Conference of Environmental Ministers. This institutional coordination is supplemented by discussions between Ministers for Energy, Secretaries of State for Energy and heads of energy departments at Federal Government and federal state level. Ongoing cooperation and detailed exchanges of information at a technical level also take place.

A comprehensive overview of the competent bodies at Federal Government, federal state and municipal level can be found in the database 'Who is Who der Energiewende in Deutschland [Who's who in the energy transition in Germany]', which is funded by the Federal Foreign Office: https://www.renac.de/who-is-who/p/10/. Details of central contact persons in the fields of policy, industry and society are also summarised in this database.

1.3. Consultations and involvement of national and Union entities and their outcome

The Federal Ministry of Economic Affairs and Energy set up a participatory process for national and regional consultations, in accordance with the provisions of the EU Regulation on the governance of the energy union, in order to consult with and involve the public, national entities, stakeholders, other EU Member States and the European Commission regarding the creation of the Federal Government's final NECP. As such, the most important information about the NECP process as well as the draft NECP were published via the following link both in German and English shortly after the draft NECP was completed at the end of 2018. The intention is for the final NECP to also be accessible in both languages via this website:

https://www.bmwi.de/Redaktion/DE/Artikel/Energie/nationaler-energie-und-klimaplan-necp.html

The consultations with and involvement of the individual players are described in the following subsections.

1.3.i. Consultations with stakeholders, including social partners, and engagement of civil society

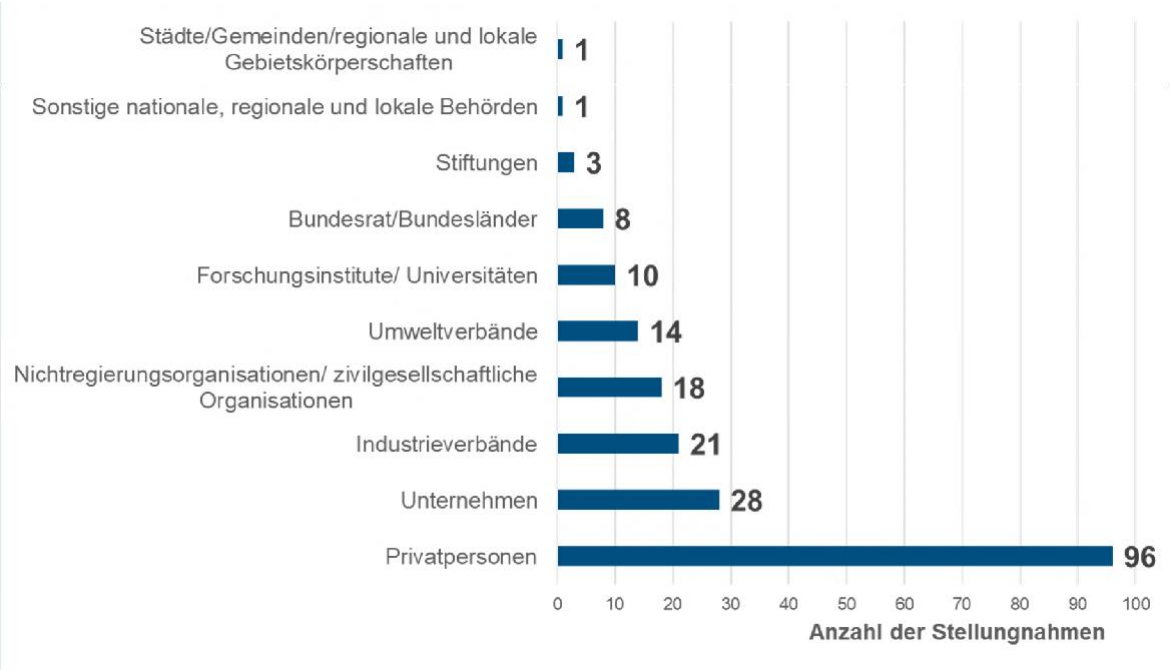
The national consultation on the Federal Government's draft integrated National Energy and Climate Plan was conducted online between 14/06/2019 and 02/08/2019 on the basis of the draft NECP from the end of 2018 and a survey which covered the five dimensions of the energy union.

The results of the online consultation are summarised in this section 1.3.i. in accordance with Article 10 of the EU Regulation on the governance of the energy union and climate action. A detailed report containing an assessment of the responses received during the consultation process is attached to the NECP as a separate annex. The responses reproduced in it relate to the draft version of the NECP. Since then, the Federal Government has made far-reaching decisions on its energy and climate policy, taking a substantial number of the suggestions that were made into consideration. In the second half of 2019, numerous points of criticism from the responses were addressed, in particular as part of the implementation of the recommendations of

the Commission on Growth, Structural Change and Employment and of the Climate Cabinet process. This is illustrated in this NECP. The summary of the responses is reproduced in the document without the addition of any comments. The extent to which the responses were taken into consideration is clear to see from the NECP. Aside from the consultation on the draft NECP, there are regular exchanges of information with stakeholders on various different energy and climate policy-related projects in meetings of the energy transition platforms of the Federal Ministry of Economic Affairs and Energy.

A total of 200 responses were received as part of the online consultation process. Approximately half of the participants were private individuals (96 participants). The next sets of responses were from companies (28 participants) and industrial associations (21 participants). Then there were those from NGOs and civil society organisations (18 participants) and environmental organisations (14 participants). Research institutions/universities were represented by 10 participants. Half of the federal states also provided responses (8 participants). Foundations were represented by 3 participants whilst other national, regional and local authorities were represented by 1 participant and cities/municipalities/regional and local governments were also accounted for by 1 participant.

Figure A3: Frequency of responses per group of participants



Städte/Gemeinden/regionale und lokale Gebietsköroerschften	cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Stiftungen	Foundations
Bundesrat/Bundesländer	Bundesrat/federal states
Forschungsinstitute/Universitäten	Research institutions/universities
Umweltverbände	Environmental organisations
Nichtregierungsorganisationen/zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Industrieverbände	Industrial associations
Unternehmen	Companies
Privatpersonen	Private individuals
Anzahl der Stellungnahmen	**Anzahl der Stellungnahmen**

1.3.ii. Consultations with other Member States

The regional consultation on the Federal Government's draft NECP was conducted on 9 April 2019 at the Federal Ministry of Economic Affairs and Energy at head of department level and at a technical level. In addition, the Federal Ministry of Economic Affairs and Energy held a high-level meeting for ministers and

secretaries of state on 8 April 2019, the evening before the regional consultation. The high-level meeting was aimed at the group of electricity neighbours (see Section 3.4.3.vi) and was used to present the recommendations of the Commission on Growth, Structural Change and Employment for the gradual reduction and phase-out of coal-fired power generation in Germany, which were published at the start of 2019. The consultation meeting on 9 April was aimed at all neighbouring countries and EU Member States. Representatives from Belgium, Denmark, France, Greece, Ireland, Italy, Croatia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Romania, Sweden, Switzerland, Slovakia, Slovenia, the Czech Republic, Hungary, the United Kingdom and Cyprus as well as representatives of the European Commission and employees of various different federal ministries attended the consultation meeting.

Every dimension of the Federal Government's draft NECP was presented in detail during the regional consultation meeting. A Q%A session was held after each dimension was presented.

Dimension 1: Decarbonisation (GHG reduction and renewable energy)

During the presentation of this dimension, a Member State enquired about Germany's 2030 goal for renewable energy. The Federal Ministry of Economic Affairs and Energy responded by saying that the Federal Government's 2010 Energy Concept had set a goal of a 30% share of renewable sources of energy in gross final energy consumption and that a goal for 2030 of a 65% share of renewable energy in the electricity mix had been announced. Another Member State enquired about Germany's goal range for greenhouse gas reduction of -80% to -95% by 2050 compared to 1990 and asked whether this also included achieving net zero greenhouse gas emissions at the same time. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety responded by saying that that was the goal range agreed in the Energy Concept and, with regard to the other point, referred to the discussions to be held for creating the programme of measures for the Climate Action Plan which would not be starting until April 2019. Another Member State enquired about the expansion of the use of renewable sources of energy, reported facing challenges in their own country with expanding onshore wind farms and also highlighted, in light of this, the importance of offshore farms and the North Seas Energy Cooperation. The Federal Ministry of Economic Affairs and Energy responded by saying that efforts were being made to increase people's acceptance of onshore farms through compensation payments but that the same challenge was essentially also being faced in Germany. The Federal Ministry of Economic Affairs and Energy agreed that offshore wind energy was very important and explained that Germany intended to use its presidency of the North Seas Energy Cooperation in 2020 to discuss the North Sea's potential for offshore technology and to develop a shared vision for joint projects. Another Member State was interested in the Federal Government's goals regarding e-mobility. The Federal Ministry of Economic Affairs and Energy responded by saying that this was a key point in the discussions regarding the programme of measures for the Climate Action Plan and was being fleshed out there. Finally, a Member State enquired about the use of renewable energy in the cooling sector. The Federal Ministry of Economic Affairs and Energy responded by saying that in Germany the cooling sector currently accounted for only a small proportion of energy consumption. The Federal Ministry of Economic Affairs and Energy also responded by saying that, just as there were heating networks in the heating sector, cooling networks nevertheless also existed. In this regard, the Federal Ministry of Economic Affairs and Energy mentioned heat pumps as technology that was used in both the heating sector and the cooling sector. The Federal Ministry of Economic Affairs and Energy stated that a third of all new buildings in Germany were equipped with heat pumps.

Dimension 2: Energy efficiency

When this dimension was presented and discussed, a Member State enquired about the status of the Energy Efficiency Strategy. This Member State and another Member State also asked whether Germany had an efficiency goal and/or trajectory for buildings. The Federal Ministry of Economic Affairs and Energy responded by saying that the Energy Efficiency Strategy would continue to be worked on until the end of 2019 and would then be incorporated into the Federal Government's final NECP. Germany's contribution to the EU's energy efficiency goal for 2030 would also be embedded in this. The Federal Ministry of Economic Affairs and Energy also stated that there was no separate goal for energy efficiency in buildings. The 2030 goal was designed as a cross-sector goal. However, the Federal Ministry of Economic Affairs and Energy explained that the Federal Government's Climate Action Plan did contain a sectoral goal for 2030 for greenhouse gas reduction in the buildings sector.

Another Member State enquired about the numerical unit of the energy efficiency goal and about the connection between the energy efficiency goal and the goal for the expansion of the use of renewable energies and asked whether the latter would change once the efficiency goal for 2030 had been set. The Federal Ministry of Economic Affairs and Energy stated that the efficiency goal was designed as a reduction in primary energy consumption and said that the goal for the expansion of the use of renewable energy would not be changed again once the goal for increasing energy efficiency by 2030 had been set.

Dimensions 3 and 4: Energy security and internal energy market

Electricity

During the presentation and discussion, two Member States raised questions about the phase-out of coal-fired power generation. The Member States wanted to find out more information about the composition of the Commission on Growth, Structural Change and Employment, about security of supply in connection with the phase-out of coal and about any funding measures for coal. They reported that in their countries, due to the EU ETS, there was also pressure to phase out coal.

The Federal Ministry of Economic Affairs and Energy responded to the questions and provided information on the composition of the commission. The Federal Ministry of Economic Affairs and Energy then stated that there would no longer be any direct subsidising of coal in Germany but that during the phase-out process operators of coal-fired power plants would be paid compensation. However, cogeneration plants would receive funding. With regard to security of supply, the Federal Ministry of Economic Affairs and Energy stated that, in the medium term, gas would play a bigger role but that the phase-out of coal would also be tackled by means of the expansion of the use of renewable energies and greater flexibility on the grid. The assumption was that the market would also send out the right signals. A Member State enquired about offshore wind energy plans whereupon the Federal Ministry of Economic Affairs and Energy responded by saying that this was an important topic for the Federal Government and that it was very interested in forging ahead with the North Seas Energy Cooperation in this regard.

Gas

With regard to this topic, a Member State highlighted the importance of the decarbonisation of gas, and two Member States enquired about the composition of the 'Gas Dialogue 2030'. The Federal Ministry of Economic Affairs and Energy reported that the issue of decarbonised gas would also be covered in the 'Gas Dialogue 2030' and said that the dialogue would take the form of a stakeholder process within Germany.

Another Member State enquired about the LNG infrastructure in Germany and asked whether this was lucrative, given that there was general striving for a future with net zero greenhouse gas emissions. The Federal Ministry of Economic Affairs and Energy responded by saying that at this point in time it still did not know which types of technology would prevail in the medium term and that an approach which was open to different types of technology was being pursued. The Federal Ministry of Economic Affairs and Energy did not voice any opinions on the investment decisions of entrepreneurs who were supporting and expanding this infrastructure.

Dimension 5: Research, innovation, competitiveness

When this dimension was presented and discussed, a Member State enquired about the Federal Government's key priorities in terms of energy research. The Federal Ministry of Economic Affairs and Energy stated that the Federal Government was pursuing an open approach and was not prioritising any of the technologies being researched. It said that market signals and market trends were also relevant here. Another Member State enquired about the importance of Carbon Capture and Utilisation / Storage (CCU/CCS) in the Federal Government's German Energy Research Programme. The Federal Ministry of Economic Affairs and Energy stated that there were concepts and also specific research projects for this and said that this technology was also being discussed as part of the creation of the programme of measures for the Climate Action Plan.

Following on from the consultation meeting, the neighbouring countries and EU Member States were given the opportunity to submit written comments regarding the Federal Government's draft NECP. Belgium, Poland and the United Kingdom took advantage of this opportunity.

The written comments from the three Member States focused, in particular, on the issues of market coupling, a common European electricity market and renewable sources of energy. There was specific interest in the geographical separation between generation and consumption and the resulting influence on neighbouring Member States. In this context, reference was made to the German-French energy platform and the question was raised as to whether there was any opportunity for similar cooperation with other neighbouring Member States. Furthermore, detailed questions were raised regarding re-dispatching costs, the market integration of the gas sector, and dynamic electricity supply contracts. Interest in smart meters and related monitoring was also expressed.

Further remarks from the Federal Government concerning renewable sources of energy in the final NECP were eagerly awaited. The main focus here was the transmission system infrastructure. The issue of the recovery of electricity costs as part of the expansion of the use of renewable sources of energy and a request for experience and technical know-how regarding offshore wind energy to be shared were both raised.

Questions were also raised concerning the next steps for CCUS/CCS and toxic waste. With regard to the phase-out of nuclear energy, the issue of substitution and further planning was raised in light of existing

greenhouse gas reduction goals. The statements regarding the phase-out of coal in the final NECP were eagerly awaited, in particular those relating to overall costs.

Interest was also expressed in the Energy Efficiency Strategy for Buildings. The issue of best practice was raised here.

With regard to the scenarios, there was a lot of interest in the WAM (with additional measures) scenario. As such, the expectations entertained regarding the final NECP were expressed.

This final NECP deals with many of these issues, which have been addressed in specific measures in connection with the Climate Action Programme 2030 and the implementation of the recommendations of the Commission on Growth, Structural Change and Employment.

1.3.iii. Iterative process with the European Commission

On 18 June 2019, the European Commission published its communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: United in delivering the Energy Union and Climate Action – Setting the foundations for a successful clean energy transition. In addition to the communication, the recommendations of the European Commission regarding the draft NECPs of the EU Member States were also published in accordance with the EU Regulation on the governance of the energy union and climate action. 11 recommendations were issued to the Federal Government, which form the central basis of the so-called iterative process with the European Commission. The following table lists the topics covered in the recommendations and indicates where in the final NECP they are located and addressed. An overview of the European Commission's recommendations and all draft NECPs of the EU Member States can be accessed via the following link.

https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union/national-energy-climate-plans

Table A4: Recommendations of the European Commission as part of the iterative process

No	Recommendation regarding	NECP section
1	Greenhouse gas reduction	2.1.1, 3.1.1., 3.1.3.
2	Renewable energy	2.1.2., 3.1.2.
3	Energy efficiency	2.2., 3.2.
4	Reliability of supply	2.3, 3.3.
5	Internal market	2.4., 3.4.
6	Research/ innovation/competitiveness	2.5., 3.5.
7	Regional cooperation	1.4.
8	Need for investment	5.3.
9	Energy subsidies	4.6.
10	Air quality	5.1., 5.2.
11	Structural change	2.4.4.i, 3.4.3, 5.2.

1.4. Regional cooperation in preparing the plan

1.4.i. Elements subject to joint or coordinated planning with other Member States

Whilst working on their NECPs, the EU Member States of the Pentalateral Energy Forum (Belgium, Luxembourg, the Netherlands, France, Austria and Germany), on the initiative of Belgium, the Netherlands and Luxembourg, and the EU Member States of the North Seas Energy Cooperation (Belgium, Luxembourg, the Netherlands, France, Denmark, Sweden, Ireland, the United Kingdom and Germany), developed joint sections on the initiative of Denmark. The Federal Government expressly welcomes cooperation in these forums and highlights their importance in achieving the EU's energy and climate goals by 2030.

JOINT SECTION ON THE PENTALATERAL ENERGY FORUM

PENTA
Pentalateral Energy Forum

INTRODUCTION

As part of the Pentalateral Energy Forum for regional cooperation set up in 2005, Belgium, Germany, France, Luxembourg, the Netherlands and (since 2011) Austria work together on a voluntary basis – together these countries account for more than a third of the population of the EU and more than 40% of the electricity generated in the EU. Switzerland joined in 2011 as a permanent observer and actively contributes to the technical work carried out and to the decision-making. In close cooperation with the European Commission (at the latter's invitation), the Pentalateral Energy Forum strengthens cooperation between all relevant stakeholders and hence seeks to create a regional electricity market as a stepping stone towards creating a single European electricity market.

Cooperation is managed by the respective Ministers for Energy, who meet on a regular basis. The activities are continuously supported by the Penta coordinators and the Penta-NECP Committee under the leadership of the corresponding Directors-General for Energy in the countries involved. The work programme is implemented by the transmission system operators (TSOs), ministries, regulatory authorities, the European Commission and the market players, who meet regularly in three working groups (Support Groups).

The huge success achieved over the last 15 years is demonstrated by the fact that the outlook of each of the countries involved in terms of their energy policy has developed from one with a purely national focus to one with a truly regional approach. The countries involved have set up specific regional milestones in various different areas which are still relevant today:

Internal electricity market/market integration:
Penta Support Group 1 (SG 1) focuses on the coupling of the electricity markets in the region. SG 1 had set itself the goal of ensuring the flow-based market coupling (FBMC) of the day-ahead markets. This was introduced in May 2015 in the Penta region making this the first region within the European Union to achieve this. Since then, flow-based market coupling has been continuously optimised in order to achieve higher welfare gains, and now provides the basis for market coupling for the day-ahead markets which is fully embedded in the EU.

In order to increase the available transmission capacity for cross-border trade on the intraday market, SG 1 promoted a coordinated process for calculating intraday capacities which was implemented in March 2016 following the flow-based market coupling of the day-ahead markets for all borders in the region as an initial step towards the coupling of the European intraday markets.

The Support Group has been able to gain privileged insights into the radical changes in the electricity landscape and management of the electricity markets. Whilst the electricity operators were still operating largely independently of each other in 2005, over the years the working group has promoted

cooperation between the players, which for example has led to the formation of regional groups of TSOs within their associations, the merging of electricity exchanges and TSOs and the formation of new regional players (TSCNet, Coreso, formerly CASC-CWE, SSC).

With regard to the new implementation plans, which must be presented in accordance with the 'Clean energy for all Europeans' package, the countries involved will coordinate closely and explore opportunities for joint action.

Internal electricity market/flexibility:
Support Group 3 (SG 3) concentrates on issues concerning flexibility in the region. So far, the work of SG 3 has been focused on the areas of balancing energy, intraday and the role of load management, and hence three important areas for regional cooperation for improving the flexibility of our electricity markets. Several technical background documents have been drawn up detailing the main obstacles to any greater use of flexibility within the Penta region. SG 3 is open to traditional participants (regulatory authorities and TSOs) as well as other players such as distribution system operators (DSOs), major consumer associations and renewable energy producers.

Existing approaches have been evaluated and good practices have been shared within the Pentalateral Forum in the area of balancing energy. The Pentalateral Forum also plays an important role in the implementation of the European Union's guidelines on balancing energy. A separate expert group has drawn up a report on load management which depicts the current situation in the Penta region and in particular details the regulations and areas of responsibility of new market players in each country with the region. A hydrogen workshop has been held in order to identify potential areas for further cooperation in this field between the countries involved.

Reliability of supply
Support Group 2 (SG 2) focuses on issues concerning security of supply in the region. In June 2017, the countries involved signed a memorandum of understanding (MoU) on cooperation concerning security of supply. On that basis and in light of the new EU Regulation on cooperation in the area of risk-preparedness, a crisis exercise was organised in 2018 entitled 'PENTEX 2018' in order to achieve a better shared understanding of national concerns, identify potentially relevant (cross-border) crisis situations within the region and assess various different measures for reducing the impacts of any crises.

The first regional Generation Adequacy Assessment (GAA) carried out by the TSOs of the countries involved and published in March 2015 was a real milestone. The methodology used for the assessment was based on a probabilistic and chronological approach with hourly resolution for the years 2015/2016 and 2020/2021 and hence represented a significant improvement compared to the existing deterministic approaches. Furthermore, the transmission system operators of the countries involved used a shared regional dataset, whereby they relied on the same scenarios and assumptions, such as for example a temperature-dependent load model for the entire region and harmonised probabilistic hydrological data.

The governments of the countries of the Pentalateral Energy Forum are certain that these parameters will also continue to be relevant in the future. In addition to continuing their work in the aforementioned areas, the countries involved will also work on the following key focus areas in the next few years as part of the Pentalateral Energy Forum:

DECARBONISATION OF THE ELECTRICITY SECTOR

Shared vision of a decarbonised electricity supply in the countries involved by 2050:
The countries involved discuss their ideas for achieving a decarbonised electricity supply by 2050 (and intermediate goals for 2030 and 2040) based on a highly efficient energy system heavily characterised by renewable sources of energy, a gradual phase-out of fossil fuel power generation and efficient final consumption of electricity. As part of an initial step, national scenarios for the potential creation of the electricity system in 2050 are being compared and similarities and differences between these scenarios and the ways in which security of supply is guaranteed in them are being identified. This is providing a basis for the development of a shared understanding of the expectations and challenges involved in the development of the future electricity system.

Start of cross-border cooperation in the area of renewable sources of energy:
The countries involved are voluntarily drawing up a package of joint approaches covering various different levels of cooperation; for example, opportunities are being explored for opening up national calls for tenders and/or carrying out cross-border calls for tenders, joint calls for tenders for interested Penta countries and ensuring increased use of the EU's renewable energy funding framework as well as existing forms of cooperation such as joint projects and statistical transfers ('cluster approaches') for interested Pentalateral Energy Forum countries.

The countries of the Pentalateral Energy Forum also support the work currently being carried out by the European Commission and the Member States to develop a financing mechanism for renewable sources of energy in the EU.

Integration of e-mobility options and services without regional restrictions

By promoting e-mobility (including options with fuel cells), the countries involved are contributing to an increase in the share of renewable energies used in the transport sector. They are supporting the integration/implementation of unrestricted e-mobility options and services in the Penta region by identifying and, where necessary, removing barriers to the cross-border deployment of e-mobility and charging services and ensuring interoperability.

Assessment of various different carbon pricing options and their cross-border effects on electricity prices

Penta countries which are planning on or are considering pricing carbon are voluntarily exchanging information on political approaches to introducing carbon pricing, on the positive and negative impacts on the reduction of CO_2 emissions as well as on security of supply, price developments and fair competition.

INTERNAL ELECTRICITY MARKET

Market integration

The Penta countries are continuing to work on improving monitoring of flow-based market coupling with the aim of increasing cross-border trade, improving public welfare and optimising benefits for consumers. The countries involved are making the monitoring process more innovative in order to be able to create joint key indicators which are necessary for assessing progress towards a fully decarbonised Pentalateral electricity market by 2050.

The countries involved are working together on a swift implementation of the 'Clean energy for all Europeans' package and are looking into potential cross-border impacts on the energy markets (e.g. further development and improvement of re-dispatching cooperation in the Penta region).

Flexibility

The Penta countries are focusing on the effects of the implementation of flexibility options, including the role of load management, PtX ('Power-to-X') and hydrogen as well as the role of storage systems and e-mobility and are analysing specific electricity-related barriers to sectoral coupling.

In light of the potential use of hydrogen, which is increasingly derived from renewable sources of energy, the countries involved are exploring possible joint approaches to guarantees of origin, cross-border infrastructure, the relevant roles of TSOs and DSOs and standards for hydrogen admixtures and are exchanging information and best practice on funding programmes for hydrogen projects and innovative projects and on the future role of hydrogen in general.

RELIABILITY OF SUPPLY

The countries involved are continuously improving the Pentalateral Energy Forum's Generation Adequacy Assessment and are including improved weather data, the latest figures and goals from the National Energy and Climate Plans (NECPs) for identifying the future energy mix, and other sensitivity analyses. The TSOs of the countries involved are currently developing the third assessment for the timeframe up until 2021 and/or 2025 and are including regional circumstances (based on national ones), improved flow-based calculations and sensitivities relating to flexibility on the consumption side.

Within the context of the 'Clean energy for all Europeans' package and even more specifically within the context of regional cooperation and the Regulation on risk-preparedness, the Penta countries have begun to hold talks with ENTSO-E, the Commission and other stakeholders in order to set out rules for cooperation between the Member States which will help to identify potential regional crisis scenarios as well as prevent and handle electricity supply crises and prepare for them, taking solidarity and transparency as well as the requirements of a competitive internal electricity market into consideration. The Penta countries are working together on developing specific regional measures for crisis situations.

FINANCIAL INSTRUMENTS FOR THE ENERGY TRANSITION

The Pentalateral Energy Forum will exchange views and ideas on potential regional approaches to increasing energy efficiency and expanding the use of renewable sources of energy; as such, joint approaches could be explored, for example with financial institutions such as the European Investment

Bank (EIB), by means of which the risks in both areas could be reduced, in turn making it easier to achieve the goals in the countries involved.

JOINT SECTION ON THE NORTH SEAS ENERGY COOPERATION

Germany is part of the wider North Sea region, which has impressive renewable energy potential. The European Commission estimates that offshore wind energy from the North Sea could cover up to 12% of the EU's electricity consumption by 2030.

Projects in the areas of offshore power generation and cable infrastructure can have cross-border impacts on energy prices, security of supply and the environment, including the availability of maritime space and the pace of innovation. As such, the North Sea coastal states can benefit considerably from cooperation.

The North Seas Energy Cooperation (NSEC) was founded in 2016. It is an initiative for voluntary, grass roots-based and market-oriented regional cooperation. The aim is to create synergies, prevent incompatibilities in terms of national policies, share and exchange knowledge regarding tried-and-tested approaches, and promote joint strategies, where possible and beneficial. The continued cost-effective use of offshore renewable sources of energy, in particular wind energy, should be coordinated and promoted in order to ensure a sustainable, secure and affordable energy supply in the North Sea coastal states through an increased and better coordinated use of offshore wind energy as well as through potential joint projects or cluster projects. The NSEC primarily pursues a gradual approach with the long-term perspective of further integration and increased efficiency of electricity wholesale markets, while contributing to the simultaneous reduction in greenhouse gas emissions and average wholesale price ranges and to an improved security of supply in the region.

The North Seas Energy Cooperation comprises the following 10 countries and also enjoys the involvement of the European Commission: Belgium, the Netherlands, Luxembourg, France, Germany, the United Kingdom, Ireland, Norway, Sweden and Denmark.

Regional cooperation

When drawing up this plan, Germany availed itself of the NSEC, whereby experts in the working groups exchanged and shared their knowledge and experience of certain aspects, for example regarding obstacles and tried-and-tested approaches relating to national use of offshore wind energy and in particular regarding the coordination of national renewable energy plans concerning offshore wind energy for 2030 and market integration.

Germany also consulted the other North Sea coastal states for its National Energy and Climate Plan with regard to planned offshore wind energy for 2030 and related aspects of cable planning.

The Cooperation's working groups focus on the following issues:

WG 1: Maritime spatial planning and environmental soundness
WG 2: Development and regulation of offshore cables and other offshore infrastructure
WG 3: Support framework and financing of offshore wind energy projects
WG 4: Standards, technical specifications and regulations in the area of offshore wind energy

Maritime spatial planning and environmental soundness

As part of the North Seas Energy Cooperation, Germany is contributing to developing a joint environmental impact assessment procedure. In order to achieve our energy and climate goals within the EU, we need to gain a better understanding of the potential ecological limitations of using wind energy on a large scale in the North Sea. More work needs to be done in the area of maritime spatial planning and environmental soundness so that the North Sea's potential can be fully utilised. In order to expand their knowledge and support the use of offshore wind energy in the North Sea, the North Sea coastal states will continue to cooperate closely in the areas of maritime spatial planning, environmental research and cumulative environmental impact assessments of wind farms by authorities responsible for energy, maritime spatial planning and the environment.

Offshore cables and other offshore infrastructure

The NSEC serves as a platform for collaborating on concepts for potential joint offshore wind energy projects and a coordinated electricity infrastructure, including the transmission infrastructure.

Germany is working with the other North Seas Energy Cooperation countries with a view to seizing the opportunities offered by specific cooperation projects. In addition to joint offshore wind energy projects, which connect several Member States and are funded by them, this also includes work on possible 'hybrid' solutions, which would use cross-border solutions to connect offshore wind farms to the grid and would strive to achieve synergies with the capacity to interconnect countries, as well as work on corresponding rules for the market.

Germany is therefore contributing to developing opportunities for cooperation in the area of hybrid projects, is identifying legal, regulatory and commercial barriers and is dealing with them. Coordinating a stronger degree of interconnection between the NSEC countries could also result in more surplus energy flowing into other countries and covering demand there as part of a well-functioning internal energy market.

The NSEC has drawn up a list of potential areas and projects in the region where joint projects could be particularly beneficial. These include: (1) the IJmuiden Ver offshore wind farm to the UK, (2) CGS IJmuiden Ver – Norfolk, (3) COBRA Cable, (4) the DE-NL offshore wind farm and (5) the North Seas Wind Power Hub. The NSEC is working on developing specific concepts for the implementation of select projects from the aforementioned list.

The NSEC will continue to work on action plans for the specific hybrid projects, which could also be further developed at national and regional level. The NSEC will also continue to serve as a forum for deliberating on how to deal with uncertainties regarding the regulatory treatment of hybrid projects at EU level and national level as well as a forum for discussing options for solving such issues.

Support framework and financing of offshore wind energy projects

As far as measures are concerned, Germany benefits from the NSEC in many respects: The NSEC's work provides a platform for sharing and exchanging tried-and-tested approaches to designing funding programmes and developing and further developing new concepts for overcoming new challenges in the area of funding offshore wind energy as well as developing potential options for future joint wind energy projects.

Germany's work as part of the NSEC involves coordinating the scheduling of calls for tenders, sharing and exchanging tried-and-tested processes for designing funding programmes for offshore wind energy and, where possible, establishing joint principles and potential options for aligning funding.

With regard to the coordination of calls for tenders, Germany regularly shares information with other NSEC countries regarding its national call-for-tenders schedule. This helps identify any potential time overlaps and ensures as steady a flow as possible in the call-for-tenders process in the North Sea region in order to optimise competition and ensure the best value for money for consumers. Alongside other criteria and where possible, Germany is prepared to take the call-for-tenders schedules into consideration in its future call-for-tenders planning in order to avoid any unnecessary bottlenecks and ensure a steady capacity flow without any disruption cycles for those involved.

As part of the NSEC, Germany shares information regarding its expected national offshore wind energy course, its national offshore use plans and tried-and-tested processes for developing calls for tenders for offshore wind energy and discusses these topics in this context.

During the meeting of ministers held on 20 June 2019 in Esbjerg, the North Sea coastal states agreed to cooperate in order to achieve total installed capacity for the NSEC member states of an estimated minimum of 70 GW by 2030 based on national planning. Germany's indicative contribution to this aggregated capacity for 2030 is 15 GW (also see Section 2.1.2).

In order to take the dynamics involved in the use of offshore wind energy in the region into account, the long-term planned aggregated capacity of at least 70 GW by 2030 can be achieved with indicative milestones for the region of around 25 GW in 2020 and 54 GW in 2025.

As part of the NSEC, Germany also helps with analysing and developing options for the mobilisation of investments in joint projects, for example through EU funds such as the European Fund for Strategic Investments (EFSI) and the Connecting Europe Facility (CEF) infrastructure fund as well as through help from institutional investors. Such future joint projects could include cross-border projects for renewable sources of energy in line with the CEF proposal.

Harmonisation of specifications, regulations and technical standards

The North Seas Energy Cooperation works on harmonising standards and technical requirements, which could help further reduce the costs involved in the use of offshore wind energy. The harmonisation of specifications, regulations and technical standards focuses on five areas. These are: (1) aviation, identification and lighting, (2)

health and safety, (3) certification of regulatory requirements, (4) design of wind farms and site investigation, and (5) research approaches. The NSEC works on developing proposals and recommendations for implementation in close cooperation with industry. The goal of the recommendations is to reduce costs whilst simultaneously ensuring feasibility. The Cooperation will continue to work on harmonising standards and technical requirements as well as sharing and exchanging tried-and-tested approaches for removing unnecessary regulation and reducing costs for the industry.

1.4.ii. Explanation of how regional cooperation is considered in the plan

The energy transition can only succeed, and progress can only be made in the field of climate protection if both are enshrined at EU level and backed up with regional cooperation. Regional cooperation – in the form of bilateral cooperation or joint initiatives and forums involving multiple EU Member States – therefore represents a core component of the Federal Government's energy and climate policy. Some of the most important existing regional cooperation arrangements with European partners covered in the plan are mentioned below by way of an overview. They can be found in the corresponding regional cooperation sections of the NECP:

Bilateral cooperation

The Federal Government cooperates closely with many other EU Member States (in particular its direct neighbours) on energy and climate policy. Cooperation with certain Member States has been stepped up and made more concrete through the adoption of joint memoranda of understanding. In the current parliamentary term; for example, the Meseberg Declaration was adopted in June 2018, the Declaration on Energy Cooperation was adopted in July 2018 and the Treaty of Aachen was signed by Germany and France on 22 January 2019 with a view to strengthening yet further the existing (and highly productive) cooperation between France and Germany in the field of energy and climate policy. Germany cooperates with France inter alia through the French/German Energy Platform, the internal energy market and energy research projects (see Sections 3.2., 3.4.3., 3.5.). A great deal of knowledge and experience is also exchanged thanks to the activities of the German/French Office for the Energy Transition. In addition, the energy agencies of both countries, dena and ADEME, have been cooperating for years in cross-border projects as part of the French/German Energy Platform (see Sections 3.2. and 3.4.3.). The memorandum of understanding on energy cooperation with Belgium issued in October 2018 stated inter alia that Germany would help Belgium to resolve the specific security-of-supply problems faced by the country in winter 2018/19. In October 2019, a declaration of intent on the energy transition was signed with the Netherlands, which defines major areas of cooperation, for example in offshore wind, hydrogen and security of supply. As part of the strategic dialogue between the Federal Republic of Germany and the Czech Republic, there are regular exchanges on bilateral and European climate and energy issues in Working Group 5 on the Environment and Climate and in Working Group 10 on Energy.

European Climate Initiative

The European Climate Initiative was launched by the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety in 2017. Bilateral and multilateral projects within the framework of the European Climate Initiative will focus on topics including the development of climate strategies and their implementation at various levels, exchanges of information on climate policy instruments, and measures and projects in all the relevant sectors: energy, industry, transport, private households, commerce, trade and services, waste, agriculture and land use (see Section 3.1.1.).

Baltic Energy Market Interconnection Plan (BEMIP)

BEMIP was set up in 2009, and its members include all of the Baltic Sea coastal states which belong to the EU, as well as Norway in the role of observer; organisational matters are chiefly handled by the European Commission. The Federal Government sits on the BEMIP working groups (see Section 3.1.2.) and is involved in revising the BEMIP action plan.

North Seas Energy Forum/North Sea Energy Cooperation

In 2016, the North Sea coastal states and the European Commission founded the North Seas Energy Forum with a view to further expanding their cooperation in the energy sector. The cooperation facilitated through the Forum relates primarily to the expansion of offshore wind power and grid infrastructures, as well as maritime spatial planning in the North Sea. The Member States involved (including the Federal Republic of Germany) have exchanged information on the relevant sections of the North Sea coastal states' NECPs and developed a joint NECP section (see Sections 1.4.i., 3.1.2. and 3.5.) within the framework of this initiative.

Pentalateral Energy Forum

The Pentalateral Energy Forum was set up in 2005 for the purpose of facilitating cooperation between the EU Member States of Belgium, Luxembourg, the Netherlands, France, Austria and Germany in the areas of electricity market coupling, security of supply, crisis preparedness and flexibility of electricity markets. Switzerland participates in this Forum as an observer. The Penta Member States involved (including the Federal Republic of Germany) have exchanged information on the relevant sections of the NECPs and developed a joint NECP section within the framework of this initiative (see Sections 1.4.i. and 3.4.3.).

Pentalateral Gas Forum

The Pentalateral Gas Forum was set up in 2009 for the purpose of facilitating cooperation between the EU Member States of Belgium, Luxembourg, the Netherlands, France and Germany in the area of gas supply (see Section 3.3.).

Cooperation in regional groups within the framework of the Trans-European Energy Networks (Trans-European Networks Energy – TEN-E Regional Groups)

The Federal Government participates in several TEN-E Regional Groups for the purpose of cooperating with other EU Member States. The Regional Groups correspond to the primary energy infrastructure corridors referred to in the TEN-E Regulation and hold regional responsibility for identifying projects of common interest (PCI) relating to the energy infrastructure developments required under the TEN-E Regulation. Pursuant to Article 4 of the TEN-E Regulation, the projects in question should contribute to at least one of the following criteria: market integration, sustainability, competition (diversification of supply sources, routes and supplying counterparts) and security of supply (see Sections 3.3. and 3.4.3.).

2. National objectives and targets

2.1. Decarbonisation dimension

2.1.1. GHG emissions and removals

2.1.1.i. The elements set out in Article 4(a)(1)

Annually binding national limits pursuant to the Effort Sharing Regulation (ESR)

The Effort Sharing Regulation stipulates that Germany must achieve a mandatory reduction in greenhouse gas emissions from non-ETS sectors of 38% by 2030 (compared to 2005). Germany will be assigned annual emission budgets on the basis of a linear emission reduction trajectory, starting with the actual average for the 2016-2018 period and ending with the final emissions goal for 2030.

Binding goal under the LULUCF Regulation (Land Use, Land Use Change and Forestry)

For the first time, all EU Member States must meet a LULUCF objective defined under European law. The 'no debit rule' which applies to all EU Member States stipulates that the total debits for the land accounting categories eligible pursuant to Article 2 of the LULUCF Regulation must not exceed total credits by the end of the two stipulated 5-year periods (2021 to 2025) and (2026 to 2030).

2.1.1.ii. Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable for the contribution to the overall Union commitment of reducing the GHG emissions, other objectives and targets, including sector targets and adaptation goals, if available

In the Federal Government's Energy Concept (published in 2010), Germany set itself the goal of achieving a drop in greenhouse gas emissions of at least 55% by 2030 compared to the baseline year of 1990. This must also be seen in the context of the commitment made under the Paris Agreement based on the United Nations Framework Convention on Climate Change, in accordance with which the rise in average global temperatures must be kept well below 2°C and where possible 1.5°C compared to pre-industrial levels in order to minimise the effects of global climate change, as well as the Federal Republic of Germany's commitment, made at the UN Climate Action Summit on 23 September 2019 in New York, to pursue the long-term goal of reducing greenhouse gas emissions to net zero emissions by 2050. Germany is therefore working together with the EU Member States in order to achieve the goal of reducing greenhouse gas emissions to net zero emissions by 2050 in Europe. In December 2019, the heads of state and government in the EU agreed on the goal of achieving a climate-neutral EU by 2050. In the Meseberg Declaration of 18 May 2020, the German and French governments welcomed the EU Commission's proposal to increase the emission reduction goal for 2030 to between 50% and 55% compared to 1990. France and Germany emphasise the need for a meticulous impact assessment in particular with regard to impacts on the competitiveness of the European economy and on the social system as well as with regard to a shared understanding of sector-specific contributions and corresponding measures.

Table A5: GHG reduction goal*

	2030
Reduction compared to 1990 in [%]	at least 55

* Goal based on the Energy Concept and the Climate Action Plan 2050

The Federal Government confirmed these goals in its Climate Action Programme 2030. The national climate goal for 2030 is also underpinned with sectoral goals. Although Germany works towards its national objectives independently, its efforts in this area also contribute to achievement of the EU goal. The Federal Government takes this to mean that Article 14(3) of the Regulation on the governance of the energy union and climate action does not apply in this respect.

2.1.2. Renewable energy

2.1.2.i. The elements set out in Article 4(a)(2)

In addition to the GHG removal targets referred to in Section 2.1.1., decarbonisation will be further promoted through an increase in the share of renewables in energy consumption. Rising carbon prices under the EU

emissions trading system will mean that the funding needed to cover surcharges payable under the Renewable Energy Sources Act will diminish as a result of concomitant increases in the trading price of electricity. The European Union has set itself the binding goal of increasing the share of renewables in gross final energy consumption to at least 32% by 2030. This goal will be reviewed in 2023 with a view to increasing it yet further. The Federal Government aims to achieve a 30% share of renewables in gross final energy consumption by 2030 (share in 2020: 18%). This goal was enshrined in the Energy Concept published on 28 September 2010 (Energy Concept 2010).

It is important to ensure that the goal is achieved through concurrent increases in the share of renewables in the electricity, heating and cooling, and transport sectors, since two of these sectors taken together (the heating and cooling sector and the transport sector) account for two thirds of energy consumption. The Federal Government uses a reliable, predictable trajectory as the basis for continuous growth in renewables. The indicative trajectory for the total share of renewables in gross final energy consumption follows a linear increase from 18% in 2020 to 30% in 2030. This corresponds to an annual increase of 1.2 percentage points (see Table A6).

If a Member State falls below the EU trajectory, progress made in terms of the growth of renewables will be measured (according to the Governance Regulation) against reliable reference points of 18% of 2020-2030 growth in 2022 (i.e. total share of renewables equalling 20.2%), 43% in 2025 (i.e. total share of renewables equalling 23.2%) and 65% in 2027 (i.e. total share of renewables equalling 25.8%).

Table A6: Indicative linear trajectory for growth in renewables measured against gross final energy consumption*

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
19.2 %	20.4 %	21.6 %	22.8 %	24.0 %	25.2 %	26.4 %	27.6 %	28.8 %	30.0 %

* Indicative trajectory based on the Energy Concept

2.1.2.ii. Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sectors

The sectoral trajectories are secondary to the main trajectory for the total share of renewables in gross final energy consumption. They add a further level of detail below that of the main trajectory and allow progress to be monitored.

Electricity

In addition to the replacement of coal cogeneration with gas cogeneration and the reduction of coal-fired power generation, the purposeful, efficient, grid-synchronous and increasingly market-oriented expansion of the use of renewable sources of energy is a crucial component in the achievement of the national climate goals in the energy industry. On 9 October 2019, within the context of the Climate Action Programme 2030, the Federal Cabinet decided on measures designed to promote the expansion of the use of renewable energies and implement the goal of achieving a 65% share of renewable energies in electricity consumption in 2030. The current legal framework (Renewable Energy Sources Act 2017, see Section 3.1.2) stipulates a share of 35% for 2020 and a range of 40-45% for 2025. Based on a current forecast share of 43% in 2020, a range of 48-54% is expected for 2025, which includes the uncertainties regarding technological developments. The target of 65% in 2030 reflects the decision taken within the context of the Climate Action Programme.

Table A7: Indicative sectoral targets for electricity for 2020, 2025 and 2030–share of renewable energies in gross electricity consumption

2020	2025	2030
35% (pursuant to the Renewable Energy Sources Act 2017) 43 % (forecast)	40-45% (pursuant to the Renewable Energy Sources Act 2017) 48-54 % (forecast)	65%

As part of the upcoming amendments to the Renewable Energy Sources Act, of which the Federal Ministry of Economic Affairs and Energy is to produce a draft, amendments are expected to be made to the targets and the technology-specific expansion trajectories in the Renewable Energy Sources Act. As a result, this indicative trajectory may change. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

Growth of renewables must be stepped up significantly, not only to achieve the national climate goal in the energy industry, but also to cover the additional electricity demand resulting from efforts to achieve the national climate goals in the transport, buildings and industry sectors (sectoral coupling).

Heating and cooling

Although buildings consume the largest share of energy used for heating and cooling purposes (around two thirds of final energy consumption for heating and cooling), process heating and cooling in industry also play a decisive role (around one third of final energy consumption). The Federal Government adopted a strategy for the energy transition in the buildings sector back in 2015, in the form of the Energy Efficiency Strategy for Buildings. Implementation of the Energy Efficiency Strategy for Buildings thus makes a key contribution to the achievement of goals relating to the use of renewables for heating and cooling, and also to increasing energy efficiency (see Sections 2.2. and 3.2.).

According to the Renewable Energies Heat Act and on the basis of the recast version of the EU Directive on the promotion of the use of energy from renewable sources (Renewable Energy Directive, RED II), the target share of renewables in final energy consumption for heating and cooling is 14% by 2020. According to the recast version of the Renewable Energy Directive, the EU Member States are obliged to take action to increase the share of renewables in the heating and cooling sector by 1.3 percentage points a year between 2020 and 2030. The increase is calculated as a yearly average for the periods 2021-2025 and 2025-2030, hence a share of 20.5% has been set for 2025 and a share of 27% has been set for 2030. The Federal Government has used this ambitious goal for the heating and cooling sector as the basis for its contribution to achievement of the EU goals for 2030. The above also makes it clear that future growth in renewables must be accelerated significantly if the national climate goals for 2030 are to be met in the areas of industry (in particular process heat) and buildings (in particular space heating).

Table A8: Indicative sectoral trajectory for heating and cooling – share of renewables in final energy consumption for heating and cooling*

2020	2025	2030
14%	20.5%	27%

* Indicative trajectory is based on the EU Renewable Energy Directive

Transport

According to the recast Renewable Energy Directive, parties supplying fuels to the market will be obliged to increase the share of renewables consumed in the transport sector to at least 14% by 2030 (mandatory target, double counting permitted). This target is to be achieved in Germany inter alia through developments in respect of the greenhouse gas reduction quota, which increases in 2020 from 4% to 6%. No national targets have been set to date for the period beyond 2020. The Federal Government will fulfil its obligation to transpose the Renewable Energy Directive into national law and will ensure alignment with the goals of the Climate Action Plan 2050. Changes to the GHG quota between 2021 and 2030 and any further measures required are currently being examined. In addition, a steep rise in carbon pricing is likely to result in higher demand for electricity and renewable fuels in the transport sector.

Table A9 shows the share of renewable energies in the transport sector in accordance with the provisions on EU statistics (RED II), whereby the figures were ascertained in a projection on development as part of the implementation of the Climate Action Programme 2030 (see Section 5.1.i; Prognos (2020). Projections, such as the underlying projections, which cover a long period up until 2030 and 2040, are naturally fraught with uncertainties.

Table A9: Indicative sectoral trajectory for transport – share of renewable energies in final energy consumption for the transport sector*

2020	2025	2030

9%	13%	27%

Source: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2019 – rounded.

In the upcoming consultations within the Federal Government regarding the transposition of RED II into national law in the transport sector, there may be specific concretisations and adjustments compared to the projection. As a result, this indicative trajectory may change. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

The Federal Government plans to increase the share of renewables in the transport sector significantly by 2030, inter alia in view of the ambitious carbon savings goal enshrined in the national Climate Action Plan 2050. The most effective way of increasing the share of renewables in the transport sector is to use renewable electricity, preferably directly but also in converted form in areas where electricity cannot be used directly. The market ramp-up phase for e-mobility, in particular in the road transport sector, will be crucial for ensuring increased use of renewables in the transport sector. Renewable electricity or sustainably produced biomass will need to be used to produce sustainable alternative fuels. Projects funded by the Federal Government include electric battery-powered, hydrogen/fuel cell-powered and gas-powered vehicles as well as plug-in hybrids. There are also plans to fund the production of advanced biofuels and renewable electricity-based fuels.

2.1.2.iii. Estimated trajectories by renewable energy technology that the Member State projects to use to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030, including expected total gross final energy consumption per technology and sector in Mtoe (million tonnes of oil equivalent) and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW

Technology-specific growth of renewables does not represent a goal in and of itself; it merely indicates the ways in which a goal can be achieved and is intended to promote the achievement of targets in the electricity, heating and cooling, and transport sectors. The sectoral technology mix is flexible.

Electricity

The Renewable Energies Act 2017 currently sets out technology-specific trajectories for the electricity sector. On 9 October 2019, within the context of the Climate Action Programme 2030, the Federal Cabinet decided to increase the share of renewable energies in electricity consumption to 65% by 2030. The legal implementation of this specification is scheduled for 2020 as part of the amendments to the Renewable Energy Sources Act.

The share of renewable energies in gross electricity consumption is, in addition to the expansion trajectories, heavily dependent on the development of electricity consumption (inter alia efficiency and sectoral coupling). If, as presumed, gross electricity consumption in 2030 is 580 TWh, 377 TWh of renewable electricity or approx. 200 GW of installed capacity from renewable energies and therefore a considerable increase in the expansion of the use of renewable energies will be required in order to achieve the 65% target. Provided that, for example, the planning and approval processes for onshore wind energy and the grid expansion can be successfully expedited, the following goal for the expansion of the use of renewable energies in 2030 will be pursued.

Table A10: Indicative technology-specific shares for renewable energies in the electricity sector in 2030

Renewable technology	2030 electricity generation in TWh*	2030 installed capacity in GW*
Onshore wind	140-145	67-71
Photovoltaics	90	98
Offshore wind	79-84	20
Biomass	42	8.4

Hydropower and others	21	6

* Indicative targets are based on the Climate Action Programme 2030

Calls for tenders will be published with a view to achieving the gross increase. In order to expand onshore wind energy, obstacles need to be removed in particular with regard to the wind farm planning and approval processes but also with regard to the availability of land. Measures need to be implemented which ensure sufficient competition and acceptable solutions for the construction and operation of wind farms on site and which also serve to increase people's acceptance of the expansion of the use of renewable energies. Subject to binding agreements with the federal states concerned on Germany's North Sea and Baltic Sea coast as well as the transmission system operators with a view to the connection cables of offshore wind farms, the expansion trajectory for offshore wind shows an increase in installed capacity to 20 GW in 2030. The technology-specific trajectories may need to be regularly reviewed depending on further political developments and any progress made. According to the Renewable Energy Sources Act 2017, 150 MW of biomass capacity was to be tendered out each year until 2019, and then 200 MW each year between 2020 and 2022. The Federal Government will in due course submit a proposal for the annual volume to be tendered from 2023 onwards.

From 2021 onwards, many older installations will pass the 20-year mark and cease to be eligible for bonuses under the Renewable Energy Sources Act. These plants will be gradually dismantled or repowered on the basis of technical or financial considerations. This will apply to many onshore wind farms from the early 2020s, and also to bioenergy plants from 2025 onwards. Support is to be available for the options for repowering onshore wind energy. Special calls for tenders were published as part of the Renewable Energy Sources Act from 2019 onwards in addition to the volumes of calls for tenders planned up until then as an additional effort towards achievement of the climate goals. In total, an additional 4 GW of capacity will be tendered out by 2021 for solar and onshore wind respectively. Depending on the specific nature of the projects, they will come online as early as 2020 or in the years following. The capacities tendered will not count towards the current 52 GW ceiling for PV systems. The special tendering procedures formed part of the 'Omnibus Energy Act' (Federal Government bill dated 5 November 2018). The Federal Government will submit a proposal for the amendments to the Renewable Energy Sources Act in the summer. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

The challenge in this respect is also to achieve better synchronisation of renewables and grid capacities. The measures which need to be implemented within the transmission system in order to ensure that the electricity grids have the necessary capacities in this respect will be investigated when the Network Development Plan 2019-2030 is produced.

Heating and cooling

Increasing the use of renewable energies in the supply of heating and cooling is a major component in achieving the renewable energy share of 27% in Germany in 2030 in accordance with the Renewable Energy Directive. The measures are divided into incentives for encouraging the continued dissemination of renewable energy-based heating technologies in buildings and for encouraging the switch to increasingly decarbonised district heating.

The buildings funding programmes (see Section 3.2.) have been designed so as to be open to different types of technology, whereby in addition to the biomass boilers that have been dominant up until now a continued increase in demand for heat pumps is forecast on account of the improvement in energy standards. This applies in particular to newly constructed buildings which, in accordance with the Renewable Energies Heat Act, must cover a proportionate share of the heating and cooling requirements with renewable energies.

The structure of district heating production will change dramatically in the next few years. Due to the phase-out of coal-fired power generation, the majority of district heating produced by coal cogeneration plants will disappear by 2030. The major drivers behind the expansion of the use of renewable energies for the production of district heating are the various types of funding available through the Renewables Bonus in the Cogeneration Act, through the investment grants in the Market Incentive Programme and through the Heating Networks 4.0 programme as well as its expansion to include funding for existing networks (federal funding for efficient heating networks), which is expected to be implemented from 2021 onwards. Further details on this topic can be found in Section 3.2.

Transport

The Federal Government intends to implement the requirements set out in the recast version of the Renewable Energy Directive in the transport sector. These include the provisions stating that parties supplying fuels to the market must increase the share of renewables in the transport sector to at least 14% by 2030.

This share was calculated on the basis of the following agreed multiplying factors: a factor of 4 for renewable electricity in the e-mobility sector, a factor of 1.5 in the rail transport sector, a factor of 1.2 in the air and sea transport sector, and a factor of 1 or 2 for progressive biofuels (chosen at national level). The share of first-generation biofuels must not exceed 7%.

Germany plans to limit the share of first-generation biofuels allowed under the Renewable Energy Directive to 5.3% in 2030 in accordance with the status quo in 2020. By way of contrast, the share of advanced biofuels will increase by 2030 to at least 1.75% (single counting) or 3.5% (double counting). The total quota is also to be achieved on the basis of electricity from renewable sources for e-mobility and rail transport. Furthermore, conventional fuels are also expected to be produced and accounted for in a more climate-friendly way on account of the deployment of more efficient processes and the use of primary and intermediate products made using renewable resources. The implementation is expected to be technology-neutral so as to ensure that the best and most cost-effective technologies on the market are the ones that succeed.

The minimum quota of 14% for the share of renewable energies in the transport sector set out in RED II will not, however, be enough to meet the Federal Government's energy and climate goals in the transport sector or the European targets for non-ETS sectors. A more ambitious approach to transposing RED II at national level with the aim of achieving real emissions savings should therefore be adopted.

Table A11 shows the indicative technology-specific shares for renewable energies, which were determined as part of a projection of the implementation of the Climate Action programme 2030 (see Section 5.1.i; Prognos, 2020). Projections of this type, which cover a long period up until at least 2030, are fraught with uncertainties.

Table A11: Indicative technology-specific shares for renewable energies, specifying the expected total gross final energy consumption per technology and sector in Mtoe

Mtoe	2020	2025	2030
Electricity			
Onshore wind	9	10	12
Offshore wind	1	3	6
Photovoltaics	4	6	8
Hydropower	2	2	2
Biomass	4	4	3
Biogenic fraction of waste	1	1	1
Transport			
Biodiesel (including HVO and vegetable oil)	2	2	2
Biogenic petrol	1	1	1
Biogenic jet fuels	0	0	0
Biogases (biomethane)	0.0	0.1	0.2
Renewable energies – electricity	1	1	3
PtX	0.0	0.2	0.3
Heating and cooling			
Biomass and renewable waste	13	14	14
Other renewable energies	2	4	6

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures

Research, International Institute for Sustainability Analysis and Strategy, (2020) – rounded. For the transport sector: up to 2020 RED I; from 2021 RED II.

It should be noted, in this context, that the Renewable Energy Sources Act is to be amended. The Federal Ministry of Economic Affairs and Energy will submit a draft for this. Furthermore, a bioenergy dialogue process is currently being planned in order to analyse and discuss criteria and measures for the distribution of biomass across the sectors. The figures in the table are projections. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

2.1.2.iv. Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink

The bioenergy used will be more heavily based on waste and residues in the future. As such, it is important for all waste and residues to actually be captured; the principle of cascading use must therefore be taken into account. There are no plans to expand the cultivation areas for bioenergy and no expansions are being considered due to land surface area restrictions. The sustainability criteria of RED II must also be used for imports (from the internal market and from third countries). Taking all aspects into account, the maximum biomass available in Germany for bioenergy is currently approximately 1 000 to 1 200 PJ / a (domestic potential).

Although the use of biomass is dropping in significance in the electricity sector according to forecasts to date, it will increase in importance between now and 2030 in the heating and cooling sector and the transport sector. The downward trend for biomass in the electricity sector is attributable to the fact that it is a relatively cost-intensive renewable source of energy compared to other technologies such as wind and photovoltaics. This applies in particular to the generation of electricity from renewable feedstocks, and also in view of the need to provide variable output and flexibility. Whilst allowing for the limited potential of sustainable biomass production, biomass can be a more cost-effective option than, in particular, electricity-based fuels for achieving national climate goals when used to generate energy for air transport, sea transport and heavy goods transport, for high-temperature processes in industry, and for buildings which cannot be insulated or are difficult to insulate on account of technical or legal restrictions.

Table A12: Expected trajectory for biomass demand

Figures in PJ	2021	2025	2030
Final energy consumption	**1,130**	**1,140**	**1,104**
Solid biomass	516	505	490
Liquid biomass	119	116	118
Biogas	354	376	352
Biogenic waste	141	143	144
Transformation input for electricity generation			
Solid biomass	91	75	69
Liquid biomass	0	0	0
Biogas	254	251	218
Biogenic waste	62	62	61
Final consumption of energy for transport			
(Liquid) biofuels	106	99	98
of which Annex IX	*32*	*37*	*45*
Biogas (biomethane / CNG)	2	5	10
Biogenic waste	0	0	0

Final energy consumption for heating purposes (including biodiesel in agriculture)			
Solid biomass	425	430	421
Liquid biomass	14	17	19
Biogas	98	120	124
Biogenic waste	78	81	83

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

It should be noted, in this context, that the Renewable Energy Sources Act is to be amended. The Federal Ministry of Economic Affairs and Energy will submit a draft for this. Furthermore, a bioenergy dialogue process is currently being planned in order to analyse and discuss criteria and measures for the distribution of biomass across the sectors. The figures in the table are projections. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

2.1.2.v. Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewables self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

Share of renewables in heating and cooling networks

The Federal Government intends to achieve a further increase in the share of renewables in heating and cooling networks. The share of renewables in heating and cooling networks has followed an upward trend to date, and the Federal Government intends to grant financial incentives and adopt legislation to ensure that this continues to be the case. For further details, see Section 3.1.2. According to the recast Renewable Energy Directive, the EU Member States are obliged to work towards an annual increase of 1% in the share of renewables in heating networks between 2020 and 2030 (calculated as a yearly average for the periods 2021-2025 and 2025-2030). This ambitious goal is also enshrined in the NECP. The expected share of renewables in heating networks in 2021 is accordingly around 21%, with the figures for 2025 and 2030 being 25% and 30% respectively.

Table A13: Indicative trajectory for the share of renewables in heating networks*

2020	2025	2030
20%	25%	30%

* The trajectory is based on the EU Renewable Energy Directive

Use of renewable energy in buildings:

A share of renewables of 24-32% (depending on the transformation pathway) must be achieved in the buildings sector by 2030 in order to achieve the energy and climate goals (see Section 2.2.i.). The precise details of this increase depend on the supporting measures to be fleshed out in the course of national processes in the buildings sector.

2.2. Energy efficiency dimension

2.2.i. The elements set out in Article 4(b)

National contributions to the EU's 2030 goal

In June 2018, an agreement was reached at EU level between the Member States, the European Parliament

and the European Commission (the agreement entered formally into force in late 2018) to achieve a drop in primary energy consumption of 32.5% by 2030 compared to the value currently forecast for that year; this agreement was enshrined in the recast version of the EU Energy Efficiency Directive (EED). The Member States must report their national indicative contributions to this goal. As part of its Energy Efficiency Strategy 2050, the Federal Government has set a national energy efficiency goal for 2030 of -30% primary energy consumption (compared to 2008). The German energy efficiency goal for 2030 corresponds to primary energy consumption of approx. 240 Mtoe in 2030 (including non-energy consumption) or primary energy consumption of approx. 216 Mtoe excluding non-energy consumption, on the assumption that the latter remains more or less constant. The calculations from the modelling carried out by the Federal Government regarding the effects of the climate protection measures in the NECP show a drop in final energy consumption down to 185 Mtoe by 2030. The Federal Government is aiming to achieve a continual reduction in energy consumption in the decade 2021-2030.

From the Federal Government's perspective, the national energy efficiency goal for 2030 represents a reasonable contribution to the achievement of the EU's energy efficiency goal for 2030. This is illustrated, for example, in the following comparison: in order to achieve the EU's energy efficiency goal for 2030, current EU-wide primary energy consumption must be reduced EU-wide by 18.5% (compared to 2017). Germany's contribution (on the basis of the same baseline year, 2017) represents a reduction in energy consumption of at least 28%.
Achievement of the energy efficiency goal will make a significant contribution to helping ensure that the Federal Government's Climate Action Programme is implemented. The basis for this is the commitment made under the Paris Agreement based on the United Nations Framework Convention on Climate Change, in accordance with which the rise in average global temperatures must be kept well below 2°C and where possible 1.5°C compared to pre-industrial levels in order to minimise the effects of global climate change, as well as the Federal Republic of Germany's commitment, made at the UN Climate Action Summit on 23 September 2019 in New York, to pursue the long-term goal of reducing greenhouse gas emissions to net zero emissions by 2050.

Cumulative final energy savings pursuant to Article 7 of the EU Energy Efficiency Directive (EED)

Based on the statistical data currently available from Eurostat, the cumulative savings target pursuant to Article 7(1), first sentence, (b) of the Energy Efficiency Directive is 3 996.5 PJ or 95.46 Mtoe for the period 2021 to 2030. Notification thereof is to be provided on the basis of Annex III of Regulation (EU) 2018/1999 on the governance of the energy union and climate action (concerning the notification of Member States' measures and methodologies to implement Article 7 of Directive 2012/27/EU). The notification required in accordance therewith is attached to this text, in addition to the other required information, as an annex pursuant to Article 3(2)(h) of Regulation (EU) 2018/1999. The calculation of the savings target pursuant to Article 7(1), first sentence, (b) of the Energy Efficiency Directive is based on Eurostat data regarding final energy consumption in Germany between 2016 and 2018.

Long-term renovation strategy pursuant to Article 2a of the Directive on the energy performance of buildings

Like all sectors, the buildings sector must make an appropriate contribution to the long-term climate goal for 2050. Adjusting to the effects of global climate change also presents new challenges for the buildings sector.

Annual final energy consumption in the buildings sector, approx. two thirds of which is attributable to the buildings sector and around one third of which is attributable to industrial and commercial processes, was 898 TWh in 2016. This corresponds to around 35.9% of German's total final energy consumption and around 14% (only direct emissions) or around 25% of greenhouse gas emissions (including electricity and district heating in buildings). In accordance with the Climate Protection Act (specifically the source principle), the buildings sector will be permitted to emit only 70 $MtCO_2eq$ in 2030. What is more, Germany has set itself the goal, in terms of final energy consumption in the heating and cooling sector, of achieving a share of renewable energies in final energy consumption for heating and cooling of 27% (see Section 2.1.2.ii). The Energy Efficiency Strategy for Buildings of 18 November 2015 is also crucial for the buildings sector.
There is also potential for energy consumption in the buildings sector to be significantly reduced and for renewable energies for producing heating and cooling to be used efficiently. An appropriate combination of the two could be used to essentially create solutions with 2030 and 2050 in mind. It is important to ensure here that these are feasible, affordable, economical, open to different types of technology, sustainable and, not least, reliable, durable and user-friendly. Social impacts also need to be taken into account.

Further savings could be achieved across various sectors by reducing indirect emissions, which occur during the production of building materials, components and plant technology, etc. in the industrial sector. In addition to promoting the use of resource-efficient building materials, the selective dismantling of buildings and the recycling of building materials could also contribute to reducing energy demand here.

The Federal Government will submit an overall strategy for existing building stock in the form of the long-term renovation strategy pursuant to Article 2a of the Energy Performance of Buildings Directive.

Total floor area to be renovated/energy savings to be achieved pursuant to Article 5 of the EU Energy Efficiency Directive with reference to the exemplary role of public buildings

Article 5 EED (2012/27/EU) requires Member States to ensure that buildings owned and occupied by the central government meet the national minimum energy performance requirements. At least 3% of the building stock which does not meet these minimum requirements must be renovated each year. Member States may opt for an alternative approach which results in a comparable level of energy savings. The total floor area to be renovated or the equivalent annual energy savings to be made must furthermore be reported for the period 2021 to 2030, pursuant to Article 4(4) of the provisional final version of the Governance Regulation. The savings to be made could be calculated using the methodology developed by the Federal Ministry of the Interior, Building and Community (Report II7-01-10-01-2017 by the Federal Institute for Research on Building, Urban Affairs and Spatial Development). A suitable system will be developed for the purpose of monitoring the savings achieved.

2.2.ii. The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU

The indicative milestone will be established with the long-term renovation strategy in accordance with Article 2a, paragraph 2 of the Energy Performance of Buildings Directive, which will be communicated to the EU Commission as soon as possible. On account of the fact that the contributions of the individual sectors to reducing greenhouse gas emissions in Germany for subsequent years after 2030 have still not been set out at national level and that important specifications still need to be set out at European level, Germany will quantify the milestones for 2040 and 2050 when the necessary guidelines have been set out at national and European level. This will be no later than the point at which the annual emissions levels are updated in the Climate Protection Act in 2025. A qualitative classification will be undertaken for the period after 2030 in the current LTRS. The indicators and indicative milestones will be further developed as part of the update of the LTRS by 30 June 2024.

Germany will set out energy performance as the first indicator. In the course of updating the LTRS, Germany will also check the configuration of other indicators, in particular regarding final energy consumption. Other indicators may also emerge as a result of the continuation of the buildings database (e.g. regarding the rate and extent of renovation), approaches to the classification of energy performance certificates and the heating label.

Table A14: Indicative milestone in accordance with the long-term renovation strategy

	2008 (Baseline year)	2030
Energy performance – non-renewable primary energy consumption ($PEC_{n.R.}$ in PJ)	4,400	2,000

2.2.iii. Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

Transport

The 2010 Energy Concept stipulates that final energy consumption in the transport sector must be reduced by around 10% by 2020 and by around 40% by 2050 (in both cases compared to 2005). In addition, the Federal Government states in its Climate Action Plan 2050 that Germany's transport system will be almost independent of fossil carbon fuels and therefore largely GHG-neutral by 2050.

2.3. Energy security dimension

2.3.i. The elements set out in of Article 4(c)

Reliability of the energy supply is one of the triad of energy transition goals (see Figure A1). In qualitative terms, this means ensuring that Germany can meet domestic demand for energy from any sector at all times. No quantitative goals have been set in this respect. As a basic principle, however, the goals described in Section 2.1. and 2.2. (and the relevant measures set out in Section 3.3.) have a stabilising effect on reliability of supply, since domestic renewables production and improved energy efficiency will reduce demand for sources of energy which are characterised by limited availability and are primarily imported (over 70% of Germany's primary energy demand is covered by imported sources of energy).

The European Union has established a detailed framework with a view to overcoming limitations and disruptions in the energy supply and carries out ongoing work to develop it further. This framework determines the Member States' responses in the event of a crisis. Such a crisis might involve a disruption in the supply of either petroleum or gas and electricity. The main requirements concerning reliability of supply are set out in the Energy Industry Act.

Natural gas

Natural gas continues to represent a significant portion of the energy supply in Germany and the European Union as a whole. A major supply disruption could therefore affect both Germany and the EU as a whole and cause significant damage. Resilience to supply crises should therefore be maintained and where necessary increased in order to reduce yet further the likelihood of such crises and increase preparedness for a deterioration in the supply situation. Responsibility for security of the grid-based supply is primarily held by the undertakings active on the market in Germany. All gas supply undertakings operating in Germany must comply with clearly defined public service obligations in terms of supplying the public (and vulnerable customers in particular):

- Pursuant to §§1 and 2 of the Energy Industry Act, they are obliged to guarantee to the general public a supply of gas which is as reliable, cost-effective, consumer-friendly, efficient and environmentally sound as possible.
- Pursuant to §15 of the Energy Industry Act, transmission system operators (TSOs) must guarantee the stability of the network. The tools referred to in §16 of the Energy Industry Act can be used for this purpose.
- Pursuant to §53a of the Energy Industry Act, gas supply undertakings must continue to supply natural gas to customers (in particular 'protected customers') even if the supply of natural gas is partially disrupted or the demand for gas is unusually high, 'provided that they can reasonably be expected to do so on economic grounds'.

As a basic principle, the undertakings (in particular the TSOs and operators of gas distribution networks) are therefore responsible for eliminating any hazards or disruptions by means of network-related and market-related measures. This also includes the key issues paper approved in winter 2015 by the Federal Ministry of Economic Affairs and Energy, which strengthens gas supply security by means of market-based, EU-compliant, cost-effective and flexible measures in the balancing energy market. In consultation with the Federal Ministry of Economic Affairs and Energy, every year in the summer the TSOs and market area coordinators set a volume to be tendered for the coming winter and the tendering methods for long-term options (LTOs) and demand side management (DSM). Depending on how the winter plays out, a so-called short-term balancing product can be added at a later date. In order to guarantee the best possible level of preparedness and prevent or mitigate the impact of gas supply disruptions, the competent authorities also produce preventive action plans and emergency plans for individual risk groups after consulting the stakeholders. Provision for these plans is made in Articles 8, 9 and 10 of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply (previously: Articles 4, 5 and 10 of Regulation (EU) No 994/2010). The plans are designed in such a way that national risks can be overcome by leveraging the full benefits of regional cooperation. The technical and operational nature of the plans means that they are suitable for preventing the occurrence or deterioration of an emergency, limiting its consequences and taking into account the security of the electricity systems. Further details can be found in Section 3.3. on measures and strategies.

Petroleum

Germany's oil crisis preparedness measures are embedded within both the European Union and the supra-national International Energy Agency (IEA). Germany must comply with requirements in this respect imposed by both the EU and the IEA; these provisions are combined and transposed into national law in the Petroleum Stockholding Act and the Petroleum Data Act. Within Germany, these pieces of legislation form the legal basis for large-scale stockholding of petroleum and petroleum products for the purpose of crisis preparedness. In accordance with their provisions, Germany holds petroleum stocks of crude oil, petrol, diesel, extra-light fuel oil and the fuel JET A-1 which are adequate to cover 90 days of net imports. The

Petroleum Stockholding Association, which is a corporation under public law, ensures that these petroleum stocks are held properly. In the event of a supply crisis, the Federal Ministry of Economic Affairs and Industry, the Federal Office for Economic Affairs and Export Control and the Petroleum Stockholding Association, including the Supply Coordination Group (a group which brings together representatives of the petroleum industry) will work together on the basis of the established procedures to approve release of the Petroleum Stockholding Association's stocks.

Electricity

Germany's supply of electricity is secure; along with Denmark, it ranks top among EU Member States in terms of reliability of supply (Council of European Energy Regulators – CEER, 2016). Germany's geographical location means that a stable supply of electricity within the country is of crucial importance for the EU's internal market as a whole.

Ensuring a secure supply of electricity, even under the conditions of the energy transition, is a key objective for the Federal Government. This applies in particular in view of the almost simultaneous phase-out of nuclear energy and coal. We want to ensure that we maintain security of supply at its current high level in each phase of this fundamental transformation.

The energy transition and the phase-out of nuclear energy and of coal-fired power generation present Germany with major challenges. The switch to renewable energies means, firstly, that wind power from the north needs to be transported to the centres of consumption in the south. The optimisation and increased utilisation of existing electricity grids and above all the rapid expansion of the electricity grids are therefore extremely important. Secondly, the supply of electricity must also be secured even if wind farms and photovoltaic systems are able to supply only a small amount of electricity due to weather conditions. Therefore, in addition to power generation from renewable energies, Germany also needs to optimise and expand the grids, consistently develop the electricity market further at EU level, adopt approaches offering greater flexibility on the demand side and finally have gas power plants and storage reservoirs which can respond flexibly to the level of wind and solar power generation available. Load management may also play an important role for electricity consumers as it minimises so-called peak loads when many customers demand electricity at the same time.

The Electricity Market 2.0 represents Germany's main solution to the problem of balancing supply and demand, even in times of scarcity, therefore guaranteeing the reliability of the electricity supply. Cross-border exchanges of electricity (through integration into the European electricity markets) will also help boost Germany's security of supply. The capacities required will mainly be refinanced via market mechanisms. It will be a capacity reserve, rather than a capacity market, that provides additional back-up for the Electricity Market 2.0 (see also Section 2.4.3.ii.). As in the gas and oil sector, the primary responsibility for guaranteeing the security of supply in the electricity sector in Germany rests with the undertakings which operate on the market. The following requirements must be met by undertakings:

- Pursuant to §§1 and 2 of the Energy Industry Act, they are obliged to guarantee to the general public a supply of electricity which is as reliable, cost-effective, consumer-friendly, efficient and environmentally sound as possible.

- Pursuant to §13 of the Energy Industry Act, the transmission system operators hold responsibility at system level. The system-related and market-related measures referred to in §13 of the Energy Industry Act can be used for this purpose.

- Pursuant to §14 of the Energy Industry Act, the operators of electricity distribution systems can use the same measures as the operators of transmission systems. They must also take steps (as and when requested to do so) to support operators of other transmission systems or upstream operators of electricity distribution networks into whose networks they are integrated.

Requirements imposed at EU level in the field of risk preparedness are also playing an increasing role in the electricity sector. On 22 May 2019, within the framework of the 'Clean energy for all Europeans' package, the European Council approved the Regulation of the European Parliament and of the Council on risk-preparedness in the electricity sector, repealing Directive 2005/89/EC – COM (2016) 862. The aim of this Regulation is to improve cooperation between the Member States in the area of crisis preparedness, limit the impacts of electricity supply crises in the EU, establish procedures for mutual support between Member States and increase transparency in respect of crisis preparedness. The Regulation came into effect on 4 July 2019.

Coal

There is a functioning international market for hard coal. Lignite is a domestic energy source in Germany. On

the basis of recommendations from a national commission on the role of coal as a source of energy for the generation of electricity, the Federal Government has presented the legislature with a Coal Phase-out bill, in which the gradual phase-out of coal-fired power generation by no later than 2038 is to be enshrined in law (see Section 3.4.3.). Section 3.3. on measures relating to security of supply therefore contains no details on coal as a source of energy.

2.3.ii. National objectives with regard to increasing the diversification of energy sources and supply from third countries, for the purpose of increasing the resilience of regional and national energy systems

Appropriate diversification of Germany's energy supply is perceived as an ongoing task by the Federal Government. It continuously monitors energy supply trends and publishes its findings in monitoring reports pursuant to §51 of the Energy Industry Act. According to these reports, the supply of electricity in Germany is based on a relatively broad mix of power generation sources, which effectively minimises the risk of a supply bottleneck affecting individual energy sources.

Diversification of supply sources and transport routes represents a key pillar of Germany's gas supply. The gas industry is undertaking significant efforts to expand the natural gas infrastructure (lines and reservoirs) in line with demand and adapt it to the changing market environment as well as diversify the natural gas supply yet further for the purposes of security of supply and foreseeable exploitation of fields in the North Sea. As such, there are advanced plans for the creation of a German LNG import infrastructure in Brunsbüttel, Stade and Wilhelmshaven. The commissioning of German LNG terminals will expand and strengthen the already broad diversification of Germany's sources of supply and pipeline transport routes. At the same time, the natural gas industry will decide in the German and European liberalised gas market on the sources of supply of its natural gas imports. The extent to which and under what conditions the LNG infrastructure will be able to gain importance in the future for the importation of hydrogen remains to be seen.

Natural gas/petroleum

The number of natural gas import routes into the German market is comparatively high. Adjacent markets can also procure gas via different routes. This reduces the risk of supply disruptions, not only in the German market but also in neighbouring markets. Cross-border flows of gas are exchanged with all neighbouring countries, and some of the gas supplied from Russia and Norway is transported directly via pipelines which do not transit through other countries. There are also direct connections between Germany's natural gas network and the LNG import infrastructure of the neighbouring countries of Belgium, France, the Netherlands and Poland. Germany's network of oil pipelines is adequately secured. The oil supply complies with market criteria. There is no need for state regulation. The natural gas and petroleum industry ensures that supply structures are adequately diversified and takes precautions to maintain this level of diversification.

Coal

All of the lignite used in Germany is mined within the country's borders. The supply can be regarded as secure. Imports of hard coal are widely diversified. Given the liquid global market and international supply structures, the security of supply for hard coal is regarded as high. In accordance with the recommendations of the Commission on Growth, Structural Change and Employment, the generation of electricity from lignite and hard coal will be continuously reduced so that the capacity of the power plants on the market in 2022 is approximately 15 GW for lignite and 15 GW for hard coal, maximum 9 GW for lignite and 8 GW for hard coal by 2030 and zero GW by the end of 2038 at the latest.

Electricity

An increase in interconnectivity is planned in the electricity sector (ratio of cross-border capacities to national peak load). The 2030 target for interconnectivity (thermal interconnector capacity) is 30%. Further details on this topic can be found in Section 2.4.

2.3.iii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

The Federal Government undertakes ongoing efforts to guarantee appropriate diversification of Germany's energy supply (see Section 2.3.i. for further details in this respect).

2.3.iv. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

As already noted in Section 2.1.2., the Federal Government is aiming for a continuous increase in the share of renewables in gross final energy consumption and in the electricity, heating and cooling and transport

sectors. The national goals are set out in this section. Developments such as the integration of renewables into the electricity market and the increasing electrification of other sectors require flexibility on both the demand and supply sides in order to compensate for the fluctuating supply of wind and solar electricity in Europe and Germany. Further details in this respect are provided in Section 2.4.3.ii.

2.4. Internal energy market dimension

2.4.1. Electricity interconnectivity

One of Germany's priorities in this area is to strength the internal European electricity market. A larger market area for electricity and a higher level of liquidity in this market mean that fluctuating wind and solar feed-ins can be compensated for more easily, accurately and cost-effectively by means of flexible generators and consumers throughout Europe. A large and liquid European market area of this kind is a vitally important factor in implementing Europe's energy transition at a reasonable price and without forfeiting security of supply. Another important task is to overcome the structural challenge posed by the geographical distance that often separates Europe's most cost-effective locations for electricity generation and its load centres for electricity consumption.

Grid expansion is a crucially important step in ensuring that electricity can be traded at any time between all EU Member States. Member States can only rely on electricity from neighbouring countries or purchase their electricity and hence make their national energy systems more efficient if electricity is in fact exchanged on the basis of balance sheet trading. By allowing traded electricity to be distributed to the Member States, grid expansion therefore represents the backbone of the internal European electricity market. For this reason, Germany intends to make substantial investments in national and cross-border grid expansion.

Europe's grids need to be expanded, and this is particularly true in the case of Germany. Germany intends to push forward with the growth of renewables in future, thereby making a significant contribution to the EU's 2030 goal. What is more, the electricity flowing through Germany's electricity network not only moves from North Germany to South Germany, but also (in view of Germany's central geographical position) from South Germany to Austria or from Denmark to Italy, for example. Germany faces particularly thorny challenges in connection with grid expansion, but the Federal Government is taking decisive action to overcome these challenges.

2.4.1.i. Level of electricity interconnectivity that the Member State aims for in 2030 in consideration of the electricity interconnection target for 2030 of at least 15%, with a strategy with the level from 2021 onwards defined in close cooperation with affected Member States, taking into account the 2020 interconnection target of 10% and the following indicators of the urgency of action

1. The difference in wholesale prices between Member States, regions or bidding zones exceeds the guideline threshold of EUR 2/MWh.
2. The nominal transmission capacity of interconnections is below 30% of peak load.
3. The nominal transmission capacity of interconnections is below 30% of installed renewables capacity.

Each new interconnector shall be subject to a socioeconomic and environmental cost-benefit analysis and implemented only if the potential benefits outweigh the costs

The Federal Government supports the new provisions on interconnectivity and the development of additional interconnectors with other Member States in the interests of a functioning internal European electricity market. In Germany, new interconnectors are currently either under construction or at very advanced planning stages and will be put into operation between 2020 and 2022. Further interconnectors will also be examined as part of network development planning. As such, no other country in Europe will increase its cross-border transport capacity by 2030 to the same extent as Germany.

Germany welcomes the fact that the interconnection target is now being operationalised through the specified criteria (indicators) because, as such, differences between the Member States in terms of geography and energy mix can be better taken into consideration. The three differentiated indicators serve a vitally important role as the basis for decisions on further interconnector expansion pursuant to Article 4(d)(1)-(3) of the Governance Regulation. The Federal Government believes that only by implementing the specifically planned interconnectors and those under construction will the criteria (indicators) be met, enabling Germany to achieve the interconnection target. This applies in particular to transmission capacity as a share of peak load and installed renewables generation capacity.

On account of the new provisions of Articles 14 to 16 of the EU Electricity Market Regulation, and in view of the interconnection target, it is also now important to better synchronise the development of additional interconnectors with the expansion of the corresponding national grids. Germany is therefore now regularly conducting the prescribed socioeconomic and ecological cost-benefit analysis for new interconnectors as part of network development planning.

2.4.2. Energy transmission infrastructure

The transmission system operators (pursuant to §12b of the Energy Industry Act for electricity and §15a of the Energy Industry Act for gas) produce new network development plans (NDPs) on a regular basis; these plans cover the expansion of electricity and gas transmission infrastructures. The network development plans for electricity and gas are produced within the framework of a multi-stage process in which the transmission system operators and the Federal Network Agency (as regulatory authority) play an important role.

2.4.2.i. Key electricity and gas transmission infrastructure projects and, where relevant, modernisation projects that are necessary for the achievement of objectives and targets under the five dimensions of the energy union strategy

The following sections explain the Federal Government's plans in detail. Subsections 2.4.2.i. and 2.4.2.ii. have been consolidated.

2.4.2.ii. Where applicable, main infrastructure projects envisaged other than projects of common interest (PCIs)

Electricity transmission infrastructure

Germany is aware of the significance of national grid expansion for the functioning of Europe's internal electricity market. The Federal Government is therefore firmly committed to the task of grid expansion. In December 2019, the 2019-2030 Network Development Plan was confirmed by the Federal Network Agency, illustrating the transmission system expansion required by 2030. The related investments in the expansion, reinforcement and optimisation of the transmission systems are investments in the internal European electricity market and in Europe as a business hub. The time involved in implementing large-scale investment plans of this kind is significant, however. In order to reduce grid congestion, the Federal Government is therefore working on an action plan for reducing grid congestion within the framework of the Electricity Market Regulation, which contains grid-related measures as well as measures relating to generation and re-dispatching (see Section 3.4.3.i.)

Based on past network development plans, the urgent requirement for 65 projects with a total of approx. 7 700 kilometres of cables, around 900 km of which relates to interconnectors, has already been enshrined in law in the Federal Requirements Planning Act and the Energy Line Expansion Act (see below). Germany will amend the Federal Requirements Planning Act in 2020 in light of confirmation of the 2019-2030 Network Development Plan. The goal of expanding the use of renewable energies to account for a 65% share by 2030 as well as the opening up of the interconnectors, as provided for in the European energy package, will form the basis of this. The planned phase-out of coal will also be taken into consideration. In addition to the grid expansion projects already set out in the Federal Requirements Planning Act and the Energy Line Expansion Act, further grid expansion projects with a length of just under 3 600 km, including new interconnector projects, are required by 2030 in accordance with the 2019-2030 Network Development Plan.

In legislative terms, grid expansion covering a total length of approximately 1 800 km was enshrined in law back in 2009 in the Energy Line Expansion Act.

On the basis of previous NDPs, grid expansion covering a total length of approximately 5 800 km was given the legal go-ahead in the Federal Requirements Planning Act. The status of projects under the Federal Requirements Planning Act and the Energy Line Expansion Act after the fourth quarter of 2019 was as follows:

- Expansion goals under the Federal Requirements Planning Act: total length of around 5 800 km; around 700 km (12% of total) currently approved; around 370 km (6%) implemented. 16 of the 43 projects involve multiple federal states or multiple countries. Of the 43 projects under the Federal Requirements Planning Act, 9 are PCI projects (No 2, 3, 4, 5, 8, 29, 30, 32, 33).
- Expansion goals under the Energy Line Expansion Act: total length of around 1 800 km; around 1 400 km (77% of total) currently approved; around 910 km (50%) implemented. Project No 1 under the Energy Line Expansion Act is also a PCI project.

Against this backdrop, the 2018 coalition agreement provides for a stepping up of efforts in relation to expansion of the electricity networks. The Federal Ministry of Economic Affairs and Energy drew up an ambitious set of measures known as the Electricity Grid Action Plan which it presented in summer 2018. They include not only measures to accelerate grid expansion, but also measures for improved utilisation and optimisation of the existing grid. The Transmission System Expansion Acceleration Act was therefore amended and simplified in 2019. Regular, transparent and realistic monitoring is crucially important for the timely implementation of all grid expansion projects under the NDP. The quarterly monitoring reports published by the Federal Network Agency were enhanced on an ongoing basis and supplemented with predictive controlling.

Gas transmission infrastructure

During the preparation of the 2020-2030 Gas NDP, the transmission system operators (TSOs) set out a scenario framework for consultation on 17 June 2019. The Federal Network Agency made a decision on the scenario framework on 5 December 2019. As a result of this confirmation, the TSOs are now drawing up the 2020-2030 Gas NDP. The scenario framework's key topics are Green Gases and their integration into the gas infrastructure as well as the market area merger planned for 1 October 2021.

The gas demand scenarios and gas-related final energy demand were considered on the basis of the dena-TM95 and EUCO30 scenarios. The focus of dena-TM95 is 'Green Gases'. The trajectory for the phase-out of coal, as recommended by the Commission on Growth, Structural Change and Employment, is depicted in both scenarios. Both scenarios show an increase in hydrogen demand in the transport sector. The Federal Government is not adopting the scenarios as its own.

The scenario framework also contains details as to how the TSOs wish to depict the merger of the two German gas market areas planned for 1 October 2021 in the 2020-2030 Gas NDP. Transferring the present capacity level from the two separate market areas into the future joint market area is not straightforward. In particular because of the low exchange capacity between the two present market areas there is likely to be congestion in the future, limiting the amount of firm capacity. The TSOs have therefore developed a calculation system for identifying potential congestion in the entire German market area by looking at numerous load cases. They should also be able to weigh up whether the emerging congestion could be rectified more efficiently through investments in the network infrastructure or through the use of market-based instruments. No decision will be taken, in the gas network development planning process, on the appropriate design of the instruments from a regulatory and legal standpoint or on any possible approval of costs. In this context, the instruments are simply deemed to be surety for load cases which cannot be handled with the existing infrastructure.

The completion of the process for the current 2018-2028 Gas NDP meant that a basis was created for the expansion of the natural gas infrastructure in line with demand. The NDP, which is binding upon TSOs, contains 155 measures with a total investment volume of around EUR 6.9 billion, which are to be implemented by 2028. This involves:

- the construction of new gas pipelines with a length of 1,364 km, and
- the creation of additional compressor capacity of 499 MW.

The completion of the process for the upcoming 2020-2030 Gas NDP will result in further expansion measures.

The transmission system operators are also planning to convert individual natural gas pipelines into hydrogen pipelines and construct new hydrogen pipelines. Hydrogen infrastructure is currently not covered by regulations and is also not part of binding network development planning. However, the Gas NDP could serve as a transparency platform for the further development of the hydrogen infrastructure. The Federal Government has set out requirements for an expansion of the hydrogen infrastructure in its climate package.

2.4.3. Market integration

2.4.3.i. National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met

2.4.3.ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets including a timeframe for when the objectives are to be met

2.4.3.iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters

Subsections 2.4.3.i., 2.4.3.ii. and 2.4.3.iii. have been consolidated.

A large and liquid market area for the efficient balancing of generation and consumption

In order to guarantee the reliability and cost-effectiveness of the power supply while also integrating an increasing share of renewables into the electricity system, Germany has opted for an energy-only market and a single German bidding zone. A large market area makes it possible to use geographic balancing effects during generation and consumption. A high level of liquidity in the electricity market makes it possible to consolidate supply and demand flexibly and efficiently, even when electricity is generated on a fluctuating basis (as in the case of renewables). It also reduces the power of major providers to determine market outcomes and allows innovative players to enter the market. Uniform wholesale prices ensure that the most cost-effective generation technologies gain an appropriate share of the electricity mix, regardless of their location within Germany. Facilities with the lowest input costs are used on a supra-regional basis. This reduces the variable costs of the system as a whole. A single German bidding zone and a large European electricity market area reduce total demand for generation capacity, load management and storage facilities. This leads to a drop in the investment and maintenance costs of the overall system. The Federal Government believes that that a single European electricity market and the associated grid expansion is the best way to guarantee a cost-effective power supply. Creating local price signals is risky since it might distort the merit order effect, which ensures that the most cost-effective power plants at national level are the first to produce electricity. In the Federal Government's opinion, however, grid expansion (together with other solutions such as the construction of decentralised power plants) can reduce grid congestion.

A single German bidding zone and a large European electricity market area reduce total demand for generation capacity, load management and storage facilities. Against this backdrop, exchanges of electricity between the EU Member States are gaining in importance. Supra-regional generation and consumption synergies can be harnessed to make the electricity system even more flexible. European capacities can also provide a joint basis for security of supply. Both reduce the overall costs of electricity generation in Europe.

Sectoral coupling for electricity, heating, industry and transport

The Federal Government plans to press ahead with sectoral coupling, or in other words the efficient use of electricity from renewable energies. As a result of sectoral coupling, electricity from renewables will play an increasingly important role in the buildings, transport and industry sectors and contribute to their decarbonisation. The framework conditions for sectoral coupling should therefore be improved in these sectors with a view to creating a level playing field for the various sectoral coupling technologies.

Gradual reduction and phase-out of coal-fired power generation

The Energy Concept sets out a roadmap for modernising Germany's power supply: with regard to the gradual reduction and phase-out of coal-fired power generation, the Federal Government set up a commission which developed a programme of measures for achieving Germany's climate goals in the energy sector, phasing out coal-fired power generation and supporting structural change (Commission on Growth, Structural Change and Employment, see Sections 3.1.1. and 3.4.3).

Increased coupling of the electricity markets

Increased coupling of Germany's electricity market with markets in neighbouring countries is a vital step towards implementation of the energy union and European market integration. Pointers are provided by Europe's goal of a harmonised capacity calculation method for day-ahead and intra-day trading, with associated guidelines for capacity allocation and congestion management.

Reduction of grid congestion

The new EU Electricity Market Regulation 2019/943 of the European Parliament and of the Council states that Member States should take appropriate measures in order to address grid congestion. Member States with internal structural congestion may decide themselves how to rectify internal congestion. They may choose whether to address it through an action plan for reducing grid congestion or to review and, where

applicable, adjust their bidding zone.

Demand within Germany's transmission network will continue to rise, and may lead to grid congestion, until construction of the major high-voltage DC transmission lines has been completed (and possibly beyond). This is due in part to the fact that new wind farms are mainly located in the north and east of Germany whilst some of the large load centres are located in the south and west of Germany. At the same time, some of the power plants in Germany will be taken offline in the future as a result of the nuclear power phase-out.

Germany is also a hub for international trading in electricity on account of its geographical position between the Scandinavian electricity markets (with comparatively low prices) and the western or southern European countries (with comparatively high prices). This is why Germany frequently exports electricity to its southern neighbours on a market-driven basis.

The provisions of the new EU Electricity Market Regulation 2019/943 on trading in electricity state that the interconnectors should be open for cross-border trade. Internal grid congestion and loop flows will in future only be taken into consideration to a very limited extent in the context of capacity allocation. A target of 70% of line capacity is to be made available to cross-border trade. Member States with structural internal congestion, which develop an action plan, will receive transitional arrangements. They must achieve the 70% target by the end of 2025 based on a linear trajectory. The new, stricter provisions on trading in electricity set out in the new EU Electricity Market Regulation will increase transmission demand.

In order to address the resulting challenges, the Federal Government plans to reduce grid congestion and the associated re-dispatching quantities to an acceptable level and increase utilisation of the electricity grids (see Section 3.4.3).

2.4.3.iv. National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met

Guaranteeing adequacy

Germany's goal is to maintain a functioning Electricity Market 2.0 and jointly guarantee reliability of supply within Europe. Within Germany, security of supply is guaranteed by the Electricity Market 2.0. The latter makes it possible for the necessary capacities to be refinanced via market mechanisms. This relates not only to price peaks, but also to the long-term price signals sent by an intact Electricity Market 2.0. Two conditions must be met in order for the refinancing of power plants, flexible demand and other flexibility options to function correctly under the Electricity Market 2.0: the first of these is that electricity prices must continue to be formed freely on the market, and the second is that electricity suppliers must be subject to robust incentives to meet their supply obligations, and to financial penalties if they do not. The Electricity Market 2.0 is more cost-effective than an electricity supply system which involves an additional capacity market, since the latter creates superfluous overcapacities. In addition, the cheapest solutions to the problem of integrating renewable energies will prevail under the conditions of market competition. The Electricity Market 2.0 is safeguarded by a capacity reserve. By way of contrast to a capacity market, the capacity reserve only covers power plants which are not present on the electricity market and do not distort competition and price formation. Security of supply monitoring offers an additional safeguard.

Reliability of supply can be guaranteed on the basis of joint European capacities. In a large and liquid European market area, synergies can be leveraged between different locations with different production conditions. This makes it possible to respond efficiently to fluctuations in generation and consumption, reducing total electricity production costs and demand for capacity. In order for this to happen, however, reliability of supply must be examined at EU level rather than merely at national level, with a view to ensuring that the shared internal market can provide adequate capacities even in the event of a shortage, and that electricity can in fact be transported across borders.

Guaranteeing flexibility

Developments such as the integration of renewables into the electricity market and increasing electrification of other sectors require flexibility on both the demand and supply side in order to compensate for the fluctuating supply of wind and solar electricity in Europe and Germany. The Federal Government has set itself the goal of building a flexible electricity system consisting of well-developed electricity networks and flexible power plants and consumers. Storage facilities will also be integrated into this system wherever expedient. The fact that the EU's 2030 renewables goal has increased to at least 32% makes the need for flexibility in the electricity market even more urgent. It entails an increase in the share of renewables in the EU's electricity sector to almost 50% in 2030.

2.4.3.v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

Healthy competition exists in Germany among providers in the end energy customer sector. The Federal Government's aim is to preserve the high intensity of competition on the electricity and gas end customer market. Competitive price formation and market liberalisation represent the key foundations for achieving this goal. The legislative framework for the protection of domestic customers will be developed further by the Federal Government in any area where this appears necessary. For example, there are plans to reinforce consumer protection by increasing transparency, in application of the EU's directive on the internal market in electricity (still at the consultation stage). Further details on the protection of energy consumers and competitiveness of the end customer market can be found in Section 3.4.3.iv.

2.4.4. Energy poverty

2.4.4.i. Where applicable, national objectives with regard to energy poverty including a timeframe for when the objectives are to be met

Affordability of energy in the context of the energy transition is a priority for Germany. Affordability is furthermore one of the triad of goals which Germany has set itself in connection with the energy transition (see Section 1.1.). The Federal Government is therefore working to ensure that this affordability is guaranteed for all citizens. Energy costs can, essentially, also be positively influenced, for example, through a change of supplier, energy-saving behaviour and energy efficiency measures.

The Federal Government follows a comprehensive approach within the framework of social legislation and does not restrict itself to individual aspects of poverty. In Germany, vulnerable individuals have a constitutionally guaranteed right to a guaranteed minimum subsistence level fit for human beings (Article 1(1) of the Basic Law in conjunction with the social state principle pursuant to Article 20(1) of the Basic Law). This includes material needs essential to physical existence and a minimum level of integration in social, cultural and political life. In accordance with the provisions of the Federal Constitutional Court, the guaranteed minimum subsistence level fit for human beings is ensured through permanent legal rights (as part of basic income for jobseekers in accordance with Volume II of the Social Code and social assistance in accordance with Volume XII of the Social Code; so-called minimum guaranteed income schemes). These benefit entitlements for guaranteeing a livelihood are designed so that they always cover all needs required to ensure subsistence. As subjective rights, they are enforceable and subject to judicial review. The extent of these entitlements is set by the legislature based on requirement types and the funds required for them. An energy requirement essentially forms part of the minimum subsistence level fit for human beings. It is covered in the aforementioned minimum guaranteed income schemes as follows:

- Reasonable costs for heating energy (including the production of hot water as part of a centralised heating energy supply) are covered in full (cf. §22(1) of Volume II of the Social Code and §35(4) of Volume XII of the Social Code).

- Household energy (excluding decentralised production of hot water) is taken into consideration as part of the 'normal requirement' ['Regelbedarf'] on a flat-rate basis (cf. §20(1) of Volume II of the Social Code and §27a(2) of Volume XII of the Social Code). The level of 'normal requirements' is calculated based on the specific consumption expenditure, deemed to be relevant to the 'normal requirement', of households in the lowest income groups which, not exclusively, receive subsistence benefits in accordance with Volume II of the Social Code and Volume XII of the Social Code (based on special analyses of the Income and Consumption Sample Survey). In order to ensure that the 'normal requirement' does not lose any of its purchasing power, it is recalculated whenever a new Income and Consumption Sample Survey is conducted and, during the years in between, is updated using a mixed index (rate of change of the price development of all goods and services relevant to the 'normal requirement' at a proportion of 70% and rate of change of net wages and salaries at a proportion of 30%). This means that expenditure on household energy relevant to the 'normal requirement' is also updated annually.

- An additional requirement is recognised for the decentralised production of hot water (cf. §21(7) of Volume II of the Social Code and §30(7) of Volume XII of the Social Code).

The group of people specifically entitled to claim is determined in accordance with individual aspects, whereby the minimum subsistence level defined by the legislature is compared with the relevant income and financial situation of the individual seeking assistance. The abstract definition of a group of people affected by 'poverty' or 'energy poverty' would not be sufficient for the constitutional provisions in force in Germany regarding the

guaranteed minimum subsistence level. The at-risk-of-poverty rate and the primary indicators suggested by the EU Energy Poverty Observatory are statistical values. They do not provide any information about individual need.

Supply disconnections on account of payment arrears on the part of the customer are essentially possible only under strict conditions in Germany, which are set out for the electricity sector in §19(2) of the Ordinance on the Default Supply of Electricity and for the gas sector in §19(2) of the Ordinance on the Default Supply of Gas. As such, the default supplier may disconnect the electricity supply only if the customer is in arrears of at least EUR 100 following the deduction of any advance payments and is unable to demonstrate that there is a good chance that they will fulfil their payment obligations. When calculating the outstanding payments, any debts which are not legally enforceable which the customer has objected to in due form, in due time and showing conclusive justification are not taken into consideration. In addition, any arrears which, on account of an agreement between the supplier and the customer, are not yet due for payment or which result from a disputed price increase by the default supplier which has not yet been legally decided on are also not taken into consideration. §19(2)(2) of the Ordinance on the Default Supply of Electricity also sets out a proportionality test. In this context, special circumstances (for example infants in the household or a need for a permanent electricity supply for medical reasons) may be taken into consideration, regardless of the time of year. Corresponding regulations also apply to the disconnection of the default gas supply, however with the difference that disconnections are possible without any consideration of a minimum amount with which the customer is in arrears.

A warning period of 4 weeks must be provided before the supply is disconnected. Only a small proportion of warnings actually result in the supply's being disconnected. Figures from the Monitoring Report by the Federal Network Agency show that in 2018 only just under 6% of households supplied with electricity and around 3% of households supplied with gas which received a warning that the supply could be disconnected actually had their supply disconnected. This therefore means that around 0.6% of households supplied with electricity and around 0.2% of households supplied with gas actually had their supply disconnected. In the majority of cases, the problem that had led to the disconnection warning was dealt with beforehand. In 2018, the total number of disconnections fell in comparison to the previous year. For urgent cases resulting from the fact that a customer is in arrears, the German social system also boasts a wide range of support options to prevent the supply from actually being disconnected:

- Where the payment obligations for energy costs cannot be met and the energy supply has been disconnected or the supplier has issued a warning stating that it might disconnect the supply, loans or, as an exception, non-repayable grants may be considered (cf. §24(1)(22) and §22(8) of Volume II of the Social Code; §37(1) and §36(1) of Volume XII of the Social Code). Where applicable, old debts (payment obligations which were already due before the subsistence benefits were approved) may even be covered if, otherwise, an emergency situation comparable to homelessness would arise.

- Support for energy costs is also available for individuals who otherwise receive no subsistence benefits (cf. §21 second sentence of Volume XII of the Social Code in conjunction with §36(1) of Volume XII of the Social Code).

- Ultimately, the competent authority can pay basic income for jobseekers and social assistance benefits directly to the energy supplier in order to prevent any risk of the supply's being disconnected beforehand (cf. §24(2) and §22(7) of Volume II of the Social Code; §35(1) of Volume XII of the Social Code).

As illustrated, energy law and social law in Germany already provide an extensive framework whose purpose is to prevent social hardship in relation to supply disconnections as far as possible. A study published at the end of November 2016, entitled 'Analysis of electricity supply disconnections pursuant to §19(2) of the Ordinance on the Default Supply of Electricity', commissioned by the Federal Ministry of Economic Affairs and Energy, also came to this conclusion. Existing funding programmes and consumer advisory services (including consulting on energy saving) are also useful measures for preventing supply disconnections. One such advisory service is the Energy Savings Check – energy consulting which low-income households can access free of charge. Firstly, the Energy Savings Check includes tips on how to reduce energy consumption. Secondly, households also receive helpful technical devices free of charge such as energy-saving and LED bulbs, switchable power strips, TV standby cut-off switches, time switches and tap aerators, which can help to reduce energy consumption and related costs.

2.5. Research, innovation and competitiveness dimension

2.5.i. National objectives and funding targets for public and, where available, private research and innovation relating to the energy union including, where appropriate, a timeframe for when the objectives are to be met

Research and development into innovative energy technologies and the demonstration of these technologies rely not only on the involvement of the private sector, but also on public research funding. The aim of the latter should be to support and promote collaboration on technological developments and innovations by industrial players, research institutions and universities; topics may range from fundamental research or applied research through to the transfer of technologies or innovations to the market. Public funding for energy research represents a cornerstone of energy policy; as such, it is aligned with the Federal Government's political goals and addresses major challenges relating to the energy transition. The central framework for energy research funding in Germany at a research policy level is the Federal Government's cross-departmental energy research programme, which is a multi-annual programme aimed at steering the funding activities of the various ministries involved. The current Seventh Energy Research Programme of the Federal Government was adopted in September 2018. The programme focuses on accelerated transfer and extensively aligns energy research with the needs of the energy transition. As such, it is built around the following goals:

- **Driving forward the energy transition**: The primary goal of research funding is the development of innovative and holistic solutions to the challenges associated with the energy transition and a rapid time-to-market for these solutions. Progress towards this goal is supported by means of a broad funding approach along the entire energy chain and a particular focus on the transfer of findings. Attention is paid not only to the technical dimensions of the energy transition, but also to its non-technical dimensions such as societal processes or innovation-friendly framework conditions and their interactions. Innovative technologies and concepts are prioritised if they can deliver significant progress in terms of increasing efficiency and integrating renewable energies into demand sectors. Particular importance is attached to the complex tasks faced in the heating sector (space heating and process heat).

- **Strengthening Germany's reputation as an industrial powerhouse**: Research funding in the energy sector is a key factor in modernising the German and European economy and safeguarding the country's reputation as an industrial powerhouse. This will also improve the competitiveness of German companies (see 2.5.iii). Key tasks include making constructive use of 'trendy' innovations such as digitalisation, preserving and expanding technological know-how in the energy sector and improving export opportunities for innovative energy technologies. Research funding is therefore also targeted at technologies for global markets, particularly those in developing and threshold countries. An especially key task involves the activation of innovation potential in small and medium-sized companies and start-ups.

- **Risk provisioning at a macro-social level**: The technology-neutral approach enshrined in the Seventh Energy Research Programme is aimed at ensuring that energy research rapidly develops and makes ready for use a broad range of potential technologies for the transformation of the energy sector. This will provide the room for manoeuvre needed to respond to future developments which cannot yet be foreseen. Since climate change and environmental impacts do not respect national borders, it is important to develop highly efficient renewable energy technologies and system solutions with a view to solving related problems not only at a domestic but also at a global level.

The Federal Government's research funding is based on a technology-neutral approach and covers a broad range of sustainable energy technologies. In thematic terms, the Seventh Energy Research Programme also reflects the core and special priorities of the European Strategic Energy Technology (SET) Plan and the energy union which are most relevant to Germany. Priority is given to areas which have the potential to contribute to the energy transition as well as economic importance and innovation potential. The relative importance of individual areas of research is continuously assessed. Certain areas of research are specifically activated through funding announcements and complementary strategies. Between 2020 and 2022, around EUR 1.3 billion per annum will be provided by the Federal Government for research funding as part of the Seventh Energy Research Programme. The Federal Government is striving to ramp up energy research in the period between 2020 and 2030. The long lead times between research and widespread use mean, in view of the target date of 2050, that application-oriented energy research needs to be stepped up.

2.5.ii. Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives including long-term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy- and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

Carbon dioxide emissions are the chief driver of anthropogenic climate change. In Germany, most CO_2 emissions result from the use of fossil fuels such as coal, oil and gas. One of the main goals of energy policy is therefore to reduce energy-related carbon emissions. Energy research tackles this goal through increased energy efficiency, the integration of renewable energy into the energy system and the development of alternative industrial processes which generate fewer or no greenhouse gas emissions.

Two complementary strategies are being followed in the area of industrial processes. Firstly, increased energy efficiency based on lower energy inputs will lead to a permanent drop in energy-related carbon emissions in the industrial sector. Secondly, technologies for closing the carbon cycle will be developed for certain industrial processes in which the generation of carbon is difficult or even impossible to avoid. Technologies which separate carbon out of industrial exhaust gases and in particular the atmosphere are needed for this (carbon dioxide removal – CDR). They can be biological in nature (plant growth) or technological (direct air capture – DAC), whereby sustainability criteria need to be developed and taken into consideration. Research into carbon separation, transport, storage, long-term sequestration and use technologies will be stepped up so that domestic companies and research institutions can assume a pioneering role in this area, which furthermore holds tremendous export potential. For example, carbon dioxide can be used in the chemicals industry as a starting point for the manufacture of inputs into other processes (by converting it into polymers, basic chemicals, etc.). It can also be used to manufacture liquid fuels.

2.5.iii. Where applicable, national objectives with regard to competitiveness

The long-term transformation into an economy and society with net zero emissions in accordance with the Paris Agreement can only be successfully achieved in conjunction with industry. According to a communication on industrial policy issued by the EU in September 2017, the target EU-wide industry share of economic output is 20% (current figure in Germany: 23%). Against this backdrop, a successful energy transition must be designed in such a way as to preserve the industrial basis as a key factor in job growth and retention. International competitive framework conditions are therefore required. Three factors are of vital importance when it comes to shaping the energy transition in energy-intensive industries: cost trends (in particular competitive energy prices), guaranteed security of supply and a reliable framework. Increased energy and emissions trading costs may place companies at a competitive disadvantage, particularly if they are active on the global stage. Planning and investment security is vital for companies in Europe, and their international competitiveness must be maintained in order to prevent the outsourcing of production and jobs abroad (‘carbon leakage’).

Innovative energy technologies which contribute to both climate protection and industry policy goals are of decisive importance in this respect. Industry plays a particularly prominent role in tackling the economic consequences of climate change, increasing resource and energy efficiency and using more renewable energies. Industrial processes alone account for around 7% of German greenhouse gas emissions, for example. Consideration must also be given to energy demand in the industry sector and the resulting emissions.

At the same time, the long-term transition to net zero emissions offers opportunities for economic growth and employment and potential in terms of industrial production or the establishment of technological supply chains. German industry – in particular machinery and plant engineering, instrumentation and control engineering and electrical engineering – occupies a world-leading position in terms of potential exports of environmental and climate protection products. This means not only that it is uniquely placed to benefit from these developments, but also that it can leverage its know-how to help solve related challenges.

Research, industry, investors and authorities are working together closely to leverage the opportunities which emerge in all of the leading markets and key areas of technology where Germany has a presence, using targeted innovation processes which deliver energy-efficient and climate-friendly solutions. To list but a few examples, it is important to harness the potential of sectoral coupling and storage and efficiency technologies, as well as the opportunities available in the raw materials industries and in the fields of plant engineering and microelectronics. A research and industry policy oriented towards this goal can be expected to deliver ‘first-mover’ advantages both domestically and in international markets, with positive impacts on competitiveness and employment.

Sustainably increasing the competitiveness of German and EU industry is a key goal of the 2030 National Industrial Strategy. The strategy focuses on industry, which must continue to be competitive so that prosperity, employment and the private financing of environmental measures can be secured in the long term. A modern industrial policy involves the triad of goals, namely economic performance, social justice and sustainability in all areas.

3. Policies and measures

3.1. Decarbonisation dimension

3.1.1. GHG emissions and removals

3.1.1.i. Policies and measures to achieve the target set under Regulation (EU) 2018/842 as referred to in Section 2.1.1 and policies and measures to comply with Regulation (EU) 2018/841, covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low-emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement

Enshrining of climate goals into law

3.1.1.i.1. Federal Climate Protection Act

The Federal Climate Protection Act lays down a legislative framework for Germany's GHG reduction goal for 2030. Germany has also committed to pursuing greenhouse gas neutrality by 2050 as a long-term objective. In 2025, annual emissions will be set for subsequent periods after 2030. These emission volumes must be in line with the climate protection goals of the Act and with European requirements. By 2030, greenhouse gas emissions will be reduced by at least 55%, in accordance with the goals of the Climate Action Plan 2050. For this purpose, the Act lays down annual emissions for the sectors energy, industry, transport, buildings and agriculture, and reviews these levels each year. For the energy sector, where a steady, continuous decrease in emissions is aimed for, the years 2022 and 2030 are crucial in line with the recommendations of the Commission on Growth, Structural Change and Employment. Progress in the individual sectors will be assessed annually and monitored by an independent panel of experts on climate issues. If a sector deviates from its reduction trajectory, the Federal Government will readjust without delay. The federal ministry that is mainly responsible for that sector by dint of its portfolio will put forward a contingency programme within 3 months. On the basis of that programme, the Federal Government decides what measures it will take to achieve the climate targets.

Carbon pricing

3.1.1.i.2. Carbon pricing in the heating and transport sectors

Introduction of a national fuel emissions trading system
On 15 November 2019, the German Bundestag passed its law on the national fuel emissions trading system (Fuel Emissions Trading Act, BEHG). After referral to the Bundesrat, the Act was promulgated on 19 December 2019. The Act introduces a national emissions trading system for sectors that are not covered by the European emissions trading system, thereby creating a basis for carbon pricing in those sectors. In principle, all fuels are included in the national emissions trading system, regardless of the sector in which the fuels are used. In a start-up phase during the first 2 years, however, only the main primary fuels – petrol, gas oil, fuel oil, natural gas and liquefied petroleum gas – will initially be included.

In the heating sector, the system covers the emissions produced by heat generation in the buildings sector and from energy and industrial complexes outside the EU Emissions Trading System (EU ETS). In the transport sector, the system also includes all fossil fuel emissions, but not air transport, which is subject to the EU ETS. The companies that place the fuels on the market are obliged to participate in the emissions trading system. Companies are required to purchase and surrender allowances for the fuel emissions attributed to them through the placing of the fuels on the market. As a result, future fuel prices will also include an incentive to reduce CO_2 emissions.

In an introductory phase, allowances will be issued at a fixed price that increases from year to year. This creates a reliable price trajectory that enables the general public and industry to adjust to the progression. Because of the varying points of contact between fuel emissions trading and EU emissions trading, double counting of emissions from plants under the EU emissions trading scheme and fuel emissions cannot be entirely ruled out. As far as possible, double burdens resulting thereby are to be prevented well in advance. In the event of unavoidable double entries, financial compensation is provided to avoid a dual burden on plant operators.

The Act provides for the setting of annual emission levels (caps), which decrease from year to year and which contribute to meeting the sector targets under the Federal Climate Protection Act and to the reduction obligation under the EU Climate Protection Regulation. The annual budgets under the EU Climate Protection Regulation are the decisive factor in determining the emission levels. When setting the total amount of emissions, double counting of fuel emissions that are also covered by the EU ETS will be avoided by means

of a system of forecasting of the pro rata emissions to be deducted, as well as retroactive correction in the following years. If more allocations are issued in a given year than are equivalent to the annual emission level set and the annual budget under the EU Climate Protection Regulation is not met as a result, the additional need for allocations will be covered by government use of options to increase flexibility under the EU Climate Protection Regulation, including the purchase of a corresponding amount of emission allocations from other Member States. This restriction on the balancing options ensures that any excess quantities will only ever be offset within the limited total emissions level under the EU Climate Protection Regulation. The overall structure of the national emissions trading system has thus been geared towards an emission budget that is limited in total from the outset. The use of flexibility options is not unusual in other emissions trading systems; in the EU ETS, for example, this takes place via the possibility of using emission credits from international climate protection projects. The emission allocations are transferable and can be traded. After the introductory phase from 2021-2025, the emission allocations will generally be issued by way of an auction process. The relevant authority will periodically offer the available auction volume in equal subsets. The price of the emission allowances essentially follows the market. During the introductory phase, however, a fixed-price system will be introduced in which the emission allocations are sold to those responsible for the emissions. This creates a reliable price trajectory that enables the general public and industry to adjust to the progression. In the first year, the price is to be EUR 25 and will then increase to EUR 55 by 2025 (2021: EUR 25/t CO_2, 2022: EUR 30/t CO_2, 2023: EUR 35/t CO_2, 2024: EUR 45/t CO_2, 2025: EUR 55/t CO_2). These prices reflect the Federal Government's declaration on record to the Bundesrat in December 2019. The declaration on record was implemented in the first law amending the Fuel Emissions Trading Act, passed by the Federal Government in May 2020. During this phase, emission allocations cannot be transferred across one year into the next ('banking ban'). At the same time, a trading platform is being set up to allow for auctioning of emissions allocations and trading. A price corridor with a minimum price of EUR 55 per emission allocation and a maximum price of EUR 65 per emission allocation is to be set for 2026. The price corridor was also set down in the declaration on record and is now being implemented by the first law amending the Fuel Emissions Trading Act. The certificate price generally follows the market, unless the maximum price is exceeded, or the minimum price undercut.

The introduction of carbon pricing in the heating and transport sectors is accompanied by other measures to reduce the burden on citizens and industry. These measures are set out in Section 3.4.3.iv.

Agriculture

3.1.1.i.3. Reduction of nitrogen surpluses including reduction of ammonia emissions and targeted reduction of nitrous oxide emissions as well as improvement in nitrogen efficiency

The Federal Government has already achieved a great deal through the legal changes that have been made and are proposed in fertiliser legislation. This will achieve a further reduction in nitrogen surpluses, including in emissions of ammonia and nitrous oxide. The fertiliser package will also be supported by the promotion of gas-tight, low-emission slurry storage and emission-reducing spreading techniques. The Federal States also have a responsibility here.

Reduction of nitrogen surpluses in agriculture:

- Implementation and consistent enforcement of the Fertiliser Ordinance by the Federal States
- Evaluation of material flow results by the end of 2021, based on an evaluation plan developed jointly by the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry of Food and Agriculture
- As from 2021, further refinement of the material flow results with mandatory introduction to other enterprises (amendments to the Fertiliser Act). Progressive alignment of the overall balance for Germany with the objectives of the sustainability strategy (70 kg N / ha) in 2030. Where the permitted balance values are exceeded, obligation to participate in a consultation. Sanctions in the event of repeated infringement
- 'Nutrient management' programme; the following approaches are currently being examined:
    - Funding under the Agricultural Investment Development Programme
    - Funding for agricultural, environmental and climate protection under the Joint Task Force for the Improvement of agricultural structures and coastal protection
    - Livestock strategy as part of additional climate protection measures
    - Research as part of additional climate protection measures.
- Digitalisation as part of additional climate protection measures.

Reducing ammonia emissions

- Rapid and comprehensive implementation of all mitigation options outlined in the measures under the national air quality management programme to comply with the National Emission Ceiling (NEC) Directive
- Investment and funding programme to support the necessary operational adjustments, and updating of that programme:

- Stepping up research on the interaction between ammonia and nitrous oxide emissions from nitrogen-based fertiliser
- Considering widening the target group of users in immission legislation
- Improving the information basis for reporting.

Targeted reduction of nitrogen emissions from agricultural soils

- Advice and incentives to reduce nitrous oxide emissions by optimising the scheduling of fertiliser application and management of harvest residues (humus formation)
- Use of low-emission fertilising technologies
- Research on the use of nitrification inhibitors (implications for climate and other environmental impacts).

Increasing the proportion of gas-tight stored slurry from cattle and pig farming to 70%.

- Reduction of methane and ammonia emissions
- To achieve a reduction in GHGs, the use of a (methane) gas consumer is necessary.

3.1.1.i.4. Support for the fermentation of farmyard fertilisers derived from animals and agricultural residues

The measure concerns the use of farm manure of animal origin and agricultural waste materials for energy in biogas plants. The increased use of farm manure in biogas plants and the gas-tight storage of digestate will be promoted using current and new instruments.

Promotion of the fermentation of farm manure in biogas plants:

- New support scheme for new systems
- Examination and removal of barriers to the fermentation of farm manure
- Creation of options for follow-up use through the development of new funding and implementation models
- Funding for the fermentation of farm manure, focusing on livestock farming on farms at a ratio of up to two livestock units per hectare (owned and leased land).

Creation of gas-tight digestate storage:

- Use of gas-tight digestate storage facilities from existing Nawaro plants as slurry tanks with a small co-generation plant (design and funding)
- Systematic examination and removal of the legal barriers to funding the gas-tight covering of digestate storage facilities
- Funding for the conversion of existing plants
- Regulatory provision for the gas-tight storage of digestate in existing and new plants in conjunction with a transitional period for funding schemes.

3.1.1.i.5. Development of organic farming

Increasing the area devoted to organic farming is also a climate measure. The Federal Government will further develop the legislation with the aim of promoting particularly environmentally friendly methods such as organic farming or other sustainable methods of agricultural management, and optimise legal and financial support:

- Expansion of support for organic farming
- Provision of the necessary subsidies for conversion in the state budgets and at national level
- Implementation of the ‘organic farming’ strategy for the future, to generate additional stimulus for growth along the entire value creation chain (indirect funding)
- Consolidation and further development of research promotion for organic farming, e.g. in the form of the BÖLN programme (Federal Programme for Organic Farming and Other Forms of Sustainable Agriculture).

3.1.1.i.6. Reduction of greenhouse gas emissions in livestock farming

The Federal Government will realise further savings potential in livestock farming and animal feeding. In addition to research and breeding, the future growth of animal populations will also be addressed. Subsidy programmes are to be geared more towards animal welfare (see also the Federal Government’s proposal for an animal welfare label), taking into account the environmental impact and the savings in emissions.

- Overall, animal improvement and land management will become more closely integrated. The Federal Government is progressively focusing its funding efforts on ensuring that livestock is kept on farms at a ratio of a maximum of two livestock units (LU) per hectare
- Focus of funding measures on animal welfare, taking into account the environmental impact and the savings in emissions
- Examination of the extension of the animal welfare label to all production sectors and the EU-wide introduction of a standardised animal welfare label
- Introduction of a target quota for conversion rates per production sector along the same lines as organic farming (at least animal welfare level 2)

- A higher level of funding where animal welfare is coupled with climate protection (e.g. red nitrate areas, moorland, ammonia-contaminated areas) in conjunction with improved husbandry standards (more land per animal and minimum share of pasture for ruminants)
- Support measures for the collection and assessment of feedstuffs from operational production, feedstuff consumption, and the determination of requirements taking into account the environmental impact and prevention of emissions
- Comprehensive labelling of the farming techniques used for all animal foodstuffs
- Elaboration of an overall strategy by 2021 to reduce emissions from livestock farming
- Development of a model for livestock farming, taking into account the 2050 climate targets of the Paris Agreement
- Development of mandatory targets – qualitative animal welfare and quantitative environmental objectives – as well as a plan for their implementation (mix of instruments)
- Integration of the national livestock husbandry strategy into the overall strategy to reduce emissions from livestock farming
- Revision of the requirements under construction and planning legislation for the approval of new or upgraded livestock farming facilities and biogas plants, combined in a mandatory fashion with high standards of animal welfare
- Gas-tight storage of unfermented farm manure
- Feasibility study of gas-tight storage of farm manure in conjunction with the installation of gas flaring using demonstration projects / pilot plants, and launch of implementation if assessment is positive
- Introduction of regulatory requirements for the gas-tight storage of farm manure in large-scale animal husbandry systems.

To support the measures set out above, the Federal Ministry of Food and Agriculture envisages promoting sustainable food consumption on the demand side.

- Development of a master plan for sustainable and healthy nutrition, taking into account the climate targets of the Paris Agreement for 2050 and the United Nations Sustainable Development Goals, including research on dietary recommendations
- Consolidation and expansion of education and guidance on sustainable, climate-friendly and healthy nutrition (e.g. public canteens)
- Reinforcement of the sustainability criteria (minimum standards) for the dining options in the federal administration's canteens on the basis of the mandatory DGE quality standards already introduced
- Optional labelling of the climate impact on menus in the federal administration's canteens
- Quality campaign for marketing animal welfare products through information and advice
- Research on and development of pricing instruments to control consumption (e.g. to establish alternative sources of protein).

3.1.1.i.7. Energy efficiency in agriculture

The methods used in agriculture and horticulture can be further improved in terms of their energy requirements. The federal programme for increasing energy efficiency in agriculture and horticulture will be continued and further developed for that purpose, and the use of renewable energies promoted.

Reduction of GHG emissions from stationary use by increasing energy efficiency and the share of renewable energies in the provision of heating / cooling

- Continuation and expansion of the Federal Ministry of Food and Agriculture's federal programme for increasing energy efficiency, including switching to renewable energies (e.g. utilisation of waste heat and geothermal energy), in agriculture and horticulture
- Regular evaluation of the entire federal programme
- Improvement of the information basis for reporting on energy consumption from stationary use (direct recording of energy consumption)
- Increase in the efficiency of biogas plants by reducing uncontrolled methane losses through regular leakage checks and the introduction of a documentation requirement with regard to the frequency of pressure relief devices being activated
- Advice for farms on the use of alternative funding programmes (KfW) in relation to buildings

Reduction of GHG emissions from mobile use

- Establishment of funding with two linkable programmes for small mobile systems:
    - Energy efficiency in the mobile sector
    - Establishment of a funding programme for private electricity supply from renewable energies on farms (particularly the substitution of site-dependent agricultural diesel use by renewable electricity); the eligibility conditions should comply with the EEG (Renewable Energy Sources Act); cultivated biomass will not be funded beyond the existing level
- Training and advice on the energy-efficient operation of heavy agricultural machines and supportive

funding for the use of suitable technology

- Integrated energy and climate advice for agricultural enterprises, covering all energy consumption including the optimised operation of biogas plants and thus specifically addressing the areas of greatest potential.

Land use, land-use change and forestry

3.1.1.i.8. Preservation and accumulation of humus on arable land

We must intensify activation of the carbon storage potential of the soil. Measures for carbon enrichment are to be taken into account, among other things, in the cultivation strategy that is currently being developed. The expansion of organic farming also contributes to carburisation. The planting of hedges, hedgerows and avenues of trees, for example, also helps with humus formation. Forested strips on agricultural land improve soil quality and reduce the CO_2 and contaminant load. The Federal Government therefore supports the planting of hedges, hedgerows and avenues of trees, for example with fruit trees, especially on field boundaries. Decisions on possible legal requirements in the context of good professional practice will be made in the mid-2020s, after evaluation of the Thünen Institute's second soil condition survey. The following measures are intended to promote humus formation and preservation:

- Promotion of crop rotation guidelines designed to increase humus levels and encourage humus-retaining management practices in enterprises that have already practised sustainable humus formation and have achieved a high humus level on their land, and at least maintain that level

- Expansion of funding for the planting of belts of woodland, field copses, hedges, hedgerows and avenues of trees, e.g. with fruit trees, especially on field boundaries, and support for agroforestry systems

- Voluntary certification as part of operational audits of management measures aimed at increasing humus levels, and corresponding support: farmers who commit to the sustained use of management practices that maintain humus levels, on compliance with certain conditions, receive an annual base payment for the implementation of the measure that includes an incentive component

- Development of consulting tools for farming practice for the precise determination of soil carbon content.

3.1.1.i.9. Conservation of permanent grassland

High levels of carbon are stored in grazing land. The conservation of permanent grassland is thus also an important climate protection measure. The Federal Government aims to develop a grassland strategy to safeguard and step up permanent grassland utilisation.

3.1.1.i.10. Protection of bog soil including reduction in use of peat in growing media

Drained peat soils are a significant source of greenhouse gas emissions. The protection of moorlands is therefore a climate-relevant measure and will be given greater support.

For moorland protection:

- Adjustments to the current legal and funding framework with the aim of ensuring the most effective protection for moorland and peat bog areas

- Advocacy for the GAEC standards envisaged in the current CAP proposal for adequate protection of wetlands and peatland, including an ambitious structure

- Creation of new funding instruments, including the necessary financing for programmes to permanently re-wet peat soils

- Intensification of research and development measures.

Federal programme for peat reduction to reduce peat use:

- Creation of a subsidy for a default insurance, limited to 10 years, to alleviate the conversion risk

- Establishment of funding instruments for the cultivation of peat substitutes in addition to the measures laid down under 'Moorland protection'

- Support for experimentation work on plant suitability

- Intensification of research into substitutes

- Creation of advisory options for enterprises

- Information for the general public about alternatives to peat potting soils

- Education of special usage groups.

3.1.1.i.11. Conservation and sustainable management of forests and timber

Major carbon sinks, particularly forests and moors, are at risk of releasing their stored emissions. There is enormous climate protection potential in conserving and sustainably managing forests and timber usage. It is vital that forests and their sustainable management are conserved and safeguarded in the long term. This calls for appropriate measures for the reforestation of deforested areas, as well as measures for the more effective overall adaptation of forests to climate change in the context of a climate-robust forest restructuring approach. The Federal Government will therefore be funding the protection of these carbon sinks. The extreme weather of the past year has shown that the forest needs help to enable it to continue to fulfil its climate protection function. At the same time, the Federal Government will promote the sustainable and resource-efficient use of timber. This includes, for example, increased use of wood as a climate-friendly building material. The following measures are intended to help conserve and manage forests sustainably:

- greater support for measures aimed at the development of climate-tolerant mixed forests (including contractual nature conservation measures with an impact on climate, such as measures aimed at improving the carbon reservoir in the forest or the structural diversity of the forest) through the joint scheme, Improvement of agricultural structures and coastal protection. Taking into consideration ecological and climate impact concerns, these efforts are aimed at
    - reforestation of deforested areas (180,000 hectares, as at September 2019)
    - stepping up the process of adapting forests to climate change

- accompanying measures (e.g. optimised monitoring, optimised wildlife management, increased international cooperation in ensuring sustainable forest management world-wide and strengthening wood competence centres to avoid displacement effects, and intensification of silviculture research)

- increased funding for research and development projects, specialist and consumer information, competitions of ideas, model / demonstration projects aiming at
    - climate-friendly and innovative timber usage, especially in the area of building with wood, and in relation to the re-use of hardwood timber, the circular economy and cascading use
    - promoting climate-conscious consumer behaviour.

Further measures for the removal of greenhouse gases

3.1.1.i.12. Funding programme for the expansion of landfill aeration and the optimisation of gas collection

Key measures in the area of ‘Other Emissions’, which focus on the vast majority of emissions under this heading, are landfill aeration, which converts the methane normally generated into biogenic carbon-based carbon dioxide (thus making it greenhouse gas-neutral), and the optimisation of gas collection.

3.1.1.i.13. ‘Climate Action 2050’ information campaign

Members of the general public are concerned about how they can personally contribute to climate protection. The Federal Government will support this widely felt willingness to take action by providing an information portal which advises on the possibilities for action for citizens and companies. In addition, a comprehensive information campaign will be launched across all relevant media with target group-specific information to explain the Federal Government’s climate protection policy.

3.1.1.ii. Where relevant, regional cooperation in this area

3.1.1.ii.1. Minimum price in EU emissions trading

The Federal Government will work in close cooperation with the EU Commission to introduce Europe-wide certificate trading for all sectors. In a first step, the existing European emission trading (for energy and industry) is to be augmented by a moderate European minimum price. The minimum price ensures that the certificate price will no longer fall arbitrarily, even when demand is low. This will create planning security for climate investments in the ETS sectors.

3.1.1.ii.2. European Climate Initiative

In 2017, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety launched the European Climate Initiative with a view to stepping up cross-border cooperation and the transfer of experiences in the field of greenhouse gas reduction in the non-governmental arena. Funding is available for projects which promote the exchange of best practices between sub-state players, civil society, industry and

science. The Federal Government, however, also engages in various other regular exchanges of information with other EU Member States. Bilateral arrangements have long been established with a great many Member States for this purpose.

3.1.1.ii.3. Meseberg Climate Working Group

In the Meseberg Declaration of 19 June 2018, Germany and France agreed to set up a cross-departmental high-level working group on climate-related issues (Climate Working Group). The Climate Working Group supports implementation of the Paris Agreement. Measures to achieve this goal include the development of joint approaches to the energy transition, sustainable financing instruments, and financial incentives, including issues relating to carbon pricing. The constituent meeting of the Climate Working Group took place on 6 September 2018 in Paris. The Climate Working Group reports on its work to the German / French Ministerial Council. It meets at least once a year and is chaired by the secretaries of state responsible for climate change.

3.1.1.iii. Without prejudice to the applicability of State aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable

3.1.1.iii.1. National Climate Initiative

Under the National Climate Initiative, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety has funded many climate protection projects since 2008, making an important contribution to achieving the national climate protection objectives. Its programmes and projects cover a broad range of climate protection activities: the National Climate Initiative is aimed at embedding climate protection at grassroots level through the development of long-term strategies, support for professional climate management and investment funding. Its main target groups include municipalities, industry, consumers, schools and educational institutions. A total of around EUR 220 million was spent in 2018.

3.1.1.iii.2. Development and implementation of a Sustainable Finance Strategy

The development of a sustainable finance strategy aims to further develop Germany into a leading sustainable finance location, to facilitate the discussion and implementation processes at national, European and global level and to contribute to a structured, focused stakeholder dialogue. On 25 February 2019, the State Secretaries' Committee for Sustainable Development decided on the following steps for this purpose: 1. to set up a sustainable finance advisory committee with members from the financial sector, the real economy, civil society and science, with the aim of advising the Federal Government on the development of a sustainable finance strategy, monitoring the European process, improving the knowledge base, pooling existing strengths and providing new impetus (the constituent meeting was on 6 June 2019), 2. to continue the established exchange of experiences within the Federal Government, in order to integrate issues of sustainability into federal investments, 3. to examine whether the issuing of green or sustainable federal bonds in Germany within the intended respective follow-on investments is economically advantageous (the Federal Ministry of Finance (BMF) has announced the issuing of 'green' government securities for 2020, see below), 4. to develop a communication strategy to make sustainable finance more widely known among consumers and the financial industry.

3.1.1.iii.3. Further development of the KfW into the transformative promotional bank for supporting the transformation of sectors of the economy and the financial market for a GHG-neutral future

The KfW is being further developed as a sustainable promotional bank to support the transformation of economic sectors and the financial market for a greenhouse gas-neutral future. Proposals for specific implementation are being put forward in accordance with the sustainable finance strategy, within the limits of the existing equity base of the KfW and in line with the KfW's strategic target system. At the same time, the Federal Government will press ahead with corresponding transformation processes in multilateral development banks through its influence on the relevant bodies within those banks. The discussion on the EU taxonomy and its results are to be taken into account.

3.1.1.iii.4. 'Green' federal securities

In future, the government will be issuing green federal securities in the context of the sustainable finance strategy currently under development, thereby supporting the development of sustainable financial markets. The issuance will create transparency about the government's green spending. The preparation for and following up of the issuing of green federal securities is an interministerial measure. Tasks include, among other things, the selection and evaluation of suitable green investments and the subsequent reporting on the results achieved, which must be effected within the relevant competent department (e.g. for energy, transport, research, etc.). The issue of green federal securities is intended to position Germany internationally as a sustainable finance location.

3.1.2. Renewable energies

3.1.2.i. Policies and measures to achieve the national contribution to the binding 2030 Union target for renewable energy and trajectories as referred to in Article 4(a)(2), and, where applicable or available, the elements referred to in Section 2.1.2 of this annex, including sector- and technology-specific measures

Electricity

3.1.2.i.1. Renewable Energy Sources Act

Since 2000, the Renewable Energy Sources Act has been the primary instrument for controlling the expansion of renewable energies in Germany. As its statutory objective, the Renewable Energy Sources Act currently aims to increase the share of renewables in the power supply to at least 80% by 2050. It therefore represents the main foundation for achieving the relevant goals in the electricity sector. The Federal Government introduced the concept of mandatory direct marketing back in 2014 in the amended version of the Renewable Energy Sources Act. Plant operators must sell their own electricity on the market; in return, they receive a 'sliding premium' from the network operators.[1] This market premium compensates for the difference between the fixed feed-in payment and the monthly average trading price for electricity.[2] The level of funding therefore drops as soon as electricity prices rise. Use of the monthly average as a reference value also incentivises plant operators to respond to electricity prices.

During the first few years after the Renewable Energy Sources Act came into force, the main priority was to increase the volume of renewables in the electricity mix. Since 2014, however, it has been possible to achieve an increasingly dynamic reduction of funding costs. In the case of free-standing photovoltaic panels, the costs dropped from 9 cents/kWh in 2015 to 4 to 5 cents/kWh in 2018 (having been approx. 40 cents/kWh in 2005, i.e. many times higher).

The switch to the sliding premium also heralded a move to the market integration of renewable energies. Under the 2017 version of the Renewable Energy Sources Act, competitive calls for tender are now the main basis for determining the level of funding. The respective amounts of onshore and offshore wind power, photovoltaic energy and biomass which the Federal Government wishes to fund will be tendered out. Small facilities are exempt from these rules. This will ensure that the growth of renewables in Germany continues on the basis of competitive prices.

The Renewable Energy Sources Act 2017 outlines targets for renewables growth, tendering quantities and deadlines, and terms and conditions for tendering procedures for the relevant technologies and segments. The terms and conditions for tendering procedures for offshore wind power are regulated by the Offshore Wind Energy Act (see below). The Federal Network Agency publishes calls for tenders for all of the above technologies at varying intervals. It is expected that many projects will only come online towards the end of the implementation deadline. Comprehensive monitoring forms an integral part of the process.

The tendering quantities stipulated in the Renewable Energy Sources Act 2017 for each technology between now and 2030 are as follows:

- Onshore wind: 2 800 MW a year for 3 years from 2017, 2 900 MW a year from 2020; the Omnibus Energy Act provides for special calls for tendering covering an additional 4 GW over the period 2019-2021.
- Offshore wind: 3 100 MW in total between 2021 and 2025 (500 MW a year in 2021 and 2022, 700 MW between 2023 and 2025) and an average of 840 MW a year in 2026 to 2030.
- Photovoltaic plants from 750 kW: 600 MW a year. The overall goal for photovoltaics is an expansion corridor of 2 500 MW a year; the Omnibus Energy Act provides for special calls for tender covering an additional 4 GW over the period 2019-2021.
- Biomass plants: 150 MW a year between 2017 and 2019, 200 MW a year from 2020 to 2022.

The Renewable Energy Sources Act will be amended in 2020. The Federal Ministry of Economic Affairs and Energy will submit a draft for this. In addition to adjustments to the funding system, increased flexibility of the electricity market (see Section 3.4.3.) is a vital tool for the market integration of renewable energies.

3.1.2.i.2. Expansion of the use of renewable sources of energy to account for a 65% share of gross electricity consumption by 2030

The purposeful, efficient and increasingly market-oriented expansion of renewable energies, synchronised

[1] Derogations are in force for small facilities generating less than 100 kW.

[2] The premium is optional for old facilities and small new facilities. The latter can continue to request a fixed payment instead.

across grids, is, along with the replacement of coal-fired by gas-fired power plants and the reduction of coal-fired power generation, a key element in achieving the climate objectives in the energy sector. The Federal Government has set a goal of achieving a 65% share of renewable energies in electrical energy consumption in 2030. In 2018, the share of renewable energies in gross electricity consumption was approx. 38%. The expansion of renewable energies in power generation will be substantially supported and regulated by the Renewable Energy Sources Act. The following goals are currently laid down in the Renewable Energy Sources Act:

- 40 to 45% by 2025
- 55 to 60% by 2035 and
- at least 80% by 2050.

The share of renewable energies in gross electricity consumption is heavily dependent on the development of electricity consumption (inter alia efficiency and sectoral coupling), as are the expansion trajectories. As outlined in the Climate Protection Programme, further measures are planned in relation to the expansion of renewable energies to a 65% share in gross electricity consumption by 2030. These measures will be put into concrete form in legislative proposals.

3.1.2.i.3. Offshore Wind Energy Act

The terms and conditions for tendering procedures for offshore wind power have been regulated in the Offshore Wind Energy Act since 2017. Regions and sites for offshore wind energy are designated and preliminary inspections carried out by the government. In addition, the timings for the bringing into service of offshore wind farms and offshore grid connection cables are coordinated. Like the Renewable Energy Sources Act, the Offshore Wind Energy Act will also be amended in 2020. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

3.1.2.i.4. Closer synchronisation between the expansion of renewable energy sources and grid expansion

The focus of the current phase of the Renewable Energy Sources Act is the network and system integration of renewable energies. Given Germany's position as a major EU Member State in the centre of Europe, one of the Federal Government's main tasks in the future will be to expand the electricity grid and modernise and optimise existing grids. Consideration will also be given to optimisation and further development of grid management, including re-dispatching measures. This is essentially a Europe-wide challenge: if electricity is to be generated in the most cost-effective locations, adequate capacities must be available to transport this electricity to load centres. Germany's early move into the renewables market has meant that this challenge is particularly visible here. In order to align renewables growth in the electricity sector more closely with grid expansion, the former is controlled directly (alongside grid-related measures). The Renewable Energy Sources Act will be amended in 2020. The Federal Ministry of Economic Affairs and Energy will submit a draft for this.

3.1.2.i.5. Review of regional control of renewable energies in the power sector

The regional control system has particular implications for the federal states' plans and targets for renewables growth, on grid development plans and on public acceptance of renewables growth, and is therefore highly relevant in political terms. It therefore also results in closer synchronisation between renewables growth and grid expansion. A great deal of flexibility is available when it comes to regional control of renewables growth: whereas with large power plants, the flexibility lies in the generation itself, the generation capacity of renewable energies can be controlled geographically in the short and medium term if the need for grid relief is identified and the necessary political framework is in place. The level of renewables growth in South Germany has been around 25% in recent years. In a first bidding round held in 2017, only around 10% of the contracts awarded went to wind projects in South Germany. Tighter regional control could ensure that at least 25% of the quantity tendered out (around 750 MW) went to South Germany (i.e. a proportion which reflects real renewables growth in the region). Regional control resulting in lower installed wind capacity in Northern Germany could also minimise curtailments, since less electricity would need to be transported to Southern Germany. Against this backdrop, the ruling parties agreed in the 2018 coalition agreement that steps should be taken to control renewables growth by setting a minimum percentage (across all energy generation types) for tendering procedures south of the grid bottleneck.

3.1.2.i.6. Pilot project relating to technology-neutral and innovation-focused procurement

As part of the State aid approval procedure under the Renewable Energy Sources Act 2017, the Federal Government approved the publication of cross-technology calls for tender within the framework of an experimental pilot project set to run between 2018 and 2020. Joint calls for tender which cover both photovoltaic systems and onshore wind farms mean that the different technologies are forced to compete against each other. The Regulation on Joint Tendering Procedures for Onshore Wind and Solar Energy has been in force since August 2017. Under this Regulation, 400 MW a year are being tendered out on a technology-neutral basis for onshore wind and photovoltaics respectively between 2018 and 2020. The results are being evaluated openly, also in comparison with the technology-specific auctions. New pricing

mechanisms and tendering procedures intended to promote competition and deliver grid and system benefits will be tested out in innovation-focused procurement procedures. The power to enact statutory instruments relating to innovation-focused procurement which is enshrined in the Renewable Energy Sources Act 2017 has been amended to this end; a corresponding regulation has now been adopted. A total of 650 MW will be tendered out in 2020 within the framework of these procedures, followed by 500 MW in 2021. These figures will be deducted from the standard tendering quantities for onshore wind and solar energy. The Renewable Energy Sources Act will be amended in 2020. The Federal Ministry of Economic Affairs and Energy will submit a draft for this.

3.1.2.i.7. Special tendering procedures for onshore wind and solar energy

In the coalition agreement for the 19th parliamentary term, the Federal Government agreed to introduce special tendering procedures in the field of renewables with a view to achieving the 2020 climate goals and reducing carbon emissions. The special tendering procedures were introduced through an amendment to the Renewable Energy Sources Act 2017 within the framework of the Omnibus Energy Act of 17 December 2018. In the years 2019-2021, 4 GW of onshore wind and photovoltaic energy are being additionally put out to tender each year. These special calls for tender are intended to accelerate progress towards the national climate goals and the binding goals under the Renewable Energy Directive for renewables growth. In order to increase competition, the tendered quantities for onshore wind and solar will increase from 1 GW per technology in 2019 and 1.4 GW per technology in 2020 to 1.6 GW per technology in 2021.

3.1.2.i.8. Further development and extensive modernisation of cogeneration

Cogeneration will be promoted for electricity and heating in a way that is compatible with the expansion of renewable energies. Modern cogeneration systems, increasingly incorporating heat from renewable energies and use of waste heat potential, will replace fossil fuel cogeneration plants, secure the electricity and heating supply and support the integration of renewable energies through a flexible mode of operation that is appropriate for the system. The promotion of cogeneration in public service provision will also be developed further and extended up to 2030.

Heating and cooling

Measures in the buildings sector to implement the Energy Efficiency Strategy for Buildings are set out in the long-term renovation strategy (see heating- and cooling-related measures in the buildings sector in Section 3.2. on energy efficiency). At the same time, many of these measures also encourage progress towards goals under the ‘Renewable energy’ dimension, particularly the energy conservation legislation for buildings and the Renewable Energies Heat Act.

Transport

Strategies and measures relating to low-emission mobility are described in Section 3.1.3.iii.

3.1.2.ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in Section 2.1.2

Increased regional cooperation with other Member States is another driver of market integration for renewables. The Federal Government intends to focus on this area in the years to come.

3.1.2.ii.1. Opening up of calls for tender in the electricity sector

In accordance with the State aid approval procedure under the Renewable Energy Sources Act, since 2017 the Federal Government has been obliged to open up procurement in the field of renewable electricity to providers located in other EU Member States (up to a total of 5% of the capacity to be installed). The aim is to achieve greater regional cooperation, ultimately leading to a shared understanding of market integration as well as funding of renewable energies and closer convergence of national funding systems. Crucial factors in cross-border procurement include the principle of reciprocity, a cooperation agreement with the partner country and physical imports of the funded electricity into the partner country. Cross-border procurement can be implemented either through calls for tenders which are open to bidders from two or more countries, or through joint calls for tenders with one or more partner countries. The Cross-Border Renewable Energies Regulation provides the legal basis for cross-border procurement in the field of onshore wind and photovoltaics. Experience has already been accumulated in the field: to cite but one example, a pilot cooperation project implemented with the Kingdom of Denmark in 2016 involved calls for tenders which were open to bidders from both countries. The only contracts awarded in this open tendering procedure were to free-standing photovoltaic systems in Denmark. The Federal Government is also proactively seeking further cooperation partners, with the current focus being on Luxembourg and France.

Based on the experiences gained, the Federal Government also plans to develop the 'showcase' concept in order to increase the transparency of cross-border procurement procedures for stakeholders in other Member States. The concept is designed to encourage governments and companies in other Member States to participate in cross-border procurement procedures organised by the Federal Government, and to clarify the terms and conditions of tendering which would apply if the parties agreed to cooperate.

3.1.2.ii.2. Baltic Energy Market Interconnection Plan (BEMIP) – Working Group on Renewable Energy

The BEMIP Working Group on Renewable Energy serves as a platform for the exchange of experiences between the Member States involved in relation to renewables growth, particularly as regards planning and funding issues. It also works towards the goal of developing a shared vision for the EU's Baltic Sea coastal states in respect of renewables growth, especially offshore wind, and identifying potential cooperation projects. Germany actively supports the initiative and is in favour of the EU's Baltic Sea coastal states exchanging information on the relevant parts of their National Energy and Climate Plans (NECPs) within this framework. Synergy effects with North Sea energy cooperation projects (see below) will be leveraged in the process. Potential cooperation projects in the Baltic Sea area include the shared use of electricity infrastructure for the construction of additional offshore wind capacity.

3.1.2.ii.3. Cooperation with other North Sea coastal states in the area of renewable energy

This cooperation focuses on increasing offshore wind capacity, expanding grid infrastructure and maritime spatial planning in the North Sea. The relevant EU North Sea coastal states (including the Federal Republic of Germany) have also started to exchange information on the relevant sections of their NECPs within the framework of the initiative. The focus of North Sea cooperation is on the coordination of goals and expansion strategies, including individual procurement timelines for offshore wind, and the exchange of experience in relation to the growth of offshore wind capacity (funding systems, spatial and grid planning, etc.). Aggregate planning for the expansion of offshore wind in the North Sea will be carried out within the framework of NECP cooperation, along with a project pipeline which is as well-coordinated and smooth as possible. North Sea Energy Cooperation is also being used as a basis by the relevant Member States (including the Federal Republic of Germany) for concept-stage work on potential joint projects for offshore wind energy use and 'hybrid projects', i.e. projects where the network and grid connection of the offshore wind farms is used simultaneously as an interconnector and to discharge the electricity generated. The Federal Government plays an active role in North Sea cooperation (inter alia through its leadership of Working Group 3 on the Funding and Financing of Offshore Wind Power). The Federal Government also regards North Sea Energy Cooperation as a major opportunity for further integration of the internal energy market, and will continue to advocate for more frequent exchanges of best practices, improved coordination of energy use and grid expansion in the North Sea and the preparation and development of specific joint projects. Germany has been actively involved in the joint section relating to the North Sea cooperation. The Federal Government supports the continuation of the initiative beyond 2019, and in January 2020 will assume the presidency of the North Sea cooperation group.

3.1.2.ii.4. TARES project in Greece

A strategic partnership has existed between the Federal Government of Germany and Greece since 2013 in the area of renewable energies and energy efficiency. Under the aegis of the European Commission's Structural Reform Support Service (SRSS), the Federal Government funds technical support in Greece in connection with reform of the renewable energy and efficiency sector (TARES-, TARES+ and TARES4 project). This support is implemented on the ground in Berlin and Athens in the form of advice provided by the German Corporation for International Cooperation (GIZ). The advice focuses on the promotion of reform measures aimed at the achievement of Greece's national goals by 2020 and the development of a long-term strategy for energy and climate policy by 2050, particularly with regard to the further growth in renewables and energy efficiency, and the adjustments which must be made to Greece's national electricity market in order to achieve a rising share of renewable energies. The project also supports exchanges of experience between the Federal Republic of Germany and Greece in relation to the drafting of National Climate and Energy Plans (NECPs) for 2030. The development and implementation of specific pilot projects relating to renewable energies, for example in public buildings or on a Greek island, also falls under the heading of technical support. The aim is to illustrate by means of concrete examples the feasibility and cost-effectiveness of implementing renewable-heavy projects in Greece.

3.1.2.ii.5. Concerted Action on the Renewable Energy Sources Directive

The Concerted Action on the Renewable Energy Sources Directive (CA-RES) forum was founded in 2010 and pursues the goal of allowing experts from the Member States to engage in informal exchanges of experience on implementation of the Renewable Energy Directive. Germany has played an active role in the forum since its inception by taking on the leadership of thematic subgroups. As part of the current CA-RES phase which has been under way since 2016, Germany is leading the 'Core Theme 1 RES Electricity' subgroup; this means that it is responsible for preparing for and following up on related topics discussed at the twice-yearly plenary meetings, and for organising and supporting task forces between plenary meetings. In this role, Germany attaches great importance to improving the coordination of the national energy policies in the field of renewable energies. For example, during the plenary meeting held in Warsaw in April 2018, a

meeting was held at Germany's request to discuss NECPs; several Member States (including Germany) presented the first key points of the renewables section of their NECPs at this meeting. The discussions of the 'Core Theme 1 RES Electricity' subgroup also look in depth at issues such as the financing mechanism for renewable energies and the revision of the EU's environmental and State aid guidelines.

3.1.2.iii. Specific measures on financial support, where applicable including Union support and the use of Union funds, for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, transport, and electricity

3.1.2.iii.1. System of surcharges under the Renewable Energy Sources Act

Minimisation of the risks faced by renewable plant operators on the basis of the Renewable Energy Sources Act also ensures very good access to the capital market in Germany. As a central funding instrument for renewable energies in the electricity sector (see Section 3.1.2.i.), the Renewable Energy Sources Act safeguards funding (guaranteed compensation, priority feed-in) and the financing of any extra costs incurred as a result of the surcharge under the Renewable Energy Sources Act. The Renewable Energy Sources Act is updated on an ongoing basis. This updating process is based on periodic evaluations of the law. On 30 June 2018 the Federal Government presented a progress report on the Renewable Energy Sources Act 2017 to the Bundestag, in which in particular the progress made in relation to individual technologies and their current level of market integration, experience in the field of procurement and cost trends were evaluated. Under §97 of the Renewable Energy Sources Act 2017, the evaluation will be repeated every 4 years. The Renewable Energy Sources Act will be amended in 2020. The Federal Ministry of Economic Affairs and Energy will submit a draft for this.

3.1.2.iii.2. Investments in energy storage technology

In its coalition agreement for the 19th parliamentary term, the Federal Government confirmed its intention to invest in energy storage technologies and smart marketing concepts in order to continue safeguarding the reliability of supply in all parts of Germany and minimise system costs and costs under the Renewable Energy Sources Act.

3.1.2.iii.3. KfW Renewable Energies Programme

The programme facilitates the long-term low-interest financing of measures aimed at the generation of electricity from renewables, measures aimed at the generation of electricity and heat in combined heat and power (CHP) plants and measures aimed at the integration of renewable energies into the energy system. Eligible investment costs are funded up to a level of 100% and a ceiling of EUR 50 million per project.

Heating and cooling

Measures in the buildings sector to implement the Energy Efficiency Strategy for Buildings are set out in the long-term renovation strategy (see heating- and cooling-related measures in the buildings sector in Section 3.2. on energy efficiency). At the same time, many of these measures also encourage progress towards goals under the 'Renewable energies' dimension, in particular the Market Incentive Programme for renewable energies in the heating market and the funding of innovative model projects 'Heating Networks 4.0' for renewable local and district heating systems. This funding programme is described in more detail below in this Section 3.1.2. The programme will be amended to provide financial support in particular for the transformation of the hitherto mostly fossil fuel-supplied existing heat networks, which are able to undergo the process of transformation into modern low-temperature heat networks with high shares of renewable energies and waste heat only in progressive stages. Support for measures to invest in the production and use of process heat from renewable energies within the framework of the funding package 'Federal funding for energy efficiency in industry' (see Chapter 3.2) will drive the increased use of renewable energies in the industrial sector.

Transport

Strategies and measures relating to low-emission mobility are described in Section 3.1.3.iii.

3.1.2.iv. Where applicable, any assessment of the support for electricity from renewable sources which the Member States are required to carry out pursuant to Article 6(4) of Directive (EU) 2018/2001

Not applicable at the time of preparation of this NECP.

3.1.2.v. Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements

Central points of contact

3.1.2.v.1. Federal Network Agency
The Federal Network Agency's tasks include receiving reports from electricity generation plants, promoting grid development and publishing calls for tenders under the Renewable Energy Sources Act.

3.1.2.v.2. Federal Maritime and Hydrographic Agency
The Federal Maritime and Hydrographic Agency is responsible for land-use planning, preliminary inspections of sites and approvals in connection with offshore wind.

3.1.2.v.3. Nationale Organisation Wasserstoff (NOW) GmbH
NOW GmbH coordinates and steers the Federal Government's National Innovation Programme for Hydrogen and Fuel Cell Technology and the Federal Ministry of Transport and Digital Infrastructure's funding guidelines on e-mobility and charging infrastructures. On behalf of the Federal Ministry of Transport and Digital Infrastructure, NOW GmbH also supports the further development of the Mobility and Fuels Strategy and the implementation of Directive 2014/94/EU on the deployment of alternative fuels infrastructure.

3.1.2.v.4. Citizens' Dialogue on the Electricity Grid
The Citizens' Dialogue on the Electricity Grid is aimed at an open and transparent exchange of information between all participants on grid expansion in Germany. It provides basic information and answers questions on grid expansion.

Summary of the policies and measures under the enabling framework Member States have to put in place pursuant to Article 21(6) and Article 22(5) of the Directive on the promotion of the use of energy from renewable sources to promote and facilitate the development of self-consumption and renewable energy communities.

3.1.2.v.5. Regulatory framework for the expansion of self-sufficiency with renewable electricity
Consumption of self-generated renewable electricity makes a significant contribution to Germany's power supply. It is estimated that approximately 4 TWh a year is generated and consumed by renewable self-suppliers. The recast Renewable Energy Directive gave a boost to the consumption of self-generated renewable electricity throughout the EU. At the same time, however, it is important to ensure that the consumption of self-generated electricity contributes in an appropriate way to the financing of the energy transition. Against this backdrop, Germany has already created a regulatory framework for self-supply which, firstly, promotes and facilitates the expansion of renewable electricity self-supply, and also ensures that consumers of self-generated electricity participate appropriately in the costs of the overall system. The following measures have been taken so far:

In Germany, consumers of self-generated electricity benefit from exemptions and caps in relation to various taxes, levies and fees. For example, electricity which is generated in small facilities (under 10 kW) and consumed on site is entirely exempt from levies, grid fees and the electricity tax, provided that the electricity is not transported through a grid. As a basic principle, consumers of self-generated electricity with facilities which are rated over 10 kW or which produce more than 10 000 kWh a year are also entitled to exemptions. Consumers of self-generated renewable electricity and consumers of self-generated electricity from certain very efficient cogeneration plants are granted a partial exemption from the obligation to pay surcharges under the Renewable Energy Sources Act (60% exemption). Consumers of larger amounts of self-generated electricity in particular thus make a contribution to the financing of the Renewable Energy Sources Act.

The electricity tax exemptions which apply to electricity generated for the producer's own consumption underwent a legislative revision process on 1 July 2019, to adapt them to the EU's State aid rules. The regulatory framework for self-generation has proven in principle to be a reliable instrument. In implementation of Article 21 of Directive (EU) 2018/2001, the Federal Government is assessing whether measures in the regulatory framework will be adjusted.

3.1.2.v.6. Regulatory framework for the development of renewable energy communities
Renewable energy communities have great potential for the successful expansion of renewable energies at national and European level. Germany has also created a regulatory framework for renewable energy communities that supports and drives forward the development of such communities. This regulatory framework so far covers the following key aspects: Access to renewable energy communities is open to end consumers in Germany in a non-discriminatory manner, as is the access of renewable energy communities to the existing support schemes.

In addition, Germany has given special privileges to 'citizen energy communities' in calls for funding in the area of onshore wind energy. If selected, these renewable energy communities receive funding not just on the basis of their own bid value but based on the bid value of the highest bid accepted on the same bid date (uniform pricing). The Federal Government is assessing whether changes to the existing regulatory framework are required for the implementation of Article 22 of Directive (EU) 2018/2001.

3.1.2.vi. Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

Measures in the buildings sector to implement the Energy Efficiency Strategy for Buildings are set out in the long-term renovation strategy (see heating- and cooling-related measures in the buildings sector in Section 3.2. on energy efficiency). At the same time, many of these measures also encourage progress towards goals under the 'Renewable energies' dimension, in particular the expansion of renewable heating in buildings, the expansion of funding programmes for heating networks (in addition to the 'Heating Network Systems 4.0' as described in this section), heat reservoirs and district-related investments (see Section 3.2.).

3.1.2.vi.1. Heating Network Systems 4.0

Increasing the share of energy from renewable sources and the waste heat and cold in the heating and cooling sector can only be accomplished with large-scale additional construction of low-temperature networks and the transformation of existing heat networks into networks with a high share of renewable energy and waste heat. However, these measures are very expensive. The Federal Government is therefore specifically supporting the further expansion of low-temperature networks, and in the near term also the transformation of existing heating networks, with the aim of progressively preparing and converting them for the supply of a high share of renewable energies and waste heat. Fourth-generation heating networks, known as 'low-temperature networks', can easily be powered using renewable energies, and they open up additional options for flexibility within the electricity market. The funding arrangements for low-temperature networks represented the first ever use in Germany of system-based funding (i.e. funding whole systems rather than individual technologies and components) in the heating infrastructure sector. The systems developed within the framework of this project are remarkable for their very low temperature and very high share of renewable energies and waste heat; they often feature large seasonal heat reservoirs as a key component. Incentivisation of the market launch of fourth-generation heating networks for commercial-scale technical use represents a huge leap forward in terms of the heating transition, since Heating Network Systems 4.0 represent tangible progress towards the climate protection goals and greater integration of renewable energies into the heating sector, and can offer increased flexibility to the electricity sector on a cost-effective and energy-efficient basis.

It is proposed that the high share of energy from renewable sources and of waste heat and cold in district heating and cooling systems will be achieved, as a first step, through the amendment of the existing funding programme 'Heating Networks 4.0'. The amended funding programme provides support not only for the construction of new district heating networks with a high share of renewable energy and waste heat, but in particular for the transformation of the large-scale, hitherto mostly fossil fuel-supplied existing heating networks, most of which will progressively undergo the process of transformation into modern low-temperature heat networks with high shares of renewable energies and waste heat. The programme also contributes to the implementation of the Energy Efficiency Strategy for Buildings (see Section 3.2.).

3.1.2.vi.2. Increasing conversion of heating networks to renewable energy sources and unavoidable waste heat

Heating networks are becoming more efficient and are being converted to work with renewable energies and unavoidable waste heat. This has further positive effects in the buildings sector. With smart control, heating networks and heat storage systems, low-carbon and carbon-free heat sources such as renewable energies and unavoidable waste heat can be interlinked, allowing for a secure, largely fuel-free heat supply. This measure is closely linked to the efficiency measures on the demand side. In the most recent legislative term, the Federal Ministry of Economic Affairs and Energy has therefore launched the pilot programme 'Heating Networks 4.0', which supports the planning and construction of highly innovative multivalent fourth-generation heating networks that provide heating and cooling in a highly efficient and eco-friendly way. The main measures are: In the 19th legislative term, a funding programme is to be developed, taking into account the price trend of the fuels used, which additionally creates incentives for the transformation of existing heat networks.

The following are accompanying measures and/or support the transformation to a low-carbon heat supply (centrally via heating networks, and locally, close to the building):

- Heating levy: pay-as-you-go, market-oriented funding
- Carbon pricing
- In addition, the legal framework for the expansion and optimisation of heating networks with a high share of renewables may be adjusted where necessary
- accompanying: Stakeholder dialogue 'Heating networks in the context of the heating transition'.

3.1.2.vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation, taking into account:

- **biomass availability, including sustainable biomass: both domestic potential and imports from third countries**
- **other biomass uses by other sectors (agriculture and forest-based sectors) as well as measures for the sustainability of biomass production and use**

3.1.2.vii.1. Funding programme 'Use of Biomass for the Generation of Energy'

A new direction for the funding programme was introduced in 2015. It prioritises practical solutions in the form of demonstration or pilot projects which increase the flexibility of biomass-based systems for the generation of electricity and heat. In order to improve sustainable energy use in the (coupled) heat and electricity sector, the programme aims to tap into the potential of biomass residues and waste.

3.1.2.vii.2. Funding programme 'Renewable Raw Materials'

The aim of this programme is to promote research, development and demonstration projects relating to the use of renewable raw materials to generate energy. Alongside research and development projects, it focuses in particular on practical demonstration and pilot projects in the area of process optimisation.

3.1.3. Other elements of the dimension

3.1.3.i. Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS

3.1.3.i.1. National implementation of Directive 2003/87/EC through the Greenhouse Gas Emissions Trading Act

National strategies and measures aimed at achieving the goals of the Climate Action Plan 2050 in ETS sectors will serve as an effective means of reducing carbon emissions throughout the EU provided that unused emission certificates do not result in emissions in other Member States ('waterbed effect'). One of the factors determining whether and for how long a waterbed effect applies is the effect of the ETS market stability reserve (MSR).

3.1.3.i.2. Shutdown of power generation capacities

In cases where electricity generation capacities are taken offline as a result of additional national measures, Article 12(4), second sentence, of the ETS Directive gives Member States the option to cancel allowances rather than auctioning them at national level. In its bill on amendments to the Greenhouse Gas Emissions Trading Act, the Federal Government provides for transposition of this option into national law in line with the requirements set out in Article 12(4) of the ETS Directive and leaves any related decision to the discretion of the Federal Government. These decisions must take particular account of the fact that the reduction in surpluses will be partially addressed by the MSR when it starts operating in 2019. A decision by the Federal Government is required for any cancellation of allowances. A cancellation decision of this kind must comply with the relevant provisions of budgetary law.

3.1.3.ii. Policies and measures to achieve other national targets, where applicable

3.1.3.ii.1. Sectoral coupling

Direct use of electricity from renewable energies makes it possible to tap into efficiency potentials and reduce the use of fossil fuels. Electricity-based technologies on the basis of renewable energies are also an important method for achieving energy and climate goals in cases where other GHG reduction options are difficult to implement through the direct use of electricity (e.g. in the air and maritime transport sectors or some industrial processes). Many different funding measures, projects and programmes exist in the field of sectoral coupling. Detailed descriptions of these measures can be found in the relevant sections, e.g. heating network systems in Section 3.1.2.v., low-emission mobility in Section 3.1.3.iii., the Market Incentive Programme for heating and the CO_2 Building Modernisation Programme in Section 3.2.ii., market integration in Section 3.4.3.i., and real-life laboratories and SINTEG in Section 3.5.1.

3.1.3.iii. Policies and measures to achieve low-emission mobility (including electrification of transport)

The Federal Government's aim in shaping the future of mobility is to achieve a maximum of safety, affordability and climate-friendliness. Increased penetration of electric vehicles based on renewable electricity, and the use of zero-carbon and carbon-neutral fuels are the key pillars for low-emission mobility with a view to achieving the climate goals in the transport sector.

3.1.3.iii.1. Introduction of low-carbon passenger cars to the roads

The aim is to have 7 to 10 million electric vehicles registered in Germany by 2030. In addition to fleet adjustment, additional measures are required in order to significantly increase the percentage of vehicles with alternative drive systems in sales of new vehicles and to significantly reduce the carbon emissions of passenger car traffic. These measures are intended to significantly reduce the extra costs associated with electric cars compared to cars powered only by combustion engines, and to help make the filling and charging infrastructure more attractive from the customer's perspective. At the same time, they will stimulate the supply and demand for alternative drive systems. With the law on tax incentives to promote e-mobility, the company car regulation for the use of a battery-powered electric vehicle or a plug-in hybrid vehicle has been extended until 2030, among other measures. In addition, up to a price of EUR 40 000 the private use of purely electric vehicles will not, as has hitherto been the case, be valued on half the assessment basis, but on a quarter of the assessment basis. The tax exemption under §3d of the law on motor vehicle tax will also be extended until 31 December 2025. The 10-year tax exemption period will be limited to 31 December 2030 at the latest. In a further step, for passenger cars with electric, hybrid and hydrogen / fuel cell drive systems the purchase premium paid by the Federal Government and manufacturers has been extended until 2025 at the latest, with retroactive effect from 5 November 2019 inclusive, and increased for cars under EUR 40 000. The Federal Government will be gearing motor vehicle taxes more strongly towards carbon emission levels and will also be putting forward a law on the reform of the motor vehicle tax for passenger cars, in the expectation that these taxation aspects will exert a much stronger steering effect towards low-emission and zero-emission systems for new car purchases. For new registrations from 1 January 2021, the assessment basis for the tax will depend primarily on the CO_2 test value per km and will be increased in stages above 95 g CO_2 / km.

3.1.3.iii.2. Expansion of filling and charging infrastructure (field of action: 'passenger cars')

Expansion of publicly accessible charging infrastructure is a prerequisite for public acceptance and an increased use of e-mobility options. The Federal Government's goal is to further expand the publicly accessible charging infrastructure, and to have a total of 1 million charging points available in Germany by 2030. To that end, the Federal Government is funding the installation of public charging stations with appropriate programmes up to 2025. In addition to the funding, other measures are required to expand the charging infrastructure. In its Cabinet sitting on 18 November 2019, the Federal Government therefore approved the masterplan for charging infrastructure. The Federal Government will work together with state and local governments, the automobile industry and the energy sector to move ahead with implementing the package of measures for public und non-public charging infrastructure for passenger vehicles and commercial vehicles. In addition to further monetary measures for the funding / financing of charging infrastructure, this also includes legislative measures to improve the legal framework (changes to tenancy and residential property laws, law on buildings and e-mobility infrastructure, amendments to the Charging Stations Regulation), strategic and coordinating actions for nationwide expansion as well as inputs from the commercial sector, especially as regards the provision of necessary information for the tailored development of charging infrastructure and as regards consumer-friendly charging. The consumer is at the heart of the implementation of all measures. E-mobility will only be successful if users accept and are happy with the charging infrastructure available. The sufficient availability of charging infrastructure is a decisive factor in the decision to buy, and as a result the Federal Government aims to provide for an initially disproportionate development of charging infrastructure to prepare the market for anticipated growth. In appropriate exceptional cases of regional market failure, as provided for under European law, distribution network operators will be permitted to construct publicly accessible charging infrastructure. The Federal Government will examine whether a supply obligation could be introduced requiring that charging points also be offered at all filling stations in Germany, and how binding any such regulation could be. Consideration will be given as soon as possible to the issue of whether the construction of rapid charging stations can be treated as a decarbonisation measure by the petroleum industry. Anyone who is unable to offer the 24/7 access condition for publicly accessible charging infrastructure can apply for funding with reduced funding rates via the fifth call for funding (application period 29.4.2020 – 17.6.2020) to the Federal Ministry of Transport and Digital Infrastructure's charging infrastructure funding programme. Customer car parks in particular can benefit from this. In addition, the vast majority of charging will take place at home or at work. For this reason, a funding programme for shared private and commercial charging infrastructure (e.g. in apartment blocks and in employee car parks) will be published before the end of 2020. In addition, charging at the employer's premises and the provision of necessary charging infrastructure to the employee are tax privileged, i.e. they need not be taxed as a salary component. Changes to residential property laws and tenancy rights are intended to facilitate the construction of charging infrastructure. Apartment owners and tenants are in principle to be granted an entitlement to the installation of charging facilities, which the remaining apartment owners and the landlord can refuse only in certain limited circumstances. Further regulatory obstacles to the expansion of charging infrastructure will also be removed (among other things, by provision of accelerated grid connection of charging infrastructure in the ordinance regulating grid connection, legal certainty when calculating shares in the costs, controllability / load management of charging infrastructure for grid-appropriate charging, and user-friendly charging and charging infrastructure in the public sphere). In 2019, the National Charging Infrastructure Control Centre (Nationale Leitstelle Ladeinfrastruktur) was set up to oversee the coordinated ramp-up of public charging infrastructure at the various levels (federal / state / local governments).

3.1.3.iii.3. Introduction of low-carbon heavy goods vehicles to the roads (field of action: 'commercial

vehicles')

The Federal Government aims to support the purchase of heavy goods vehicles with alternative, climate-friendly propulsion systems including hydrogen technologies and to fund the development of a needs-based filling and charging infrastructure. The goal is that by 2030 approximately one third of vehicle mileage in the heavy road transport sector will be electric or based on zero-carbon or carbon-neutral fuels. A system of carbon-differentiated truck tolls favouring climate-friendly propulsion systems, and the necessary amendment of the Eurovignette Directive, will also be pursued. The Federal Government aims to introduce a carbon surcharge on the truck toll, effective from 2023, utilising the legal scope. The European regulatory framework for any such carbon surcharge and any differentiation is currently being worked out in the competent Council working groups on the amendment of the Eurovignette Directive. The present infrastructure charge for carbon-neutral alternative drive systems is to be reduced by 75%. The adoption of the revised Directive necessitates a subsequent transposition into German law. With the carbon fleet regulation for commercial vehicles, a powerful regulatory instrument has already been adopted at European level. It seeks to ensure that fleet- and Europe-wide carbon emissions will be reduced by 30% (for heavy commercial vehicles) and by 31% (for light commercial vehicles) by 2030. To achieve the GHG reduction targets of the transport sectors overall, however, there must be an even higher rate of reduction for commercial vehicles. The fleet regulation must therefore be supplemented by further measures. These accompanying measures set out to address, firstly, the extra costs associated with commercial vehicles with alternative propulsion systems: The development of market-ready commercial vehicles with hydrogen fuel cells will continue to be supported for all segments, so that vehicles with this technology can be offered by the mid-2020s at the latest. Commercial vehicles running on methane gas (CNG, LNG) also have a prominent role in climate-friendly freight transport, particularly if regeneratively produced biomethane and methane generated on the basis of electricity are used instead of fossil natural gas.

3.1.3.iii.4. Expansion of filling, charging and overhead contact wiring infrastructure (field of action: 'commercial vehicles')

The organisation of the filling, charging and overhead cable infrastructure for alternative drive systems must be geared to the intended transport and logistical applications. This involves having in view an approach that encompasses the entire system, from the use of renewable energies to customer-related aspects for zero-emission logistics. The Federal Government is developing concepts for: charging options for battery-powered commercial vehicles and overhead cables for commercial vehicles and for hydrogen refuelling stations.

3.1.3.iii.5. Increase in the proportion of electric vehicles (pursuant to §2 of the E-mobility Act) and of biogas-powered vehicles in the Federal administration's vehicle pool

Agreed objectives: Increase the percentage of vehicles with alternative and environmentally friendly drive technologies in new purchases and replacements ideally to 40% by 2025 and to 100% by 2030. This includes battery-powered electric vehicles, fuel cell vehicles, externally chargeable hybrid electric vehicles that meet the minimum criteria under §3 of the E-mobility Act, and vehicles that are verifiably 100% run on biogas. In 2030, the proportion of plug-in hybrids in the Federal Government's vehicle fleet should not exceed 50%. Special-purpose vehicles and heavy goods vehicles are exempted from this quota, but if technically feasible these too will be progressively replaced by electric vehicles within the meaning of §2 of the E-mobility Act or by other, at least equivalent, vehicles with alternative and environmentally friendly drive technologies, taking into consideration the relevant functional needs. Vehicles that serve the national and Alliance defence and corresponding international obligations of the Federal Republic of Germany are not taken into account due to their specification and their particular capability requirements.

3.1.3.iii.6. Automation, connection and fluidification of the transport sector, facilitation of innovative forms of mobility

Digitalisation can significantly improve existing transport operations such as traffic flow and parking facility management through automation, networking and artificial intelligence. Digitalisation can also create completely new possibilities: for instance, digital services with user-friendly, app-based operating concepts enable simplified sharing options both for passenger cars and for bicycles and e-scooters, and allow for the integration of public transport services. Digital interconnectivity also allows pooling of journeys and the selection of a vehicle size suitable for an individual trip. Amendment of the Passenger Transport Act will lay the foundations for new digital mobility services. The Federal Government will continue and intensify the practical testing of automation, networking and the use of artificial intelligence for sustainable mobility on digital test fields and demonstration projects. The expansion of fast broadband and mobile networks will continue to be supported. With an eye on emerging application scenarios for digital mobility, computing infrastructure is increasingly considered an integral part of digital networks for the gigabit society. Digital working models (for instance, increasing the use of home offices and video conferencing) also help cut down on journeys. Establishing experimental clauses and amending the Passenger Transport Act will lay the foundations for extensive networking, automation and the use of artificial intelligence for sustainable mobility.

3.1.3.iii.7. E-mobility tax incentives (Act on Further E-mobility Tax Incentives and the Amendment of Further Tax Provisions)

Company car taxation – extension of the special scheme for electric vehicles currently in force: If a company car is also used privately, this benefit is generally taxed at 1% of the domestic list price (the list price method). In 2018, this assessment basis was halved for electric and externally chargeable hybrid electric vehicles. To create a long-term, legally certain planning framework for the market ramp-up of e-mobility, this special scheme has been extended until 31 December 2030 (§6(1)(4) second sentence, (3) and (4), and third sentence (3) and (4) Income Tax Act). In order to ensure that the Federal Government's environmental policy objectives are given proper consideration in the longer term, the technical requirements of the special scheme were tightened up in two stages: from 1 January 2022 to 31 December 2024, a minimum range (when using solely the electric drive unit) of 60 km will apply. from 01 January 2025 to 31 December 2030, a minimum range (when using solely the electric drive unit) of 80 km will apply. The maximum CO_2 emissions of 50 g / km remain unchanged for the entire period. For the use of vehicles that have no carbon emissions / km and whose gross list price does not exceed EUR 40 000, only one quarter of the assessment basis is taken into account.

Special depreciation allowances for electric commercial vehicles and electric cargo bikes:
Subject to approval for State aid being granted by the European Commission, under §7c of the Income Tax Act special depreciation allowances amounting to 50% of the acquisition costs can be claimed for the purchase of new, purely electric commercial vehicles (vehicles of vehicle class N) and for the purchase of new electric cargo bikes in the period from 2020 to the end of 2030, in the year of purchase, in addition to the normal linear depreciation for wear and tear. To claim a special depreciation allowance, the commercial electric vehicle or the electric cargo bike must be used to generate income and must be part of the taxpayer's fixed assets.

Trade tax relief for the rental and leasing of electric vehicles:
Under §8(1)(d), first sentence, of the Trade Tax Act, rental and leasing expenses for a company's movable assets are added to the profit from the business operation for trade tax purposes. The addition amounts to 5% of the expenses (1/4 of 1/5). In deviation from this, rental and leasing expenses for electric vehicles and externally chargeable hybrid electric vehicles that meet certain exhaust emission or operating range criteria, and for rented bicycles that are not motor vehicles, are only added at 2.5% (1/4 of 1/10), provided that they are based on contracts that were concluded after 31 December 2019 (§8(1)(d), second sentence, of the Trade Tax Act). This measure is scheduled to apply until 2030.

Extension of the tax exemption for charging current and the flat-rate taxation scheme for the transfer of ownership of charging equipment:
Benefits granted by the employer in connection with the charging of an electric vehicle or hybrid electric vehicle within the framework of the employer's operations or those of an affiliated undertaking, and for in-plant charging equipment temporarily provided for private use, are exempt from tax (§3(46) of the Income Tax Act). The tax exemption was scheduled to apply until 31 December 2020. The employer can also levy a flat-rate of 25% on the payroll tax for the above non-cash benefit (§40(2) first sentence, number 6, of the Income Tax Act). The flat-rate taxation scheme was also scheduled to apply until 31 December 2020. To further promote e-mobility, both measures have been extended until 31 December 2030.

Tax-exempt job ticket and introduction of flat-rate taxation for job tickets:
Under §3(15) Income Tax Act, as from 2019 employer contributions to an employee's expenses for travel using regular scheduled public transport services between home and main or primary place of work, granted in addition to normal pay already owed, are tax-free (e.g. job ticket). The services received tax-free are to be credited against the distance allowance; the deduction for professional expenses is reduced accordingly. The regulation applies for an unlimited period. The introduction of a new flat-rate 25% taxation option, with no concomitant reduction of the distance allowance deductible as professional expenses for the employee, is intended to increase the acceptance of job tickets among those employees who are not able to use public transport at all or who can do so only on a very limited basis (§40(2), sentences 2 to 4 of the Income Tax Act). It also applies for the emoluments referred to in §3(15) of the Income Tax Act that are not provided in addition to the normal pay already owed (but through deferred compensation) and that therefore do not meet the requirements for tax exemption. The regulation applies for an unlimited period.

Extension of the tax exemption for the provision of a company bicycle or electric bicycle to the employee:
If the employer provides the employee with a company bicycle free of charge or at a reduced rate, from 2019 the non-cash benefit from private use is tax-free (§3(37) Income Tax Act). The prerequisite is that the bicycle is provided in addition to the normal pay already owed anyway. This is intended to acknowledge the fact that the employer is providing a real additional service and does not reduce the employee's gross pay in return. The tax-free non-cash benefit is not credited against the distance allowance; the deduction for professional expenses remains. The measure, which was limited until 31 December 2021, is to be extended until 31 December 2030.

Extension of the tax exemption for the private use of a company bicycle or electric bicycle:
If the owner of an enterprise uses a company bicycle for private purposes, this is not taken into account in the

profit calculation (§6(1)(4), sixth sentence, of the Income Tax Act). The benefit does not have to be taxed. The measure, which was limited until 31 December 2021, has been extended until 31 December 2030.

3.1.3.iii.8. Automotive industry: industrial production for mobile and stationary energy-storage devices (battery cell production)

The demand for mobile and stationary electricity storage is growing internationally at a rapid pace. The Federal Government aims to tap into the enormous value creation potential of this key technology in Germany and Europe, by pushing ahead with the development of industrial and research-based battery cell production. To this end, in the 2019 budget allocation process the Federal Ministry of Economic Affairs and Energy was given up to EUR 1 billion until 2022 under Energy and Climate Fund account 893 04 for investments in industrial production for mobile and stationary energy storage reservoirs (‘battery cell production’). Enterprises in the automotive supply industry will be supported with appropriate instruments in the upcoming transformation of their industry.

3.1.3.iii.9. Specific measures for reducing urban traffic emissions

On 28 November 2017, at the Second Municipal Summit, the Federal Government presented a package of measures for improved urban air quality entitled the ‘Emergency Clean Air Programme’. EUR 1 billion has been earmarked for this programme. It includes measures for urban transport electrification, the construction of charging infrastructure, the digitalisation of transport systems and the retrofitting of exhaust after-treatment systems in diesel buses used within local public transport networks. At the Third Municipal Summit on 3 December 2018, the Federal Government agreed to make available additional funds for the emergency programme. A total of up to EUR 1.5 billion is therefore available for affected municipalities. In addition, a further EUR 432 million in funding was approved for the funding guidelines for retrofitting light and heavy tradesman’s and delivery vehicles and for retrofitting heavy municipal vehicles. All measures will take effect by 2020.

3.1.3.iii.10. Procurement of electric vehicles – information campaign

The Federal Government plans to implement an information campaign together with the federal states aimed at increasing the share of electrically powered vehicles in publicly owned fleets.

3.1.3.iii.11. National Strategic Framework for the Expansion of Alternative Fuel Infrastructures

The Strategic Framework covers charging infrastructure for electric vehicles, natural gas supply infrastructure (compressed and liquefied natural gas) and hydrogen supply infrastructure for fuel cell vehicles. In implementation of Directive 2014/94/EU, the National Strategic Framework sets goals for publicly accessible filling and charging infrastructure and backs them up with corresponding measures.

3.1.3.iii.12. Further development of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP 2)

Further development of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP 2) not only guarantees a solid technological basis, but also supports the market ramp-up phase. Particular attention is paid to fuel cells for electric powertrains, filling station infrastructure, hydrogen generation from renewable energies, integration into the energy system and fuel cells for stationary energy supply. The Federal Cabinet adopted a decision regarding a framework programme by the Federal Government in this area on 28 September 2016. The programme will run until 2026.

3.1.3.iii.13. Funding of alternative drive systems for local public transport

The Federal Government is funding multiple projects concerning the technological development or procurement of electric, hybrid and biogas-powered buses under the corresponding funding guidelines published by the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry of Transport and Digital Infrastructure.

3.1.3.iii.14. Further development of the Mobility and Fuels Strategy 2013

The Mobility and Fuels Strategy adopted by the Federal Cabinet in June 2013 plays an important part in the energy transition in the transport sector. In its present shape, it provides an overview of energy and fuel options and technologies for the different modes of transport. Alternative drive systems and the use of liquid and gaseous renewable fuels with a view to decarbonisation of transportation play a key role in this respect.

3.1.3.iii.15. Development of electricity-based fuels

The fuel cell will also play a significant role in the mobility of the future, particularly for heavy goods vehicles and other heavy vehicles. In the longer term, Power-to-X (PtX) fuels will also play an increasingly important role. The Federal Government aims to establish a framework for the development and large-volume scaling-up of the electrolysis and refinery processes for the production of electricity-based climate-neutral gases and fuels. This enables the use of climate-friendly base materials and fuels, particularly in the industrial and chemicals sectors, and in air transport, heavy goods transport and sea transport. Furthermore, alternative drive systems on railway routes will be promoted to a greater extent, where this makes economic and

environmental sense and where electrification is not economically efficient. In the medium and long term, hydrogen-based fuel cell technology can also be widely used in the mobility sector. The Federal Government will develop a national hydrogen strategy. An industrial policy initiative by the European Union to develop an efficient e-fuel supply is also being launched. The extent to which these efforts can be appropriately supported when implementing RED II for the transport sector needs to be examined.

3.1.3.iii.16. Support of advanced biofuels

The use of biofuels in the fuel mix reduces the fossil content, and thus also the level of the carbon pricing, of the fuel. The development of liquid and gaseous renewable fuels from biomass and their large-scale production in biogas and synthesis plants will be supported, to enable their use in some segments of the transport sector in the medium and long term. There will be no additional support for first generation biofuels based on food crops and fodder crops. The future production of bioenergy is to be based more comprehensively on waste material and residues. It is therefore important that all waste material and residues actually be collected. There are no plans to expand the cultivation areas for bioenergy and no expansions are being considered because of land surface area restrictions. The sustainability criteria of RED II must also be used for imports (from the internal market and from third countries). As a supporting measure, in the context of the national implementation of RED II a sub-quota for advanced biofuels will be introduced, taking into account environmental and economic considerations and technical feasibility. Advanced biofuels are already on the market and are already making a contribution to GHG reduction in the transport sector. Taking all aspects into consideration, the maximum biomass available for bioenergy in Germany is currently around 1 000 to 1 200 PJ / annum (domestic potential). Existing gaps in research and development on innovative advanced biofuels (for instance, fuels made from straw) will be filled through projects and demonstration projects, to enable large-scale production in the medium term.

3.1.3.iii.17. Funding of natural gas mobility

The Federal Government has demonstrated its intention to bring about growth in natural gas mobility through the adoption of tax incentives for natural gas as a fuel until 2026 and a temporary exemption from road tolls. This can provide a significant opportunity for potential carbon savings, if biomethane gas and, in future, renewable, synthetic methane are used.

3.1.3.iii.18. Strengthening of rail passenger transport

The focus of this bundle of measures is carbon reduction by shifting transport to the railways, which need to be strengthened significantly for this purpose. Decarbonisation can also be further promoted through the electrification of additional rail links and the use of alternative drive systems (hydrogen, battery).

Up to 2030, the Federal Government and Deutsche Bahn will be investing around EUR 86 billion to modernise the railway system. This will further enhance the efficiency of the railway infrastructure. Capacity will also be substantially increased through the introduction of digital command and control technology on central axes and the digitalisation of signal boxes. Bottleneck corridors in rail network ‘hot spots’ will be removed, and the Federal Government aims to introduce a synchronised timetable for Germany (Deutschlandtakt). The electrified network will also be expanded and densified. The regionalisation funds, which also serve to strengthen public transport, will be continuously increased over the next few years.

The development and introduction of further technologies for digitalised railway operation will also lead to substantial improvements in rail system efficiency. Capacity increases in the available infrastructure can also be achieved by operating trains at shorter intervals, without having to accept compromises on safety. Despite an increase in rail traffic, this reduces the need for new development and expansion.

This additional expansion of capacity places high demands on planning and building capacities, also given the replacement investment measures necessary at the same time. These measures are financed through the service level and funding agreement, which is to apply from 2020 for a term of 10 years. Consideration will be given to how greater planning and investment security can also be made possible through capacity expansion and the introduction of digital command and control technology and the digitalisation of signal boxes. From 2020 to 2030, the Federal Government will provide additional federal funding in the amount of EUR 11 billion to strengthen the railway system, of which EUR 5.5 billion is additional equity capital for DB AG. This will enable the company to invest additional capital in the modernisation, expansion and electrification of the rail network and the railway system.

Flights are often cheaper than travelling by train to the same destination. In terms of climate protection, this is the wrong incentivising message. The VAT on long-distance rail tickets was therefore decreased from 19% to the reduced VAT rate of 7 % as of 1 January 2020. Conversely, the air transport tax was increased as of 1 April 2020. In the course of amendments to the air transport tax law, dumping prices for air tickets will be prevented by ensuring tickets cannot be sold at a price lower than the applicable taxes, surcharges, fees and charges.

3.1.3.iii.19. Increase in appeal of public transport

The aim of this package of measures is to increase the use of local public transport. Statutory jurisdiction for this lies with the states and municipalities. Due to the high energy efficiency and the high degree of electrification, public passenger transport is associated with substantially lower GHG emissions per passenger-kilometre than private motorised transport. The focus of this field of action is therefore carbon reduction by shifting passenger travel to local public transport. In addition, decarbonisation can also be boosted in public passenger transport (by using alternative drive systems, for example) in buses and local passenger rail transport.

The system development and network expansion for surface urban railways, underground rail and trams will be moved ahead. The use of public transport should also be made more attractive by improving the quality of the services offered. To this end, reliability will be improved, more frequent connections introduced, and comfort and safety will also be enhanced.

With the increase in federal funding under the Municipal Transport Financing Act for the development of the public transport system to EUR 1 billion a year from 2021, the Federal Government has laid the foundations for enhancing the attractiveness of public transport. The rail-based local transport system can also be expanded. The terms of the Municipal Transport Financing Act are to be focused more strongly on the objectives of climate-friendliness of public transport. To ensure that additional expansion measures can be specifically planned in the next few years, the Federal Government has increased the funding to EUR 2 billion a year as from 2025.

The modernisation and climate-friendly retrofitting of bus fleets will continue to be encouraged by stepping up the support of buses with electric and hydrogen-based drive systems and buses running on biogas. In addition, up to 50% of city buses are to be electric by 2030. This requires a substantial increase in funding measures. The Federal Government will additionally support 10 pilot projects aimed at enhancing public transport, such as the introduction of EUR 365 annual tickets. In an early minor amendment to the Passenger Transport Act, it is clarified that states and municipalities can set emission requirements for buses, taxis and rental cars.

3.1.3.iii.20. Expansion of cycle lanes and bicycle parking options as well as improvement of general conditions

The Federal Government will increase the attractiveness of cycling by further improving road safety and road traffic conditions for cyclists. The development of express cycle paths and cycle tracks along main roads will be continued. The ‘Stadt und Land’ (town and country) special programme will deliver equal opportunities for bicycle traffic, e.g. by providing secure and modern parking facilities and expanding the infrastructure for cargo bikes. For this purpose, grants for investment measures by the states and municipalities are to be made available for the first time, for the creation of cycle traffic networks (creation and expansion of cycle highways, conversion of traffic lanes into protected bike paths, construction measures to speed up cycle traffic, traffic measures such as the green wave where appropriate, intuitive road guidance measures through signage and markings and safe system alterations, in particular of intersections etc.), for secure and modern parking facilities and bicycle parking garages, for the construction of cycle paths along main roads, and for developing the necessary infrastructure and creating favourable conditions for cargo bikes. The specific content of the programme is currently being fleshed out.

The various infrastructural improvements will also support the trend towards an increasing use of electric bicycles or other new forms of mobility.

In addition, cycling has been improved by the creation of more bike-friendly conditions. This includes, for instance, a universal ban on motor vehicles stopping on protective cycle strips, higher penalties (for unlawful stopping on protective strips and in the second row, and for parking on footpaths and cycle lanes), a mandatory minimum overtaking distance for motor vehicles, the universal requirement for walking speed for right-turning motor vehicles over 3.5 t in urban areas, facilitating the establishment of cycle zones, the extension of the ban on parking in front of junctions and junction areas, the introduction of new traffic signs (green arrow for right turn on red for cyclists only, express cycle path, cycle zone, ban on overtaking of single-track vehicles such as bicycles by multi-track vehicles and ‘cargo bike’ symbol), extension of the testing clause (trials of traffic-regulating or protective measures irrespective of the danger situation) and the opening up of more one-way streets for cyclists in the opposite direction. If the implementation of the special programmes necessitates further regulatory amendments, the Federal Ministry of Transport and Digital Infrastructure will consider their implementation within the framework of a law on bicycle traffic.

3.1.3.iii.21. Strengthening of rail freight transport

Rail freight transport will also benefit considerably from the modernisation and capacity improvement on the rail network. This will make the transport of goods by rail faster and more attractive. With the promotion of Combined Transport, more goods will be put on the rails. To encourage the shift of goods to the rails, wagonload freight will be supported as an alternative to heavy goods vehicles through relief arrangements for

the system prices. The current European standard train length of 740 metres for freight trains is not being achieved at present on many routes in Germany. By expanding the 740-metre network for freight trains, the Federal Government aims to change that and thereby achieve improvements in capacity, quality and costs. There will also be a modern system of command and control technology. In the area of Combined Transport, this bundle of measures is aimed at increasing efficiency and lowering costs (e.g. by reducing process and waiting times, optimising resource utilisation at the terminal and in pre- /post-processing), by digitalising information processes and preparing information and by having digitally controlled handling facilities. The electrified freight network will also be expanded and densified. The expansion programme 'Electric rail freight' will support the further electrification of rail freight lines. Furthermore, 'alternative propulsion technology' of rail vehicles in freight transportation will be supported. The implementation of the Federal programme 'Future of rail freight transport', designed to make rail freight transport more modern, more efficient and more user-friendly, will increase the attractiveness of rail for the transportation of goods. In addition – subject to a positive evaluation in 2021 – a continuation of funding for route prices in 2023 should help further enhance the attractiveness of this option. There is also funding for the reduction of plant prices, in particular to boost wagonload freight. The bundle of measures thus follows on from key interim results of the 'Zukunftsbündnis Schiene' (Future alliance for rail) scheme (May 2019) with a focus on climate protection.

3.1.3.iii.22. Modernisation of domestic navigation and use of shore power at ports

An increase in the share of inland navigation to carry goods will be achieved through the implementation of climate protection measures from the Master Plan for Inland Navigation (May 2019). The funding programme for the sustainable modernisation of inland navigation vessels will be developed further. Infrastructure improvements at bottlenecks (measures aimed at the urgent need to eliminate bottlenecks) are to be implemented more rapidly and an interim law brought in, in which the plans for subsequent laws on measures will be identified. In addition, the phasing out of shipping fees, as already decided and in effect since 1 January 2019, is to be retained. To enable seaports to switch to electricity and low-emission, low-pollutant fuels, levies for shore power will be reduced and more low-emission, low-pollutant fuels supported on a temporary basis. In the long run, regulatory legislation will also have to apply here. In the case of seaports, an initiative will be launched for the EU-wide introduction of an obligation to use shore power; national regulations are being considered for inland ports.

3.1.3 iv. Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

3.1.3.iv.1 G20 peer review process

In 2009, the G20 states agreed that inefficient subsidies for fossil fuels should be phased out in the medium term. According to the decision, 'Inefficient fossil fuel subsidies (IFFS) encourage wasteful consumption, reduce our energy security, impede investment in clean energy sources and undermine efforts to deal with the threat of climate change.' The states agreed that this decision would be implemented on the basis of a voluntary peer review process. Germany submitted a self-report on the relevant German subsidies in September 2016.

3.1.3.iv.2 Federal Government report on subsidies

Within the framework of the Federal Government's subsidy reporting activities, all subsidies undergo a sustainability check on a regular 2-year basis. These checks involve determining the long-term economic, ecological and social effects of the relevant subsidies, for example in relation to economy prosperity, provision for the future, climate protection, conservation of resources or the protection of jobs, and the outcomes are documented in the report on subsidies. The current 27th Subsidy Report for the period 2019 to 2021 was approved by the Federal Government on 6 November 2019 and can be found on the following site: https://www.bundesfinanzministerium.de/Content/DE/Downloads/Broschueren_Bestellservice/2019-11-06-Subventionsbericht.htm

Measures to subsidise energy, including fossil fuels, are set out in detail in Section 4.6.iv.

3.1.3.iv.3 Extensive evaluation of tax benefits

In line with the subsidy policy guidelines, all subsidies taken into account in the Subsidy Report must be periodically evaluated with regard to the extent to which targets have been achieved, and in terms of their efficiency and transparency. At present, the Federal Government has had a total of 33 tax concessions listed in the Subsidy Report examined in a systematic evaluation as part of a research report with particular regard to the achievement of targets, efficiency, suitability as instruments and also, for the first time, their sustainability. The research project thus makes a worthwhile contribution to an evidence-based budgetary and taxation policy. Another key evaluation priority was in the area of energy and electricity taxes. The results of the evaluation reflect the opinion of the independent experts and were made public on 30 October 2019. In their recommendations, the experts note in summary that divergent criteria often argue for and against changes to tax concessions, and it is for the legislative authority to weigh up the advantages and disadvantages of possible reforms. With this in mind, the Federal Government will examine the findings of the report with regard to the need for action or optimisation for the individual measures.

3.1.3.iv.4 Phasing out of hard coal subsidies

The phasing out of subsidies for the promotion of hard coal is currently the most important measure being implemented in Germany with a view to eliminating fossil fuel subsidies. Germany's hard-coal mining industry is not competitive, in particular because of the geographical factors which lead to high extraction costs. In order to ensure that the phasing out of hard-coal mining complies with the principles of social justice, Germany has granted subsidies for the sale of domestically produced hard coal to cope with the decommissioning measures required, and bridging allowances for employees leaving the industry. The subsidies for the sale of domestic hard coal were paid for the last time in 2018; hard-coal mining was then discontinued. Post-decommissioning measures will be subsidised up to the end of 2022. The granting of subsidies for the early retirement of employees leaving the hard-coal mining industry will be discontinued at the end of 2027.

3.2. Energy efficiency dimension

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in Section 2.2, including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

The national Energy Efficiency Strategy 2050 (EffSTRA), containing a mixture of tools and measures with far-reaching sectoral and cross-sectoral effects aimed of the achievement of the energy efficiency goals, has been developed and was adopted by the Federal Government on 18 December 2019. The energy efficiency-related measures of the Climate Action Programme 2030 (e.g. expansion of funding offers, carbon pricing) will play an important role in increasing energy efficiency by 2030. These measures are taken up in the updated National Energy Efficiency Action Plan (NEEAP 2.0) as part of the EffSTRA. With the NEEAP 2.0, the energy efficiency measures are bundled, put into concrete terms and implemented. The EffSTRA also contains supplementary measures that are designed to effectively support efforts to tap into efficiency potentials. While the measures under the Climate Action Programme 2030 are aimed at tapping into large-scale waste minimisation potentials, the supporting measures of the EffSTRA are designed to address existing obstacles (e.g. information deficit, lack of motivation among the players involved, bureaucratic burden associated with financing) in tapping into areas with potential for greater efficiency. Many of the supporting measures use digital solutions to make it easier for consumers and energy consultants to access information and to create more transparency.

The Federal Government's energy efficiency policy is based on a broad range of instruments across all sectors and reflects its belief in the importance of providing advice, information and funding, imposing demands and promoting research. The main measures currently being implemented are outlined in detail below.

3.2.i. Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU, to be prepared in accordance with Annex III to this Regulation

In the first savings period (2014-2020), the Federal Government has implemented various strategic measures within the framework of a broader package in the interests of compliance with Article 7 of the EU's Energy Efficiency Directive. This approach is also planned for the second savings period (2021-2030). Germany is planning measures to deliver final energy savings of 3 996.5 PJ or 95.46 Mtoe; these measures are appended to this National Energy and Climate Plan as an annex in accordance with Article 3(2)(h) of Regulation (EU) 2018/1999.

3.2.i.1. Energy Efficiency Strategy 2050

In its cross-sectoral Energy Efficiency Strategy 2050, the Federal Government defines key objectives and instruments for the development of its energy efficiency policy. With its 2050 efficiency strategy, the government sets out an energy efficiency target for 2030 and a package of measures to reduce primary energy consumption in Germany. In addition, the strategy will initiate a broad dialogue process, 'Energy efficiency roadmap 2050' aimed at developing a long-term roadmap to halve primary energy consumption by 2050. Within the framework of this dialogue process, further energy efficiency measures are also to be developed for 2030 and 2050.

3.2.i.2. National Energy Efficiency Action Plan 2.0 (NEEAP 2.0)

The NEEAP defines emergency measures and areas of ongoing work with a view to achieving the national efficiency and climate goals. The most important fields of action under the energy efficiency policy are as follows: promoting energy efficiency in the buildings sector and in industry, commerce, trade and services, establishing energy efficiency as an RoI and business model and increasing personal responsibility for energy

efficiency. The NEEAP measures have been reviewed and imported to the NEEAP 2.0 with a view to achieving the energy efficiency goals with an effective set of measures.

3.2.i.3. 'Efficiency First'

In all sectors, the overriding principle is 'Efficiency First!'. In the Federal Government's opinion, firstly, energy demand must be substantially and permanently reduced ('efficiency first'); secondly, as far as possible, renewable energies must be used directly in all sectors and, thirdly, electricity from renewable sources must be used efficiently for heating, transport and industry within the framework of sectoral coupling. The main priority is to use technologies that use little electricity to replace as many fossil fuels as possible. At the same time, sectoral coupling presents challenges for electricity grids, especially at distribution network level; this also calls for grid expansion and reinforcement measures to safeguard the security of supply, at least in the ramp-up phase of e-mobility and heat pumps. The Efficiency First principle is therefore central to meeting this challenge and mitigating the increase in electricity demand. Limiting demand is necessary in order to ensure the timely and 'resource-friendly' expansion of renewable energies and infrastructures and thus also make a contribution to the decarbonisation and security of supply dimensions. To ensure that the economically efficient measures from the area of energy efficiency are implemented as a matter of priority, the Federal Government is also pushing through the implementation of energy saving measures in all sectors, through a range of funding programmes and standards. These measures and funding programmes are presented in this chapter.

3.2.ii. Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU

Under Article 2a of the EU Directive on the energy performance of buildings, the Federal Government must submit a 'Long-Term Renovation Strategy' (LTRS) to the EU Commission. In the LTRS, each Member State is required to produce a roadmap setting out measures and domestically established, measurable progress indicators for achieving the long-term climate goals, and present methods and incentives for the renovation of the national building stock. Among its objectives the EU buildings directive lists the achievement of a highly energy efficient and decarbonised building stock, and the transformation of existing buildings into nearly zero-energy buildings in a cost-effective manner (EPBD, Directive (EU) 2018/844).

Essentially, the following applies for the buildings sector: in order to substantially reduce consumption of non-renewable primary energy, the demand for energy for heating and cooling must be significantly reduced through efficiency measures, and the share of renewable energies in covering the remaining demand must be increased significantly.

The Efficiency First principle will be pursued in the buildings sector. Measures such as insulation of the building envelope, installation of efficient windows or other facade elements, airtight building construction and the use of highly efficient technical systems for heating, cooling and lighting equipment and technology can enhance efficiency potentials. At the same time, however, there are both technical and economic limitations and impediments that need to be addressed with regard to other parameters such as behaviour and information transparency.

The use of renewable energies (e.g. solar thermal energy and photovoltaics, as well as biomass / biomethane within sustainably generated and available limits), heat sources (e.g. ambient heat, environmental heat, waste heat or wastewater heat) and, in the long term, hydrogen and its derivatives in sections of the heating market, will open up considerable renewable energy potentials enabling an increase in energy performance.

With the measures implemented to date aimed at achieving the energy and climate goals, significant progress has been made in climate protection and in energy efficiency, and between 1990 and 2019, greenhouse gas emissions – decoupled from economic growth – in the buildings sector have been reduced by around 42% to 122 million t CO_2 (1990: 210 million t CO_2). In the same period, the share of renewables in final energy consumption for heating and cooling was increased by around 12 percentage points to 14.4% in 2018. In the buildings sector, the current programmes, such as the CO_2 Building Modernisation Programme, the Market Incentive Programme (MAP), the Energy Efficiency Incentive Programme (APEE) and the Heating Optimisation Programme, have provided tangible impetus to increasing energy efficiency and/or increasing the share of renewable energies in the buildings sector, which have contributed significantly to these favourable developments. However, scientific analyses show that to achieve the 2030 targets, these developments need to be accelerated. In order to make the necessary progress in the buildings sector in improving energy performance and reducing carbon emissions, the Climate Action Programme 2030 has approved a comprehensive package of measures aimed at increasing energy efficiency and using renewable energies in the buildings sector, along with measures in other sectors.

In principle, measures in the buildings sector are to be interlinked across all trades, creating synergies in such

a way that obstacles are addressed, funding measures are more broadly supported, the high quality of remedial measures is ensured and potentials for energy efficiency and use of renewable energies in buildings are considered jointly.

3.2.ii.1. Public relations work

Under the Federal Ministry of Economic Affairs and Energy's 'Germany Does It Efficiently' information campaign, information will in future be more technical and more tightly targeted at specific audiences. For further information see Section 3.2.iv under Communication.

3.2.ii.2. Independent consultancy services provided by Verbraucherzentrale Bundesverband e. V. (vzbv)

Initial and brief consultations are provided by the independent organisation Verbraucherzentrale Bundesverband e. V. (vzbv) and funded by the Federal Ministry of Economic Affairs and Energy. The federal funding for energy consulting services provided by these consumer advice centres is tailored to the various interests of private households. The consulting services provided throughout Germany are intended to eliminate bias and obstacles to energy renovations and the use of renewable energies. They are also a low-threshold introduction to buildings-focused consulting. The number of consulting sessions held across Germany each year is currently just under 140 000. They serve as a launchpad either for energy-related measures or for more in-depth consulting via the federal funding for the 'Energy consulting for residential buildings (on-site inspection, individual renovation roadmap)' programme.

3.2.ii.3. Federal funding for energy consulting for residential buildings (on-site consulting, individual renovation roadmap)

The federal funding for energy consulting for residential buildings is targeted at owners of residential buildings (private owners of houses or apartments, residential development companies and commonholders' associations). A qualified energy consultant inspects the entire property and draws up a comprehensive energy consultant's report (including among other things an individual renovation roadmap). The roadmap not only flags up energy-saving potentials, but also outlines options for using renewable energies, estimates the necessary investment costs and calculates the potential heating cost and carbon savings. Energy consulting thus helps incorporate energy efficiency and renewable energies into the planning and decision-making process, thus utilising the efficiency potentials when it is most advantageous to do so. As a result, building owners will be better informed about the added value provided by energy modernisation measures. Investments make the most sense when they are coupled with upcoming maintenance or modernisation measures. In particular, the energy consulting offered under the Climate Action Programme 2030 has been further boosted by the following measures:

- Increasing the funding in the 'Energy consulting for residential buildings' programme to up to 80% subsidy (previously 60%)
- Using modernisation recommendations obtained through a state-funded energy consultation to issue energy certification (energy performance certificate)
- Addressing energy advice based on immission measurements by qualified chimney sweeps
- Making use of other opportunities for qualified consulting (inter alia, heating system replacement, use of synergy effects with disabled access conversion or burglary protection).

3.2.ii.4. Energy consulting for non-residential buildings owned by municipalities/charitable organisations

Since 2016, this measure has helped municipalities, majority-owned municipal companies and charitable organisations to carry out energy-related renovations of their building stock (including schools, kindergartens and administrative buildings) and to construct new energy-efficient buildings. Qualified and state-funded energy consultants provide the owners of these buildings with a comprehensive overview of where the most energy is wasted in their buildings, which investments make financial sense, the savings potentials of these investments and how to avoid unprofitable investments. As the next step in the process, the 'individual renovation roadmap' concept, which has already been implemented in connection with energy consulting for residential buildings, will be further developed for municipal buildings. This will help municipalities (as public authorities) to meet their obligation to assume an exemplary role.

3.2.ii.5. Federal funding for energy consulting for SMEs

Energy consulting for SMEs identifies energy-related weak spots in small and medium-sized enterprises, including in buildings; an on-site inspection is also performed (see also Section 3.2 iv.). The Federal Ministry of Economic Affairs and Energy's funding strategy envisages that the funding programmes covering energy consulting for SMEs and energy consulting for non-residential buildings owned by municipalities / charitable organisations will be consolidated and brought into line, since enterprises and municipalities often have very similar consultancy needs. At the same time, this will give the leeway necessary to enable services to differentiate by specific target groups.

3.2.ii.6. National efficiency label for old heating installations

The efficiency label scheme for old heating installations allows heating engineers (since 2016) and district chimney sweeps (since 2017) to award efficiency labels, on a gradual basis, starting with the oldest boilers. The aim of the measure is to increase the replacement rate for old heating installations by 20% (up to a rate of 3.7% a year) and provide an incentive for consumers to save energy by replacing their boiler. Around 13 million boilers will be awarded labels over a 7-year period.

3.2.ii.7. Buildings Energy Act

On 23 October 2019, the Federal Cabinet approved the draft for the New Buildings Energy Act submitted by the Federal Ministry of Economic Affairs and Energy and the Federal Ministry of the Interior. The New Buildings Energy Act creates a new, single, coordinated body of rules for the energy requirements for new buildings, for existing buildings and for the use of renewable energies for provision of heating and cooling in buildings. To this end, the bodies of rules governing energy efficiency in buildings and the use of heat from renewable energies, which are currently still separate, will be consolidated and unified. The New Buildings Energy Act fully implements the European requirements for the energy performance of buildings and integrates the provision on nearly zero-energy buildings into the unified energy conservation legislation. The current levels of performance for new buildings and renovation remain unchanged. To implement the measures relating to energy conservation legislation for buildings as approved in the key points for the Climate Action Programme 2030, a 2023 review of the energy requirements for new and existing buildings has been scheduled, a regulation has been presented on the installation of oil-fired heating systems as from 2026, and the provision of advice to the buyer or owner has been made a key element in the sale or major renovation of a one- or two-family house.

3.2.ii.8. Federal Government's CO_2 Building Modernisation Programme

The programme has been in existence since 2006 and under the aegis of the KfW's programmes in the field of 'Energy-Efficient Construction and Renovation', the programme funds energy-related renovations and high-efficiency new-builds of residential and non-residential buildings, as well as individual renovation measures in the area of energy efficiency, with a view to implementing the long-term renovation strategy for buildings. It is the most generously funded instrument in the field of energy efficiency (programme volume for new commitments in 2020 is EUR 2.5 billion). Funding is offered in the form of low-interest loans, in some cases in conjunction with redemption subsidies or alternatively, investment grants; applications may be submitted by private owners of houses or apartments, commonholders' associations, housing associations and cooperatives, property developers and businesses (e.g. also contracting providers), private and majority-owned municipal companies and municipalities and charitable organisations. In January 2020, in the CO_2 Building Modernisation Programme implementing the Climate Action Programme 2030, the funding rates for renovations to residential and non-residential buildings and the funding quotas for high-quality energy-saving new-build projects in the housing sector were increased by 10 percentage points.

3.2.ii.9. Market incentive programme for renewable energies in the heating market

The Market Incentive Programme provides funding for installations which use renewable energies to generate heating and cooling, as well as for certain heat storage facilities and local heat networks, both in residential and non-residential buildings. Almost all installations in existing buildings are eligible for funding, whereas installations in new buildings are only eligible in exceptional circumstances. The programme comprises two funding pillars. The Federal Office for Economic Affairs and Export Control awards investment grants for small installations. Solar thermal collectors, biomass systems, efficient heat pumps and, since January 2020, gas hybrid heating systems that incorporate a proportion of renewable energies are eligible for funding. Larger installations are eligible for Federal Government subsidies for the pro-rata redemption of low-interest KfW loans under the KfW programme Renewable Energies – Premium. Installations eligible under this pillar include large solar thermal systems, biomass heat or combined heat and power plants, large efficient heat pumps, biogas lines, deep geothermal systems, local heat networks for heat from renewable energies and large-scale storage facilities for heat from renewable energies. As of 1 January 2020, the Market Incentive Programme changed from the previous fixed-rate funding to a co-financing model, and the funding rates were increased by 10 percentage points in implementation of the Climate Action Programme 2030. To increase the replacement rate for oil-based heating systems, a 'replacement bonus' with a funding share of up to 45% was also integrated into the Federal Office for Economic Affairs and Export Control part of the Market Incentive Programme. The aim of this bonus is to provide an attractive incentive for all heating systems currently running on fuel oil to convert to renewable heating or efficient hybrid gas heating systems with some renewable energy inclusion.

3.2.ii.10. Energy Efficiency Incentive Programme

The Energy Efficiency Incentive Programme provides additional funds to boost the funding under the Market Incentive Programme. The Energy Efficiency Incentive Programme also supports the market launch of stationary fuel cell heating systems in new and existing buildings. Funding for stationary fuel cell heating systems with an electrical output of 0.25-5.0 kW is available in the form of a subsidy under the KfW

programme ‘Energy-Efficient Construction and Renovation – Fuel Cell Subsidy’.

3.2.ii.11. Funding programme for heating optimisation

The aim of the programme is to incentivise the replacement of inefficient heating and hot water circulation pumps with high-efficiency pumps, and the optimisation of existing heating systems by means of hydraulic balancing. Funding is up to 30% of the net investment costs. The programme also serves as a gateway to more comprehensive energy efficiency measures in buildings.

3.2.ii.12. Federal funding for efficient buildings including investment grants as well as an oil heating system replacement bonus

With the Federal funding for efficient buildings scheme, newly devised within the framework of the funding strategy (see also Section 3.2.v.iii.), the existing investment funding programmes in the buildings sector are to be packaged into a single, comprehensive and modernised funding offering and optimised in terms of content. This significantly increases the target user-friendliness and attractiveness of the funding, directs it even more towards more ambitious measures and greatly simplifies the application procedure. A single application will now suffice for the funding of efficiency measures and a transition to renewable energies for renovation or new-build projects. Within the framework of the Federal funding for efficient buildings scheme and the KfW funding, care will be taken to ensure that the investments of other users can be funded through the award of grants. Key points of the Federal funding for efficient buildings scheme include, in particular:

- bigger rewards for renewable energy use through special ‘Efficiency House renewable energy’ bonuses
- broad harmonisation of systemic funding of residential and non-residential buildings
- parallel loan and subsidy funding across all sectors
- greater consideration given to contracting models in funding
- increased funding of digitalisation measures aimed at optimising operation and consumption
- increased funding of sustainability requirements
- improved interfaces to energy consulting.

3.2.ii.13. Tax incentives for energy-related building renovations

As a key measure in the buildings sector, as from 1 January 2020 tax incentives for energy-related building renovations were introduced. The new instrument complements the existing funding set-up in the buildings sector and can be taken up as an alternative to the investment funding programmes. A deduction from the amount of tax payable ensures that as many residential building owners as possible benefit from the measure. Funding is provided for individual renovation measures to owner-occupied residential property where such measures are also considered eligible in the existing programmes offering funding for buildings. This includes individual measures such as in particular replacing heating systems, but also the installation of new windows or insulating roofs and external walls. 20% of the investment costs are eligible for funding; the funding is provided in the form of a deduction from the amount of tax payable, spread over a 3-year period.

3.2.ii.14. Funding of serial renovation work

The Federal Government will also support the industrial prefabrication of facade and roof elements and standardised installation of systems technology, including the supply of self-generated electricity, in conjunction with new investment and contract models. The approaches to serial renovation developed within the framework of the model projects carried out will be put into practice with the help of a newly launched funding programme, with the objective of supporting the industrial prefabrication of facade and roof elements and standardised installation of systems technology, including the supply of self-generated electricity, in conjunction with new investment and contract models. This will ensure that buildings are renovated to a high standard and the renovation times are shortened.

3.2.ii.15. Energy-efficient urban redevelopment

Further development of ‘Energy-efficient urban redevelopment’: With the funding programme ‘Energy-efficient urban redevelopment’, comprehensive measures in the energy efficiency of buildings (indirectly) and the supply infrastructure (heating / cooling / water / wastewater) will be implemented at district level in terms of concept and investment. The programme provides impetus for greater energy efficiency in the municipal sector. In addition to the planned continuation of the ‘Energy-efficient urban redevelopment’ programme, in 2020 new forms of assistance are to be developed and existing forms of assistance developed further. In the subsidy scheme, more attention is to be given in particular to environmentally friendly mobility concepts, inter-municipal approaches, measures relating to planning of heating networks in the designs and in the activity of renovation management, as well as concepts relating to mixed quarters (combination of new and existing buildings).

3.2.ii.16. Expansion of funding programmes for heating networks, heat storage systems and multi-building investments

The Federal Government plans to create a new funding pillar bundling together funding programmes for

heating networks, heat storage facilities and cross-building investments which involve supplying buildings, plants or processes with heating or cooling from renewable energies (see also funding strategy in Section 3.2.viii.). Investment measures which involve supplying buildings, plants or processes with heating or cooling are currently eligible for funding under the Market Incentive Programme. These measures include heating and cooling networks and storage facilities powered by renewable energies, as well as larger installations for generating heat from renewable energies (e.g. deep geothermal systems, biomass heat plants). This measure also contributes to GHG reduction under Section 3.1.1. In addition, the existing funding programme 'Heating System Networks 4.0' is to be amended, in order not only to provide support for construction of new district heating networks with a high share of renewable energy and waste heat, but in particular also to provide financial support for the transformation of large existing heat networks into low-temperature heat networks with a high share of renewable energies and waste heat.

3.2.ii.17. Further development of the innovative Future Building (Zukunft Bau) programme

With the 'Future Building' innovation programme, the Federal Ministry of the Interior is actively supporting climate protection, energy and resource efficiency, affordable construction, quality of design in the context of (urban) construction, and the management of with demographic change. One focus here is on the accrual of knowledge and transfer of knowledge of technical, architectural and organisational innovations. The innovation programme continues the 'Future Building' research initiative set up in 2006. The research priority 'Creating climate-friendly and environmentally-friendly building methods' addresses a wide variety of issues relating to the environmental dimension of sustainable construction. The research topics range from regional, climate-neutral construction and land conservation to building with renewable raw materials and building concepts that dispense with fossil fuels and instead use exclusively renewable energy sources. Building construction should be understood as a recirculating system, from the production of components to demolition and recycling. Another aspect is enhancing buildings' robustness and resilience, which serve both to help structures adapt to the consequences of climate change and also to reduce the complexity of construction.

3.2.ii.18. Building the Energy Transition (Energiewendebauen) initiative

The research initiative 'Building the energy transition' bundles together the widely varying topics of research funding in the buildings sector and serves to improve awareness of energy innovations through targeted research communication. It is a key element of the Federal Government's Seventh Energy Research Programme (see Chapter 3.5.i.1.) and in terms of content links up the research fields energy-optimised and climate-neutral buildings, energy transition at district level and supply of heating and cooling, thermal energy storage reservoirs and the funding initiative EnEff.Building.2050. As a research module, the 'EnEff.Building.2050' initiative makes available funding from the Federal Ministry of Economic Affairs and Energy for flagship projects which demonstrate widely effective solutions for climate-neutral buildings and districts using innovative technology and concepts, thereby advancing their market launch or widespread implementation. Eligible projects focus on the development of individual key technologies and procedures in the construction of new buildings or the renovation of existing buildings, and may also include small research elements ('innovation projects').

3.2.ii.19. Exemplary role of federal buildings

Government buildings must serve an exemplary function in the areas of energy efficiency, climate protection and sustainable construction in respect of the entire building stock, demonstrating that the government's climate policy objectives can be implemented in line with an ethos of cost efficiency and functionality in construction projects. At an early stage, therefore, they will be given a standard that meets the objectives and will incorporate innovative technologies. Budgetary approval will be given according to the principle of economy with the fewest resources possible. As from 2022, new government buildings are required to comply with EH 40 as a minimum; analogous targets will be developed for special uses. In the short term, this objective will be laid down in a mandatory decree issued by the Federal Cabinet in respect of climate-neutral new government buildings and building extensions. In a second step, remediation targets for the government's existing building stock for 2030 and 2050 will also be set down in binding form in this decree. This will require that, as from a yet to be specified deadline, at least an EH 55 standard will apply for all new major renovation and modernisation projects. Analogous targets need to be developed for special structures, and exceptions (protection of monuments etc.) taken into account. An annual remediation rate will be set in the decree, in order to achieve climate protection goals. Ideally, the measures aimed at achieving the climate protection goals in the existing stock are to be planned and carried out in close connection with larger renovation or replacement building measures that were coming up anyway for some other reason. This measure implements sections of the programme of sustainability measures in the area of 'Climate-neutral Federal Administration'.

3.2.ii.20. Further development of the Urban Development Funding Programme

The Urban Development Promotion Programme is the most successful instrument of the Federal Government's urban development policy. Since 1971, this joint programme run by the Federal Government and the federal states has supported cities and municipalities in correcting shortcomings in urban design, sustainably strengthening them as places to live and do business. At the same time, strategies for solutions addressing the challenges of climate change also need to be considered. As part of the further enhancement

of the Urban Development Promotion Programme 2020, measures to protect the climate and to adapt to climate change have therefore been more effectively addressed. In the future, these issues will be a mandatory condition for eligibility and at the same time will be eligible for funding in all sub-programmes of the Urban Development Promotion Programme. The funding can be used in particular to improve the green infrastructure, for example by creating, preserving or expanding green and open spaces, and to link up green spaces and open areas. But measures aimed at energy-related building renovations, unsealing soil, land recycling, climate-friendly mobility, use of climate-friendly building materials, greening of built-over areas or enhancing biodiversity are also eligible for funding. The further development of the Urban Development Promotion Programme 2020 is part of the Climate Action Programme 2030.

3.2.iii. Description of policies and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

The Federal Government has taken comprehensive strategic measures to eliminate obstacles to the roll-out of energy services in the public sector. These range from the provision of information and training through to funding programmes.

3.2.iii.1. Funding of energy performance contract consulting within the framework of energy consulting for non-residential buildings owned by municipalities/charitable organisations

One of the initiatives in the framework of the programme 'Energy consulting for non-residential buildings owned by municipalities/charitable organisations' (see Section 3.2.ii.) is co-funding for a 'contracting check' (with up to 80% of the net consulting fee) for municipalities and charitable organisations. During these checks, a qualified energy consultant determines whether and to what extent measures proposed in an earlier funded energy audit or energy consultancy session (renovation roadmap) can be implemented on the basis of a suitable contracting model. One aim is to alert municipalities to the wide range of potential contracting models which are available, many of which are relatively unfamiliar, in order to promote increased roll-out of energy performance contracting in particular. With the amalgamation of the guidelines for energy consulting for non-residential buildings owned by municipalities/charitable organisations and those relating to energy consulting for SMEs, the consulting on energy contracting will be further refined and developed.

3.2.iii.2. Dialogue on contracting between the Federal Government and the federal states

The project will provide a platform for close cooperation in the field of energy performance contracting between Federal Government and federal state representatives. The project's aim is to eliminate obstacles to the implementation of energy performance contracting and to build regional capacities in this area. Measures to be implemented include annual plenary meetings and workshops, as well as a mentoring programme and exchanges of best practices. The establishment of regional competence centres in the federal states will also be supported and model projects will be initiated.

3.2.iii.3. Model energy saving contracting projects

Within the framework of the dialogue on energy saving contracting between the Federal Government and the federal states, funding is available for the concrete implementation of around 10-15 ambitious energy saving model contracting projects in prestigious properties in municipalities and at federal state level, with a view to exemplifying the potential of contracting and encouraging the establishment of a functioning energy saving contracting market in Germany. The model projects will also be used as a framework for training key stakeholders, to develop standards and guidelines for similar projects, and to further develop funding programmes.

3.2.iii.4. Information on sample contracts and guidelines

The website of the Federal Office for Energy Efficiency contains model contracting agreements and energy saving contracting guidelines (all free of charge). Some of these are tailored to publicly owned real estate or municipalities.

3.2.iii.5. Municipality-level energy efficiency and resource efficiency networks

Municipalities can set up a network for the purpose of this funding programme with the aim of improving their energy and/or resource efficiency. With the help of a network team, they will then be able to work together to identify and implement savings potentials. Municipalities and majority-owned municipal companies can also seek qualified consultancy services in relation to energy renovations of their building stock. For further information on this subject, reference should be made to Section 3.2.ii. on the long-term renovation strategy.

3.2.iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in Section 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems, consumer information and training measures, and other measures to promote energy efficiency)

Carbon pricing

3.2.iv.1. Carbon pricing in the heating and transport sectors
In addition to its importance for decarbonisation, the introduction of carbon pricing in the heating and transport sectors is also an important instrument for increasing energy efficiency. Please refer to Chapter 3.1.1.

Product efficiency

3.2.iv.2. EU Ecodesign Directive – further development of minimum standards
Regulatory measure: further development of minimum standards for certain product groups, with the aim of regulating the level of efficiency of technologies. For suitable product groups, the further development of instruments towards establishing a systems approach will also be encouraged. For industry, cross-sectional technologies (including transformers, electric motors, heating pumps, etc.) are particularly relevant.

3.2.iv.3. Ambitious standards for energy labels and ecodesign
In the EU negotiations on product specifications, the Federal Government will continue to call for ambitious standards for energy labels and ecodesign, and will approach the EU Commission to advocate for the inclusion of further product groups, for example from the commercial and the information and communication technologies sectors, in regulatory measures.

Measures to promote the exemplary role of public buildings

3.2.iv.4. Exemplary role of publicly owned buildings
See Section 3.2.ii. on the long-term renovation strategy and the exemplary function of federal buildings.

Energy-efficient public procurement

3.2.iv.5. Energy-efficient procurement by public authorities
The public sector is the largest consumer of goods and services in Germany, with purchases totalling around EUR 300 billion a year (around 13% of GDP) (Federal Environment Agency 2014). Article 6 of the Energy Efficiency Directive obliges Member States to ensure that central governments purchase only products, services and buildings with high energy-efficiency performance (save for a few narrowly defined exceptions). Regulations and laws promoting and requiring energy-efficient procurement have therefore been adopted in recent years. Section 67 (Procurement of supplies or services relevant in terms of energy consumption) of the Regulation on the Award of Public Contracts, which must be complied with by all public contracting authorities participating in EU-wide calls for tenders, states that the highest level of energy efficiency and (where available) the highest energy efficiency class must be required if the goods being procured are relevant in terms of energy consumption or if such goods represent a key prerequisite for provision of a service. Energy efficiency must also be used as a criterion when evaluating the economically most advantageous tender. Section 8c of the EU Public Procurement Rules for Construction Services contains provisions on the procurement of construction services which are identical in terms of substance. Over and above this obligation, the Unfair Competition Act, the Regulation on the Award of Public Contracts, the Public Procurement Rules for Services – Part A, Section 1, and for Construction Services – Part A and the Public Procurement Rules for Defence and Security also call for this type of procurement. The Federal Office for Energy Efficiency also publishes lists of energy efficiency criteria for various product categories as supplementary guidance for contracting authorities.

Energy audits/energy management system

3.2.iv.6. Expedited implementation of measures from energy audits and energy management systems (EMS)
According to §8 of the Act on Energy Services and Other Energy Efficiency Measures, non-SMEs are required to carry out energy audits by 5 December 2015 and to repeat these audits at least every 4 years. If companies have introduced an energy management system (EMS) according to DIN EN ISO 50001 or an environmental management system, they are exempted from this requirement. The amendment to the Act on Energy Services and Other Energy Efficiency Measures introduces mandatory notification of the carrying out of an energy audit. In return, the companies involved receive a management summary, which not only gives them an overall view of their audit report, but also contains useful further information and best-practice examples. To further increase the implementation rate of the measures recommended in these audits, a system of voluntary commitment in industry is proposed; this system is to be structured in such a way that it would be as effective as a mandatory requirement (decision-making criteria are a payback period of up to 3 years, and an investment rate for energy efficiency to be determined based on annual profit).

3.2.iv.7. Funding of energy management systems

The purchase and installation of instrumentation and control technology and sensors for the monitoring and efficient regulation of energy flows in connection with their integration into an energy management system is funded under the programme 'Federal funding for energy efficiency in industry'. Funding is also available for the purchase and installation of energy management software and external training of staff in use of the software. The 'Energy consulting for SMEs' scheme also provides funding for advice on the introduction and maintenance of an energy management system within small and medium-sized enterprises.

3.2.iv.8. List of suppliers of the Federal Office for Energy Efficiency

The Federal Office for Energy Efficiency maintains a free public list of providers operating across Germany which offer energy services, energy audits and other energy efficiency measures. In this list of providers, end customers can search by providers of specific energy efficiency services in their postcode area and compare providers on the basis of various criteria. Providers can present their range of energy services in the provider list.

Consumer information/training measures

Measures in the buildings sector aimed at implementation of the Energy Efficiency Strategy for Buildings are set out in the long-term renovation strategy, and the Federal Government funds energy consulting both for residential buildings and non-residential buildings.

3.2.iv.9. Independent consultancy services provided by Verbraucherzentrale Bundesverband e. V. (vzbv)

See Section 3.2.ii. on the long-term renovation strategy.

3.2.iv.10. Federal funding for energy consulting for residential buildings (on-site consulting/individual renovation roadmap)

See Section 3.2.ii. on the long-term renovation strategy.

3.2.iv.11. Energy consulting for non-residential buildings owned by municipalities/charitable organisations

See Section 3.2.ii. on the long-term renovation strategy.

3.2.iv.12. Federal funding for energy consulting for SMEs

Renovation concepts for commercial buildings owned by SMEs are funded under the 'Federal funding for energy consulting for SMEs' programme. Consultants search for weak spots with regard to the company's energy efficiency and perform an on-site inspection. An in-depth energy analysis is carried out in accordance with DIN EN 16247-1; this analysis contains clear information on potential savings and a concrete action plan. For further information, see Section 3.2.ii. on the long-term renovation strategy. Funding is also provided for consultancy services relating to the introduction and maintenance of an energy management system and for a 'contracting check', during which a consultant determines the extent to which the proposed measures can be achieved by means of a suitable contracting model and issues concrete recommendations for implementation (see further details on contracting consultancy under the 'Energy consulting for non-residential buildings owned by municipalities/charitable organisations' scheme in Section 3.2.iii.).

3.2.iv.13. SME initiative for the energy transition and climate action

The 'SME Initiative for the Energy Transition and Climate Protection' has been extended until 2021. This is a joint initiative run by the Federal Ministry of Economic Affairs and Energy, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, the Association of German Chambers of Industry and Commerce and the German Confederation of Skilled Crafts, with the aim of familiarising small and medium-sized enterprises with ways of improving energy efficiency and reducing greenhouse gas emissions. Trade-specific information on the relevant topics is prepared and distributed to companies. Energy efficiency round tables will also be organised and implemented in order to facilitate trade-specific exchanges of experience on practical energy-related issues.

Industry

3.2.iv.14. EU ETS Innovation Fund: further development of the NER300 programme

The focus of the programme is emission reduction. At the same time, it also has an impact on reducing primary energy consumption. Please refer to Chapter 3.5.

3.2.iv.15. National decarbonisation programme

The focus of the programme is emission reduction. At the same time, it also has an impact on reducing primary energy consumption. Please refer to Chapter 3.5.

3.2.iv.16. Carbon avoidance and utilisation in primary industries programme

The focus of the programme is emission reduction. At the same time, it also has an impact on reducing primary energy consumption. Please refer to Chapter 3.5.

3.2.iv.17. Further development of efficiency networks

The establishment of energy efficiency networks is to be stepped up. In conjunction with the measure to introduce a voluntary commitment on the part of industry to speed up the implementation of recommendations made as a result of statutory energy audits or energy management systems, efforts will be made to continue the Energy Efficiency Networks Initiative in order to increase the transfer of know-how between companies.

3.2.iv.18. Resource efficiency and substitution

This is only to a limited extent a new measure. It builds on the approaches set out in Germany's resource efficiency programme. The goal of greater resource efficiency and resource substitution is to embed the principle of the circular or closed-loop economy in production processes, thus tapping into potentials for emission reduction that have not previously been used. The three key areas 'advice and information', 'funding' and 'upskilling and vocational training' are described below.

3.2.iv.19. Consulting and information

In addition to the topic of energy efficiency, companies should receive information and advisory services on the development and use of innovations with a focus on resource efficiency and substitution. The advice provided should build on the existing range of services already offered by the Centre for Resource Efficiency and wherever possible be combined with consulting in the area of energy efficiency. The focus of the company-specific advice should be on SMEs, as is the case with the overall advisory measures provided by the Centre for Resource Efficiency, since SMEs often have neither the time nor the staffing capacities to review their resource efficiency in their own companies. The use of environmental management systems should be increased (ProgRess II). Up to now, only energy consumption has been measured in energy audits; as proposed in ProgRess II, an explicit resource efficiency audit could be integrated into them.

3.2.iv.20. Funding

Financial resources are necessary to enable companies to implement, in particular, more comprehensive investment measures, in order to successfully integrate and enhance resource efficiency within and along the value creation chain through digitalisation and Industry 4.0. Other benefits may include increased use of CO_2-neutral raw materials and increased use of secondary materials. SMEs should be given special consideration here, since investment costs place a greater economic burden on SMEs than on larger companies. To provide evidence of material used and the related greenhouse gas savings, the submission of a resource efficiency plan detailing the savings and specifying possible secondary effects is needed. Funding is to focus on the use of resource-efficient processes and materials, and on resource substitution for lightweight construction. The Energy and Climate Fund resources complement the Federal Ministry of Economic Affairs and Energy's technology transfer programme for lightweight construction, in which a corresponding separate funding line has been integrated.

3.2.iv.21. Advanced training and vocational training

To incentivise innovation and implement investments appropriately, specific further training for employees is also required. This further training should build on existing offers provided by the Centre for Resource Efficiency. For the consultations as per Point i, use can be made of the nationwide pool of qualified consultants already established by the Centre for Resource Efficiency in cooperation with the federal states (in accordance with VDI Guideline 4801).

3.2.iv.22. Energy tax benefits

On a case-by-case basis, the Federal Government will examine the extent to which the existing energy tax benefits for fossil fuel sources can be aligned more closely with the Federal Government's climate policy goals.

Communications

3.2.iv.23. Energy efficiency communications

The Federal Government is carrying out the public relations work and technical communication about specific energy saving options and the funding opportunities available via the Federal Ministry of Economic Affairs and Energy's communications and activation campaign, under the slogan 'Germany Does It Efficiently', and will continue to develop this further. The emphasis will increasingly be shifted from general public awareness activities to technical communication and targeted consumer information. The goal is a greater degree of activation of energy consumers through a more tailored and preferably direct approach (subject-specific and target audience-specific). Alongside these efforts, a nationwide policy of ongoing communication on topics relating to the energy transition in general and on issues of efficiency in particular will ensure general consumers are kept informed and that the subject remains in the public eye. In addition, the Energy Efficiency Strategy 2050 will be communicated and, where applicable, monitored (see NEEAP meter) within the

framework of the general energy transition communication and the individual measures via the lead ministries.

3.2.iv.24. Information and Competency Centre for Future-Oriented Construction
The Information and Competency Centre for Future-Oriented Construction funds the transfer of knowledge and a society-wide dialogue on progress towards the energy-efficient construction of the future.

Transport

3.2.iv.25. Strengthening of rail passenger transport

The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.26. Increase in appeal of public transport
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.27. Expansion of cycle lanes and bicycle parking options as well as improvement of general conditions
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.28. Strengthening of rail freight transport
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.29. Modernisation of domestic navigation and use of shore power at ports
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.30. Funding for low-carbon passenger cars
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.31. Expansion of filling and charging infrastructure
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.32. Funding for low-carbon heavy goods vehicles
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.33. Filling, charging and overhead contact wiring infrastructure
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.34. Automation, connection and fluidification of the transport sector, facilitation of innovative forms of mobility
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.35. E-mobility tax incentives (Act on Further E-mobility Tax Incentives and the Amendment of Further Tax Provisions)
The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.3.

3.2.iv.36. Energy efficiency standards for electric vehicles
The EU's carbon fleet limits for new vehicles (cars and commercial vehicles) contribute to reducing the energy consumption of conventional propulsion systems (pro km). Vehicles powered by electricity or hydrogen, on the other hand, have no CO_2 exhaust emissions regardless of the level of their energy consumption. Therefore, there is currently no European regulation on the energy efficiency of electric vehicles. Since the market share of these vehicles is likely to increase substantially, the German position with regard to regulation of energy efficiency standards should be conceptualised and developed in the dialogue process.

Agriculture

3.2.iv.37. Energy efficiency in agriculture

The focus of the programme is emission reduction. At the same time, the programme also has an impact on reducing primary energy consumption. Please refer to Chapter 3.1.1.

3.2.v. Where applicable, description of policies and measures aimed at promoting the contribution of local renewable energy communities to the implementation of the policies and measures set out in paragraphs i, ii, iii and iv

At this point please refer to Section 3.1.2.v., which contains information on the regulatory framework for the development of renewable energy communities.

3.2.vi. Description of the measures to tap into the energy efficiency potential of the gas and electricity infrastructure

As part of Germany's energy transition, a substantial expansion of the electricity grid is being undertaken. This will also entail the implementation of numerous improvement measures in the existing grid. For example, existing transformers will be progressively replaced by state-of-the-art transformers that meet the requirements of the EU's Ecodesign Directive. This will reduce grid losses. In its Electricity Grid Action Plan, the Federal Government identified measures to improve the national electricity grid. It also set out measures that will have a positive impact on the energy efficiency of the electricity infrastructure. In order to eliminate bottlenecks more efficiently, power plants in neighbouring countries should increasingly be involved in re-dispatching. Better regional control of further expansion of renewable energies can reduce the need for re-dispatching and associated losses of efficiency.

In addition, the implementation of the Efficiency First principle will, in principle, result in a reduced load on the electricity grid and can open up scope for increasing cross-border electricity trading in the European internal market. The Network Development Plan prepared by the German transmission system operator (NDP 2030) takes into account the growth of electricity demand in its planning for the expansion of the electricity system in all scenarios examined. The scenario framework approved by the Federal Network Agency for the 2019-2030 Network Development Plan provides for varying growth of net electricity consumption, depending on the scenarios. For all scenarios considered, a 5.7% increase in energy efficiency by 2030, i.e. 30 TWh of electricity savings compared to 2016, is assumed. It is anticipated that these savings will be achieved through the implementation of policy measures (for example, derived from the Climate Action Programme 2030). In its assessment of the supply need, the monitoring report by the Federal Ministry of Economic Affairs and Energy relating to the security of supply in the area of grid-based electricity supply also takes into account the expected energy savings as a result of efficiency measures.

In the Federal Government's Energy Research Programme, research institutions and companies can, inter alia, receive funding for the development of technologies that can bring about a significant increase in efficiency in the electricity grid. In order to achieve a greater degree of flexibility in the demand for electricity, in addition to a reduction in energy demand, the implementation of efficiency measures, for example in industry, can be coupled with measures to improve flexibility that offer advantages for the electricity system.

3.2.vii. Where relevant, regional cooperation in this area

3.2.vii.1. German/French Energy Platform

Germany cooperates closely with France in the field of energy efficiency on the basis of the 'Joint Energy Declaration' dated 31 March 2015. The German/French Energy Platform, which was set up on the basis of the Joint Energy Declaration by dena (the German Energy Agency) and ADEME (the French 'Agence de l'Environnement et de la Maîtrise de l'Energie'), hosts two efficiency-related projects: the first relates to the preparation and cross-border exchange of best practices in the field of building renovation, and the second to cooperation on funding measures to boost the energy efficiency of industry. The German/French Energy Platform will be funded by the Federal Ministry of Economic Affairs and Energy.

3.2.viii. Financing measures, including Union support and the use of Union funds, in the area at national level

Generous subsidies or pricing and incentive mechanisms form an integral component of funding measures in the field of energy efficiency. They supplement other measures by providing targeted financial incentives with a view to facilitating the application of energy efficiency principles to various use cases. They therefore allow energy consumers to reduce their energy costs in the long term. Investing in energy efficiency brings not only cost benefits for companies, but also new opportunities on international markets.

Funding

The Federal Government has put in place a framework to boost the development and spread of innovative energy technologies from Germany, inter alia through the funding of efficiency measures and measures relating to the use of renewable heat. Programmes of investment therefore supplement consulting and information measures by providing targeted financial incentives which facilitate the application of energy efficiency principles to various use cases. This allows energy consumers to reduce their energy costs in the long term (see 'Long-term renovation strategy'). Investing in energy efficiency brings not only cost benefits for companies, but also new opportunities on international markets. For example, Germany exports significant quantities of goods used in connection with energy efficiency and renewable heat measures aimed at rational energy use and conversion, such as energy-efficient electrical appliances, insulating materials, building systems engineering or components for production processes. For further details of measures aimed at implementation of the Energy Efficiency Strategy for Buildings in the buildings sector, see Section 3.2.ii. ('Long-term renovation strategy').

3.2.viii.1. Funding strategy for energy efficiency and heat from renewable energy sources

With the 'Funding strategy for energy efficiency and heat from renewable energy sources', a comprehensive plan for reform of the funding structure has been developed and will be in place by 2021. The Federal Ministry of Economic Affairs and Energy's advisory and investment attraction programmes in the area of energy efficiency and heat from renewable energy sources are a key factor in the achievement of the climate goals. Federal funding to the value of approx. EUR 4.3 billion per annum is available for these programmes for the next 4 years. To enhance the effectiveness, efficiency and service quality of the funding programmes, the project 'Funding strategy for energy efficiency and heat from renewable energy sources' was set up, and in May 2017 a concept was put forward with recommended actions for the fundamental reorganisation of the programmes. From that time until 2021, these recommendations will have been consistently implemented.

Efficiency measures have been given a new programme format and will be allocated to four funding priorities. These are:

- Federal funding for energy consulting (see Section 3.2.ii on the long-term renovation strategy)
- Energy-efficient buildings (see Federal funding for efficient buildings, 3.2.ii.)
- Energy efficiency in industry and commerce (see Federal funding for energy efficiency in industry, 3.2.viii.)
- Heating infrastructure (see Section 3.1.2.vi).

3.2.viii.2. Federal funding for energy efficiency in industry – grant and loan as well as funding competition

The six existing funding programmes aimed at increasing energy efficiency in the industry sector were evaluated and consolidated within the framework of the funding strategy (see above). The current funding instruments were scrutinised, and any components which had proven successful retained; the necessary improvements were also made with a view to increasing funding effectiveness and funding efficiency. In future, the funding of investments in plant and process optimisation and in renewable process heat technology will be bundled together in two programmes; traditional subsidies will fall under the programme 'Federal funding for energy efficiency and process heat from renewable energies in industry – subsidies and loans' and competitive funding will fall under the programme 'Federal funding for energy efficiency and process heat from renewable energies in industry – funding competition' (see *Funding programme for energy efficiency and process heat from renewable energies in industry)*. This funding package will offer an internally consistent funding system aimed at increasing energy efficiency and the generation / use of process heat from renewable energies in processes. Restructuring the programmes in this way will result not only in technology-neutral systems optimisation and the use of renewables to generate process heating, but also in the replacement of individual components using low-threshold basic funding in the area of cross-sectional technologies. At the same time, the digitalisation of energy management will be supported through the provision of funding for investments in measurement, control and regulation technology. The funding package serves as a major incentive for companies to make timely and sustainable, holistic investments in this area, representing significant progress in terms of carbon reduction.

3.2.viii.3. Funding for mini cogeneration plants

By the end of 2020, funding will be available for highly energy-efficient installations with an output of up to 20 kW which supply energy to residential and non-residential buildings.

3.2.viii.4. ACE II – Asset Class Energy Efficiency

The 'ACE – Asset Class Energy Efficiency' (ACE) project develops approaches to make energy efficiency measures more attractive to external financial backers. It tackles key implementation problems for energy efficiency investments and thus develops an 'energy efficiency asset class'. This is done in particular through due diligence procedures for the standardised assessment of specific energy efficiency measures, bundling approaches for energy efficiency projects in order to achieve a higher volume of investments, and proposals for adapting the government's funding structure. In a second phase, the results and project tools generated

will be validated and further developed in practice, to bring them more widely into application.

3.2.viii.5. Energy and Electricity Tax Act

Tax incentives for the manufacturing sector are intended to avoid a situation where companies competing on the international market suffer disadvantages as a result of high energy charges. In addition to a general tax break of 25% for companies in the manufacturing sector and peak balancing with relief of up to 90% for energy-intensive companies, full tax exemptions are granted for certain energy- and electricity-intensive processes (e.g. electrolysis, metal working, manufacture of glassware and ceramic products). Peak balancing only applies if the company operates an energy management system or environmental management system (for SMEs: implementation of an alternative system) and the manufacturing sector as a whole achieves the annual energy intensity reduction target. All of the aforesaid tax exemptions have been evaluated with a view to deciding whether they are still necessary and whether they contribute to the achievement of goals. The findings are currently being evaluated.

3.3. Energy security dimension

Natural gas

In Germany, a number of stakeholders and all of the gas supply undertakings are responsible for supplying the general public with gas; they each hold individual responsibility for fulfilling this task. The main stakeholders are briefly outlined below, followed by a description of the measures taken in the natural gas sector:

- Transmission system operators: Transmission system operators operate systems featuring border or market area crossing points which in particular safeguard the integration of major European import lines into Germany's transmission network … and are responsible for the proper operation, maintenance and if necessary expansion of a network … (see §3(5) of the Energy Industry Act).
- Distribution system operator – gas: Distribution system operators distribute gas and are responsible for the operation, maintenance and if necessary expansion of the distribution system in a certain area and (where applicable) of the connecting lines to other systems (see §3(7) of the Energy Industry Act); they may include e.g. municipal utilities.
- Underground storage facility operator: Underground storage facility operators store natural gas and are responsible for operating a storage facility (see §3(9) of the Energy Industry Act).
- Market area coordinator: Market area coordinators are natural or legal persons appointed by the transmission system operators that act within a market area and provide the services necessary to ensure the efficient handling of gas network access in a market area … (see §2(11) of the Gas Network Access Regulation). They purchase balancing energy to compensate for physical difference between feed-in and feed-out. They gather information about the supply situation in the market area.
- Balancing group manager – gas: A balancing group manager is a natural or legal person responsible vis-à-vis the market area coordinator for handling a balancing group (see §2(5) of the Gas Network Access Regulation). They provide details of gas quantities to transmission system operators and market area coordinators on behalf of their transport customers, are responsible for controlling balancing groups, and are obliged to guarantee the availability of quantities and the balanced status of balancing groups within a market area.

3.3.i. Policies and measures related to the elements set out in Section 2.3.

Measures to maintain and (where applicable) improve the reliability of Germany's gas supply

3.3.i.1. Guaranteeing security of supply for domestic customers

The transmission and distribution system operators play a key role in this area, since secure and reliable systems are a prerequisite for the supply of gas. They must take into account the need to safeguard the supply of gas to domestic customers during measures pursuant to §16 of the Energy Industry Act. Particularly in cases where there is a risk of gas supply bottlenecks, network operation and the allocation and planning of capacities (including transit capacities) must be implemented in such a way that security of supply is maintained for domestic customers for as long as possible.

3.3.i.2. Provision of information

In order to safeguard the supply of gas, the transmission/distribution system operators are obliged (pursuant to §15(2) of the Energy Industry Act) to provide the necessary information to every other operator of gas supply systems linked to their own system. This obligation also applies to operators of storage facilities.

3.3.i.3. Capacity for gas to flow in both directions ('reverse flows')

The transmission system operators are responsible for creating long-term bidirectional capacities for load

flows in all cross-border interconnectors. They cooperate with neighbouring transmission system operators in order to achieve this goal. There are currently a total of 29 cross-border points, of which seven feature bidirectional physical load flow capacities (not taking into account cross-border gas storage facilities). These capacities are permanently available. There is currently no need for investments by neighbouring foreign grid operators in reverse flow capacities to increase Germany's reliability of supply, but consideration will be given to such investments in future.

3.3.i.4. Energy storage facilities

Adequate availability of storage capacity with a high withdrawal rate is vitally important for safeguarding the supply of natural gas, particularly in the event of supply bottlenecks and seasonal fluctuations in consumption. At present, underground storage facilities are operated commercially at 51 locations across Germany. In geographical terms they are distributed over almost the entire country, with regional clusters in North-West Germany as a result of geological factors. Responsibility for the use of commercial storage facilities rests with traders, in line with their obligation to guarantee security of supply; in particular, they must keep adequate quantities of gas in the underground storage facilities to supply customers during the cold period and in the event of unexpected supply failures.

3.3.i.5. Preventive Action Plan for Gas

The above measures for the maintenance and (where applicable) improvement of the reliability of supply in Germany are described in the Federal Republic of Germany's Preventive Action Plan for Gas. A plan of this kind must be produced pursuant to Articles 8 and 9 of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply (previously Articles 4 and 5 of Regulation (EU) No 994/2010). The Preventive Action Plan for Gas builds on the outcomes of the risk analysis which each Member State must carry out pursuant to Article 7 of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply (previously Article 9 of Regulation (EU) No 994/2010). The risk analysis is carried out on behalf of the Federal Government by the Federal Network Agency together with the Federal Ministry of Economic Affairs and Energy, with the support of the gas industry. The preventive action plan sets out measures aimed at preventing a natural gas supply bottleneck; these measures meet the relevant infrastructure and supply standards, decrease the likelihood of supply crises, avoid regional supply bottlenecks and increase resilience to supply crises. The entry into force of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply (previously Regulation (EU) No 994/2010) will entail certain amendments to the national preventive action plan and the above-mentioned national provisions.

3.3.i.6. 'Gas 2030' dialogue process

Led by the Federal Ministry of Economic Affairs and Energy, the process was officially launched in December 2018 to jointly discuss with stakeholders from industry and society the future role of gaseous energy sources (fossil and renewable) up to 2030. The report, with initial findings, was presented by Federal Minister Altmaier on 9 October 2019. The 'Gas 2030' dialogue process has shown that natural gas will remain an important part of the energy supply system in the short and medium term.

3.3.i.7. Future role of renewable gases and the Federal Government's national hydrogen strategy

Hydrogen technologies and alternative energy sources based on such technologies are an integral part of the energy transition and contribute to its success. For some areas of application, for example in air and sea transport or industries with process-related emissions, direct supply exclusively with electricity will not be possible in the long term, or will be possible only at great effort and expense. In the Federal Government's view, hydrogen will therefore be another key element that will be indispensable for the successful decarbonisation of Germany's and many other national economies, since alternative options to the fossil fuel sources currently still in use will be needed. In an industrialised nation such as Germany, gaseous and liquid energy sources remain an integral part of the energy system in the long term. Hydrogen (in the Federal Government's view only hydrogen that has been produced on the basis of renewable energies, 'green' hydrogen, is sustainable in the long term. However, because of Germany's close integration into the European energy supply infrastructure, carbon-neutral hydrogen ('blue' or 'turquoise' hydrogen) will also be important in Germany and, if available, will also be used on a transitional basis) has a key role in driving forward and accomplishing the energy transition. For this reason, the Federal Government will adopt a national hydrogen strategy, to include a plan of measures to boost the market ramp-up of hydrogen technologies.

Measures to eliminate or mitigate the potential impact of a disruption in the natural gas supply

Even though Germany's supply situation for natural gas is highly secure and reliable, provision has been made for the necessary national frameworks and entitlements for companies and authorities to take appropriate precautions in the event that the supply situation deteriorates and to ensure the necessary cooperation of all the parties involved and the availability of the relevant resources. Alongside the aforementioned Energy Industry Act, the legal basis for crisis and emergency planning within Germany comprises the following national laws.

3.3.i.8. Energy Security Act – Natural gas

The tools enshrined in the Energy Security Act in combination with the *Regulation on the Security of the Gas Supply in a Crisis* apply in an emergency in order to cover critical demand for natural gas in the event that the supply of natural gas is directly at risk or disrupted and the risk or disruption cannot be eliminated using market-based instruments, cannot be eliminated in good time using such instruments or can only be eliminated using disproportionate means. The need to perform public tasks and the international obligations enshrined in the Energy Security Act are also regarded as critically important. The instruments enshrined in the Energy Security Act come into effect when the Federal Government confirms (by means of a legislative regulation) that the power supply is at risk or subject to disruption. The Bundesrat's approval is not required. In order to achieve the above objectives in the event of an emergency, a legislative regulation can be enacted pursuant to §1(1) of the Energy Security Act with provisions on the following:

- 'the production, transport, storage, distribution, hand-over, purchase, use and maximum prices of … gaseous fuels …,
- accounting, documentation and reporting obligations concerning the … aforesaid economic activities, quantities and prices and other market conditions relating to these goods.'
- Pursuant to paragraph 3, the legislative regulation can in particular provide for, 'restrictions on the hand-over, purchase or use of goods in terms of time, place or quantity, or the limitation of such activities to certain urgent uses.'
- The term of these legislative regulations may not exceed 6 months. It may only be extended with the Bundesrat's approval.

The Regulation on the Security of the Gas Supply was enacted on the basis of the Energy Security Act. Whereas the Energy Industry Act serves as a statutory basis in particular for market-based instruments and measures carried out by gas supply companies within Germany, the Energy Security Act and the Regulation on the Security of the Gas Supply serve as a basis for sovereign powers of intervention.

3.3.i.9. Regulation on the Security of the Gas Supply in a Crisis

Pursuant to the Energy Security Act (i.e. only in an emergency), the Regulation on the Security of the Gas Supply regulates the transfer of gas load sharing tasks to the competent state authorities. If the Federal Government enacts a legislative instrument confirming the presence of an emergency pursuant to the Energy Security Act, the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways (as the federal load balancer) may enact decrees and intervene in the market if this is necessary to protect supra-regional interests, to balance the concerns of the electricity and gas industry or to regulate the use of gas storage reservoirs and other gas supply systems of supra-regional importance. The federal states can enact similar decrees provided that intervention on their part will not result in supra-regional impacts. Since a large-scale supply bottleneck is likely to have supra-regional impacts, the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways will play a key role as federal load balancer in the event of an emergency. Under §1 of the Regulation on the Security of the Gas Supply in a Crisis, load balancers can enact decrees which make it mandatory for consumers and for companies and enterprises which generate, purchase or release gas to agree to the amendment of contracts or the conclusion of contracts with certain substantive provisions within a certain deadline in the event that the necessary behaviour cannot be achieved or cannot be achieved in good time through the application of existing contracts. These decrees are sovereign measures which are determined in advance and are not market-based. The decree must stipulate the usual fee for a service or (in the absence of any such fee) an appropriate fee. The same applies to the remaining contractual conditions. Load balancers may only enact such decrees if they are absolutely vital in order to eliminate or mitigate a risk to or disruption of critical gas supplies.

3.3.i.10. Potential measures under the decrees enacted pursuant to §1 of the Regulation on the Security of the Gas Supply

Decrees pursuant to §1 of the Regulation on the Security of the Gas Supply may relate, for example, to the following measures and orders: increased withdrawals from gas storage facilities, the substitution of natural gas with petroleum, the substitution of natural gas with other fuels, the use of electricity not generated using gas, restrictions on the production of electricity in gas power plants, an increase in the production of natural gas, special arrangements for the heating of public buildings, restrictions on cross-border flows of gas, orders to use stocks of alternative fuels and additional orders to end consumers, bulk consumers or industrial customers.

3.3.i.11. Solidarity

Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply introduced a solidarity mechanism between Member States for the first time, with the aim of significantly increasing the resilience of the European gas system. This solidarity mechanism represents a last resort to be used in the event of a far-reaching and severe shortage of gas in Europe. It makes it possible for the impacts of an acute

emergency to be spread out more evenly within the EU and mitigated. In order to ensure that the capacity of the Member States to take action in a crisis is safeguarded as effectively as possible, bilateral agreements will be concluded between the Member States which are directly connected to each other, regulating the technical, legal and financial framework for the supply of gas under the solidarity mechanism. Germany is working as a matter of priority to determine the precise nature of gas supplies under the solidarity mechanism and the associated compensation scheme. Development of the solidarity mechanism requires close cooperation between the Member States, in particular within the framework of the Gas Coordination Group. Bilateral agreements between the Member States on the substantive content of the solidarity mechanism's basic principles will be reached.

3.3.i.12. Emergency Plan for Gas

The aforementioned measures to eliminate or mitigate the potential impact of a disruption in the natural gas supply within the meaning of Article 10 of Regulation (EU) No 2017/1938 are described in the Federal Republic of Germany's Emergency Plan for Gas. Drafting of this plan is mandatory pursuant to Articles 8 and 10 of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply (previously Articles 4 and 10 of Regulation (EU) No 994/2010); within the plan, measures are assigned to three crisis levels (early warning, alert and emergency). The choice of level depends on the severity of the disruption, the expected economic and technical impacts and the urgency of the need to eliminate the disruption at national level. The entry into force of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply (previously Regulation (EU) No 994/2010) will entail certain amendments to the national emergency plan and the above-mentioned national provisions.

Petroleum

The Energy Security Act, the Petroleum Stockholding Act and the Petroleum Data Act represent the main legal basis for oil crisis preparedness.

3.3.i.13. Energy Security Act – Petroleum

Among many other topics, the scope of the Energy Security Act covers petroleum and petroleum products. Under this Act, legislative regulations can be enacted with provisions on the production, transport, storage, distribution and supply of fuels, including petroleum. In particular, measures which restrict consumption such as speed restrictions or bans on driving can be imposed, up to and including potential rationing of petroleum supplies. The first and priority option for handling disruptions to the oil supply which cannot be compensated for by the market participants alone (at least in the short term) is the approval of oil stocks under the Petroleum Stockholding Act. Measures such as speed restrictions and (partial) bans on driving would only be considered in connection with extremely severe and prolonged supply crises.

3.3.i.14. Petroleum Stockholding Act

A statutory obligation to maintain stocks of petroleum and petroleum products has applied in Germany since 1966. It was introduced in view of the country's increasing dependency on petroleum imports, with the aim of safeguarding the energy supply at least against short-term interruptions in the flow of imports. It has been amended several times since then, inter alia in response to EU legislation and international developments. The Petroleum Stockholding Act comprehensively regulates the holding of petroleum and petroleum product stocks for the purpose of crisis preparedness. The Petroleum Stockholding Association was set up on the basis of this Act as a federal corporation under public law based in Hamburg, and assigned the task of building up stocks. It holds petroleum stocks of crude oil, petrol, diesel, extra-light fuel oil and the fuel JET A-1 which are adequate to cover 90 days of net imports. In the event of a supply crisis, the Federal Ministry of Economic Affairs and Energy is to enact a regulation approving use of the stocks by the Petroleum Stockholding Association in order to compensate for the shortfall.

3.3.i.15. Petroleum Data Act

The Petroleum Data Act serves as a legal basis for collecting petroleum data from all the major companies which trade in petroleum. In turn, these data serve as a basis for regular observation of Germany's petroleum supply and for measures in the event of a crisis. To this end, the Federal Office for Economic Affairs and Export Control collects petroleum data (on imports and exports, stocks and domestic sales of crude oil and petroleum products) on a monthly basis from companies subject to a reporting obligation. The data collected (in particular information on current developments on the German oil market) are used for national and international crisis preparedness.

3.3.i.16. Transport Services Act

A requirement for transport capacities may arise in the event of a severe oil supply crisis if the Federal Government (pursuant to the Energy Security Act) identifies a disruption in the supply of energy which cannot be eliminated using market-based instruments, cannot be eliminated in good time using such instruments or can only be eliminated using disproportionate means. As an 'authority entitled to impose requirements' within the meaning of §7 of the Transport Services Act, the Federal Office for Economic Affairs and Export Control

is responsible for commissioning transport services within the portfolio of the Federal Ministry of Economic Affairs and Energy from the 'coordinating authority' (Federal Office for Goods Transport) in the event of a crisis.

3.3.i.17. Fuel Supply Restrictions Regulation

The Fuel Supply Restrictions Regulation regulates the possible rationing of fuels using ration coupons. The Energy Security Act and confirmation by the Federal Government that the energy supply is subject to disruption provide the legal basis for related measures.

3.3.i.18. Fuel Oil Supply Restrictions Regulation

The Fuel Oil Supply Restrictions Regulation regulates the potential rationing of light fuel oil on the basis of a reference quantity taken from a previous period. The Energy Security Act and confirmation by the Federal Government that the energy supply is subject to disruption provide the legal basis for related measures.

3.3.i.19. Petroleum Equalisation Regulation

The Petroleum Equalisation Regulation makes provision for fair sharing between oversupplied and undersupplied companies in the petroleum industry. The aim is to preserve market structures insofar as possible and ensure that petroleum can be sold at market prices. The Regulation can also be used (on a *mutatis mutandis* basis) to comply with international commitments under the International Energy Agency's International Energy Programme. The Energy Security Act and confirmation by the Federal Government that the energy supply is subject to disruption provide the legal basis for related measures.

3.3.i.20. Petroleum Management Regulation

The Petroleum Management Regulation regulates the possible rationing of fuels and their production, distribution and use in the interest of the general public and of the Federal Armed Forces and allied armed forces on the basis of the Economic Security Act in the cases covered by Article 80a of the Basic Law. The ultima ratio principle applies in this area too.

3.3.i.21. National Emergency Strategy Organisation (NESO)

A National Emergency Strategy Organisation (NESO) has also been established. 'National Emergency Strategy Organisation' is an umbrella term which refers to the authorities, institutions and companies that would work proactively in the event of an oil crisis to evaluate its impact and decide on the nature of response measures and arrangements for their implementation. The success of a NESO relies on close cooperation between the public and private sector, including the associations which represent private-sector players. The Secretariat of Germany's NESO coordinates the activities of NESO stakeholders. It supports the Crisis Supply Council and the Supply Coordination Group in the performance of their tasks, and maintains contact with the IEA (alongside the Federal Ministry of Economic Affairs and Energy and in consultation with the latter). The NESO manual contains crisis management guidelines and has recently been revised.

Electricity

In Germany, a number of stakeholders and all of the electricity supply undertakings are responsible for supplying the general public with electricity; they each hold individual responsibility for fulfilling this task. The main stakeholders are briefly outlined below, followed by a description of the measures taken in the electricity sector:

- Transmission system operators: Transmission system operators operate systems which are used to transport electricity through an integrated maximum-voltage or high-voltage grid, including cross-border interconnectors (see §3(10) and (32) of the Energy Industry Act).

- Distribution system operator – electricity: Distribution system operators distribute electricity, i.e. transport electricity at high, medium or low voltage (see §3(3) and (37) of the Energy Industry Act).

- Balancing group manager – electricity: The balancing group manager is responsible for achieving a balance between injections and removals within a balancing group in each 15-minute period and, as the interface between system users and transmission system operators also assumes financial responsibility for any discrepancies between injections and removals within a balancing group (see §4(2) of the Electricity Network Access Regulation).

The transmission and distribution system operators play a key role in this area, since secure and reliable systems are a prerequisite for the supply of electricity. Pursuant to §13 and §14 of the Energy Industry Act, they must take appropriate measures to guarantee the security and reliability of the electricity supply system. System operators must work closely together with each other in order to comply with their supply obligations.

Measures to maintain and (where applicable) improve the reliability of Germany's electricity supply

A functioning Electricity Market 2.0 based on free price formation will automatically guarantee that the correct investments are made in generation and flexibility. The Federal Government's strategies and measures to guarantee the adequacy and flexibility of the energy system simultaneously create stronger incentives for market players to safeguard their electricity supplies (see Section 3.4.3.ii.). This makes it possible for the electricity market itself to refinance any additional capacities it needs. Joint measures must furthermore be taken within Europe to guarantee security of supply.
The Federal Government also takes additional steps with a view to the maintenance and further improvement of gas supply security.

3.3.i.22. Operation of energy supply systems
Pursuant to §11 of the Energy Industry Act, operators of energy supply networks are obliged to operate a secure, reliable and high-performance energy supply network on a non-discriminatory basis, and to maintain this network, optimise it as required, strengthen it and expand it insofar as economically feasible.

3.3.i.23. Provision of information
Pursuant to §12(2) of the Energy Industry Act, transmission system operators must provide operators of other systems (with which their own transmission systems are connected in technical terms) with the necessary information to guarantee secure and efficient operation, coordinated expansion and interconnection.

3.3.i.24. Network reserve
Pursuant to §13d of the Energy Industry Act, transmission system operators must keep in reserve resources to guarantee the security and reliability of the electricity supply system, and in particular for the management of grid congestion, voltage maintenance and restoration of the supply (network reserve). In winter 2019/2020, the network reserve volume is 6.6 GW.

3.3.i.25. Capacity reserve
Pursuant to §13e of the Energy Industry Act, the transmission system operators maintain reserve power in order to compensate for net output deficits in the event that the security or reliability of the electricity supply system is at risk or disrupted as a result of the incomplete balancing of supply and demand on the electricity markets in Germany's virtual control area [*Netzregelverbund*] (capacity reserve). For the first delivery period, from October 2020 to September 2022, it has a volume of 2 GW.

3.3.i.26. Monitoring of electricity supply security
The Federal Ministry of Economic Affairs and Energy carries out ongoing monitoring of security of supply. Monitoring covers inter alia supply and demand on the European electricity markets and systems. A large number of scenarios are modelled, reflecting different supply and demand situations in the EU Member States and the associated cross-border exchange of electricity. This makes it possible to build up a realistic picture of the security of supply in Germany, taking into account its close integration into the European electricity system. In order to monitor the level of security of supply, it is necessary to gain a realistic idea of the contribution made by cross-border exchanges of electricity, inter alia in times of crisis. Standards are therefore currently being developed in Europe which outline how the level of security of supply should be calculated in order to capture all effects appropriately. Germany's Report on the Security of Supply dated 3 July 2019 applies the standards already in force in the country. Germany also participates in drafting of the Regional Report on the Security of Supply as a member of the Pentalateral Energy Form (see Section 3.3.ii., 3.4.), which is also based on these standards.

3.3.i.27. Monitoring of load management
Under §51a of the Energy Industry Act, the regulatory authorities can undertake monitoring of the contribution of load management to the security of supply. For this purpose, the regulatory authorities can request from companies and associations of companies that have an annual electricity consumption in excess of 50 gigawatt hours information which may be required in order to analyse the current and future contribution of load management to security of supply in the electricity markets. The results of the first load management monitoring process, using data from 2017, show that significant potential for voluntary, market-based load reduction has been opened up among industrial sectors, but is still unused. This developed, but unused, potential of flexible enterprise locations amounts to about 2.5 GW (definite potential) to approx. 4.5 GW (probable potential). This potential has not yet been exploited because the current wholesale prices on the electricity market do not incentivise their use.

3.3.i.28. Overall strategy regarding system reliability and grid stability
The aim is to develop an overall strategy for 'System security and network stability, digitalisation and IT security of the grid-connected power supply'. Special focus on areas of application that are not covered by the Act on the Digitalisation of the Energy Transition.

Measures to eliminate or mitigate the potential impact of a disruption in the electricity supply

The rules and measures in the gas sector referred to above in relation to a disruption in the gas supply apply in a very similar way to the electricity sector. Firstly, the transmission system operators are authorised pursuant to §13 of the Energy Industry Act to take network-related and market-related measures and to use the network reserve and capacity reserve to eliminate risks or disruptions in the electricity supply system. If these instruments are inadequate, the transmission system operators are authorised and obliged as a next step to adjust all electricity feed-ins, electricity transits and electricity withdrawals. If these steps are again inadequate and there is a risk of disruption to the energy supply which jeopardises coverage of the critical demand for energy, the instruments under the Energy Security Act and accompanying regulations come into effect.

3.3.i.29. Energy Security Act – Electricity

The Energy Security Act sets out the measures that should be taken in the event of an acute energy crisis, and is aimed at eliminating supply disruptions, initiating countermeasures and maintaining the power supply. It covers all forms and sources of energy. The Energy Security Act contains a detailed framework which serves as a basis for the enactment of legislative regulations. Section 1 of the Energy Security Act authorises the enactment of legislative regulations containing provisions on measures which may need to be taken to secure critical demand for energy in the event that imports of petroleum, petroleum products, natural gas or electrical energy are at risk or disrupted. The Regulation on the Security of the Electricity Supply was enacted on the basis of the Energy Security Act for the electricity sector.

3.3.i.30. Regulation on the Security of the Electricity Supply

The Regulation on the Security of the Electricity Supply puts the provisions of the Energy Security Act into concrete form for the electricity sector. It authorises load balancers to take measures at all stages of the energy industry value creation chain in the event of a crisis. They can enact decrees targeted at consumers with provisions concerning the allocation, consumption and use of electrical energy, as well as a ban on consuming electrical energy. Although the Regulation on the Security of the Electricity Supply is in force, it can only be applied if a separate legislative regulation is enacted confirming that the energy supply is at risk or subject to disruption and that the Regulation on the Security of the Electricity Supply should be applied.

3.3.i.31. Electricity Effort Sharing Regulation and General Administrative Provisions on the Electricity Effort Sharing Regulation

Special rules can be applied during the build-up to or in the event of armed conflict in order to eliminate or mitigate the impacts of disruption to the power supply. If the Bundestag confirms that a situation of armed conflict is imminent or present or grants particular consent to such a measure, the Federal Government can enact a regulation regulating the supply of electricity for defence purposes on the basis of the Economic Security Act. The Electricity Effort Sharing Regulation was enacted on the basis of the Economic Security Act. The purpose of the Electricity Effort Sharing Regulation is to maintain the supply of electricity using state management measures during the build-up to or in the event of armed conflict. Pursuant to the General Administrative Provision adopted in relation to the Electricity Effort Sharing Regulation, it covers the whole spectrum of generation, distribution and use of electricity. As in the case of the Regulation on the Security of the Electricity Supply, the Electricity Effort Sharing Regulation cannot be put immediately into effect. The need for its application must be confirmed by means of a further statutory instrument. Both the Electricity Effort Sharing Regulation and the Regulation on the Security of the Electricity Supply authorise load balancers to take measures at all levels of the energy industry value creation chain.

3.3.i.32. Measures in the event of a generation deficit

Pursuant to the Energy Security Act, the transmission system operators must notify the Federal Network Agency immediately if there is a risk that a generation deficit may occur. In cases of this kind, the Federal Government can enact a statutory instrument stating that a crisis is present in accordance with the Energy Security Act, and assign the Federal Network Agency (the national load dispatcher pursuant to the Regulation on the Security of the Electricity Supply) the task of issuing orders to cover critical demand for electricity, for example by means of power outages or the privileged supply of vital facilities.

3.3.i.33. Stress testing

In the coalition agreement, the Federal Government announced that it would carry out regular stress tests to check developments in network congestion as a basis for identifying any action that needs to be taken in the interests of security of supply (see Section 3.4.).

3.3.ii. Regional cooperation in this area

Natural gas

3.3.ii.1. Solidarity between EU Member States on the basis of the SoS Regulation (Regulation (EU) No 2017/1938)

Regional structures will play a larger role in crisis preparedness in future, alongside national structures. The provisions of the amended SoS Regulation introduce for the first time the concept of solidarity between the

EU Member States with a view to guaranteeing security of the gas supply in extreme situations. Germany's goal is to develop a solidarity mechanism which makes it possible to provide rapid and effective support to any Member States affected by a gas supply crisis. At the same time, the use of market-based measures to overcome a gas crisis is to be stepped up with a view to fully leveraging the potential available in terms of voluntary demand-side responses by market participants. A robust compensation scheme is to be developed in order to provide planning security and transparency for the Member States seeking solidarity and the market players affected. Germany views detailed exchanges of information with neighbouring countries as a priority in the development of this solidarity mechanism in order to ensure that the requirements arising under the individual national legislative frameworks can be identified and taken into account.

3.3.ii.2. Gas Coordination Group

Within the meaning of Regulation (EU) No 2017/1938, the Gas Coordination Group serves as a platform for all topics relating to security of supply. It is to be activated in the event of any disruption to the supply of natural gas.

3.3.ii.3. Consultations on the preventive action plan and emergency plan

Within the framework of crisis preparedness under Regulation (EU) No 2017/1938, it will be necessary in future not only to produce national risk analyses, but also to draft the above-mentioned national preventive action plans for risk preparedness and national emergency plans for risk preparedness. Consultations on these plans will be held with the competent authorities of all neighbouring EU Member States, as well as Italy, Sweden, Switzerland and Slovakia.

3.3.ii.4. Risk groups

Since the entry into force of Regulation (EU) No 2017/1938 concerning measures to safeguard the security of gas supply, the Member States have been obliged to add a regional section to their national preventive action plans and emergency plans. These sections are drafted jointly in 'risk groups'. Germany chairs the 'Baltic Sea' risk group and also sits on six additional risk groups.

3.3.ii.5. Pentalateral Gas Forum

Since 2009, the five countries of Belgium, Luxembourg, the Netherlands, France and Germany have exchanged information on issues relating to security of the gas supply and other current gas-related matters. Several years ago, the Netherlands announced that it intended to cut funding for low-caloric gases. Exports of low-caloric to Belgium, France and Germany will consequently drop. This advance warning allowed France, Belgium and Germany to initiate adjustments in their market areas by converting gas appliances to run on higher-caloric gas. The countries in question exchange progress updates on market adjustments in their market areas within the framework of the Pentalateral Gas Forum.

3.3.ii.6. Cooperation in regional groups within the framework of the Trans-European Energy Networks (TEN-E Regional Groups) – gas

Germany is regarded as an affected Member State for four primary energy infrastructure corridors for electricity and therefore belongs to the corresponding TEN-E Regional Groups. These include the Baltic Energy Market Interconnection Plan (BEMIP) for Gas (which should not be confused with the BEMIP Cooperation Forum described in Section 1.4.), North South Interconnection (NSI) East Gas and NSI West Gas, and the Southern Gas Corridor.

Petroleum

Germany's oil crisis preparedness measures are international in scope, being embedded in the framework of the European Union and the supra-national International Energy Agency (IEA). The relevant petroleum stockholding organisations are integrated into the work of the corresponding EU and IEA working groups.

3.3.ii.7. Cooperation in regional groups within the framework of the Trans-European Energy Networks (TEN-E Regional Groups) – oil

The TEN-E Regional Groups include an energy infrastructure corridor for oil (Oil Supply Connections in Central Eastern Europe, OSC), in which Germany is involved as a member.

3.3.ii.8. Annual Coordinating Meeting of Entity Stockholders (ACOMES)

Petroleum stockholding associations are organised under ACOMES. They exchange information annually on specific technical topics and new developments.

Electricity

In the future, crisis preparedness will focus increasingly on regional as well as national structures. In accordance with the regulation on risk preparedness in the electricity sector which entered into force on 4 July 2019, provisions are to be adopted at EU level for the first time to help the EU Member States work together to guarantee the security of each other's electricity supply, even in extreme situations (see Section 2.3.i.).

3.3.ii.9. Cross-border investigation of the security of supply with reference to the electricity market

The fact that the individual electricity markets are strongly coupled to each other means that security of supply must be examined on a cross-border basis. Country-specific considerations would not give an accurate picture of the true security of supply. Reliability of supply should be assessed on the basis of probabilities. The Federal Government plans to develop its approach to security of supply monitoring using probability-based methodologies. This approach involves stipulating a target level in order to assess the real security of supply and determine any measures required. Further details in this respect can be found in Section 3.4.

3.3.ii.10. Pentalateral Energy Forum – security of the electricity supply

Since 2015, the transmission system operators in the countries which belong to the Pentalateral Energy Forum have published regular joint reports on the security of the electricity supply in the region. The methodology followed is the same as that for the national report (see above) and the European Mid-Term Adequacy Forecast. In 2018, the Member States also carried out a first joint crisis exercise involving the transmission system operators, the regulatory authorities and the ministries in the region. The aim of this exercise was to prepare the Member States for closer cooperation within the meaning of the proposed regulation on risk-preparedness in the electricity sector. Further details in this respect can be found in Section 3.4.

3.3.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The electricity grids, together with the reserves such as capacity reserve and network reserve or the security stand-by, make a significant contribution to security of the energy supply. The electricity and reserves are financed through the network charges.

In the gas sector, the security of supply is ensured by modern and well-developed transmission systems (see Chapter 2.4.2.)

3.4. Internal energy market dimension

3.4.1. Electricity infrastructure

3.4.1.i. Policies and measures to achieve the targeted level of interconnectivity as set out in Article 4(d)

3.4.1.i.1. Network Development Plan (NDP) – Electricity

Pursuant to §12b of the Energy Industry Act, transmission system operators are obliged to produce a joint NDP on a 2-yearly basis. This plan sets out shared infrastructure requirements for the next 10 to 20 years. Following its approval by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways and its inclusion in the Federal Requirements Plan pursuant to §12e of the Energy Industry Act, the requirements set out therein are of a binding nature.

In addition, the measures set out in Section 3.4.2.i. relating to the monitoring and controlling of the grid expansion projects for electricity also contribute to achieving the targeted level of interconnectivity.

3.4.1.i.2. Interconnector expansion projects under the Energy Line Expansion Act and the Federal Requirements Planning Act

With a view to meeting the requirements imposed under Article 4(d), the Federal Government is planning 10 interconnector projects under the Energy Line Expansion Act and the Federal Requirements Planning Act (Tables A14 and A15). Most of these projects are also projects of common interest (PCI). The projects in Table A15 are already at the construction stage and should be in operation by 2020. Implementation of these projects may make it possible to achieve the indicators under Article 4(d). In the current Network Development Plan (NDP) 2019–2030, further projects underwent a cost-benefit analysis as provided for in Article 4(d)(1) of the Governance Regulation. Price differences between Germany and the neighbouring countries affected play a key role in the examination of these projects.

Table A15: Interconnectors currently under construction and scheduled to come into operation by 2020

Project	No according to Energy Line Expansion Act/Federal Requirements Planning Act	No under TYNDP	Target date according to the latest monitoring report from the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways	European status
Germany–Denmark (Kriegers Flak Combined Grid Solution, P64)	No 29 under the Federal Requirements Planning Act	36/141	2020	PCI 4.1
Germany–Netherlands Niederrhein/Wesel – Netherlands Doetinchen	No 13 under the Energy Line Expansion Act	113/145	implemented	PCI 2.12

Table A16: Additional interconnectors scheduled to come into operation between 2020 and 2030 under the Energy Line Expansion Act and the Federal Requirements Planning Act*

Project	No according to Energy Line Expansion Act/Federal Requirements Planning Act	No under TYNDP	Target date according to the latest monitoring report from the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways	European status
Germany–Denmark (Central Axis) Kassø – Hamburg North – Dollern	No 1 under the Energy Line Expansion Act	39 251	2020	PCI 1.4.1
Germany–Poland ('Third Interconnector') Eisenhüttenstadt – Baczyna	No 12 under the Energy Line Expansion Act	229/230	(>2030)	
Germany–Poland (Uckermark line) Neuenhagen – Krajnik	No 3 under the Energy Line Expansion Act	94/139	2022	PCI 3.15.1
Germany–Norway (NordLink Germany – Norway, P68)**	No 33 under the Federal Requirements Planning Act	37/142	2021	PCI 1.8
Germany–Denmark (West Coast Line Niebüll – border with Denmark, P25)	No 8 under the Federal Requirements Planning Act	183	2023	PCI 1.3.1

Germany–Austria (measures M94b/M95:	No 40 under the Federal Requirements Planning Act	198	2023	
Lake Constance/ Neuravensburg – border with Austria)				
Germany–Belgium (Alegro Oberzier – border with Belgium, P65)	No 30 under the Federal Requirements Planning Act	92	2020	PCI 2.2.1
Germany–Austria (Isar – St. Peter: Altheim – border with Austria, P67/P112)	No 32 under the Federal Requirements Planning Act	47/187	2028	PCI 3.1.1

* According to information from the Federal Network Agency (www.netzausbau.de/leitungsvorhaben)
** Actual start of operation is expected to take place in December 2020.

Table A17: New interconnectors (not yet in the Federal Requirements Planning Act)*

Project	No under TYNDP	Target operations date according to the transmission system operators	European status
Germany-United Kingdom (NewConnect)	309	2022	Germany-United Kingdom (NewConnect)
Germany-Sweden (Hansa Power Bridge I)	176	2025/2026	Germany-Sweden (Hansa Power Bridge I)
Germany-Sweden (Hansa Power Bridge II)	267	2035	Germany-Sweden (Hansa Power Bridge II)
Germany-France (Eichstetten – German border)	228	2025	Germany-France (Eichstetten – German border)
Germany-Luxembourg (Aach – Bofferdange)	328	2026	Germany-Luxembourg (Aach – Bofferdange)

* According to information from the Federal Network Agency (www.netzausbau.de/leitungsvorhaben)

3.4.1.ii. Regional cooperation in this area

The scope of regional cooperation projects and collaboration extends beyond electricity infrastructure; the relevant information has been consolidated in Section 3.4.3.vi. for Chapter 3.4. as a whole (Internal energy market dimension).

3.4.1.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The financing measures at national level and through Union funds are summarised in Section 3.4.2.iii.

3.4.2. Energy transmission infrastructure

3.4.2.i. Policies and measures related to the elements set out in Section 2.4.2, including, where applicable, specific measures to enable the delivery of projects of common interest (PCIs) and other key infrastructure projects

3.4.2.i.1. Electricity Grid Action Plan

The 'Electricity Grid Action Plan' presented in the summer of 2018 is based on a two-fold strategy which responds to the increasing challenges posed by the transport demand growth described in Section 2.4.1. Firstly, existing grids will be optimised and utilised more effectively. This includes technical optimisation and modernisation measures, new technologies and operating concepts and improved congestion management. Secondly, grid expansion measures will be accelerated. This involves the application of predictive controlling principles to grid expansion, procedural streamlining to accelerate planning and approval procedures and financial incentives for grid operators. A number of Electricity Grid Action Plan measures are outlined in greater detail below.

3.4.2.i.2. Monitoring of grid expansion projects for electricity

Rapid expansion of domestic and cross-border transmission system infrastructure is of critical importance for the success of the energy transition. The Federal Government also intends to use cutting-edge technology for grid expansion wherever possible. At the same time, the timely implementation of all grid expansion projects under the NDP will only be possible on the basis of regular, transparent and realistic monitoring. Since early 2016, the Federal Network Agency has therefore produced and published quarterly monitoring reports on electricity grid expansion (individual projects under the Energy Line Expansion Act and the Federal Requirements Planning Act and projects relating to connections to offshore wind farms; www.netzausbau.de). The Federal Ministry of Economic Affairs and Energy, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways and the federal states also hold regular discussions on the topic. In addition, starting from 2018 transmission system operators are required to submit to the regulatory authority in every even calendar year, by 30 September at the latest, a progress report on the NDP as per §12d of the Energy Industry Act. In 2018 there was also a separate progress report for the offshore sector in accordance with §17c (3) of the Energy Industry Act. The progress report is to contain information on the implementation of the most recently confirmed Network Development Plan. If there are delays, the network operators must give the main reasons for such delays. The progress report must be submitted to the Federal Network Agency. The Federal Network Agency publishes the report and gives all network users the opportunity to comment.

3.4.2.i.3. Controlling of grid expansion projects for electricity

In May 2019, the energy ministers of the states and the Federal Government, the Federal Network Agency and the managers of the transmission system operators in Germany agreed on specific timetables with milestones for all grid expansion projects. The six milestones include the start and completion of the Federal planning or regional planning procedure and the planning approval procedure, as well as the start of construction and of operations. The schedules are both ambitious and realistic. They complement the existing monitoring by the Federal Network Agency and are published at www.netzausbau.de. This enables the public to obtain information about the progress on grid expansion at any time. The target vs actual performance comparison of the milestones is a regular part of the 6-monthly ministerial meetings.

3.4.2.i.4. Optimisation and modernisation of the existing grids

Optimisation and modernisation of the existing grids is enshrined as an objective in the coalition agreement for the 19th parliamentary term. Grid operators are obliged to operate, optimise, strengthen and expand their electricity grids according to need. The 'NOVA' principle is followed, i.e. grid optimisation is prioritised over grid strengthening and expansion. Various measures which increase the interconnectivity of existing electricity grids are planned with this in mind. These include the nationwide roll-out of overhead line monitoring (involving measurements of temperature so that a higher transmission capacity can be used for the lines on a weather-dependent basis), short-term interim measures (in particular phase shifters), optimisation of re-dispatching processes and the introduction / further development of modern digital technologies and system management concepts.

3.4.2.i.5. Accelerated grid expansion

With a view to accelerating the process of electricity grid expansion, which is also urgently needed, the Transmission System Expansion Acceleration Act has been amended. Planning and approval procedures have been streamlined and shortened, while still maintaining substantive environmental standards and without limiting the involvement of the public. Approval procedures (particularly in the area of grid optimisation and strengthening) were accelerated, for example by means of notification procedures for cable additions and re-cabling projects. In these cases, one procedural step can now be dispensed with. Predictive planning for future demand has also been made more straightforward. The new rules entered into force in May 2019.

3.4.2.i.6. Fee-related incentives and Incentive Regulation

The aim of the Incentive Regulation is to incentivise network operators to engage in behaviour that is analogous to competition and to prevent excessive returns ('monopoly returns'). The regulatory framework stipulates that network operators can only use the network charges to refinance those costs that would arise if the grids were to be operated efficiently. The Incentive Regulation is therefore aimed at increasing the cost-

effectiveness of electricity and gas network operators as monopolists and limiting network costs in the interests of all customers (whether industrial, commercial or private). The costs of each network operator are reviewed every 5 years from the perspective of efficiency ('efficiency comparison'). This is a total-cost benchmarking exercise which lends equal weight to capital and operating costs. The network operators are then allocated a certain budget for the performance of their obligations over a 5-year period (regulation period); this represents their revenue ceiling. If they exceed the efficiency requirements, they can retain the additional revenues for the duration of the current regulation period. Work is currently under way to investigate whether further financial incentives could be used to encourage network operators to accelerate grid expansion measures and optimise and modernise the electricity grid. For example, efficiency comparisons have so far ignored congestion management costs on the grounds that they cannot be permanently influenced; as a result, there is no explicit financial incentive to minimise them. Alternatives for handling congestion management costs will be examined in this context, in order to make the costs of congestion management subject, in part if necessary, to an incentivising tool.

3.4.2.i.7. Network Development Plan (NDP) – gas

Pursuant to §15a of the Energy Industry Act, transmission system operators are obliged to produce a joint NDP on a 2-yearly basis. This NDP must contain all effective measures both to optimise and reinforce the network and expand it as needed and to ensure the security of supply that are required for safe and reliable network operation of grid facilities in the next 10 years. The distribution system operators provide any information necessary in this respect; see §15a (4) of the Energy Industry Act. Under §15a (1), fourth sentence, of the Energy Industry Act, assumptions about possible disruptions to the security of supply are also incorporated into the preparation of the NDP Gas. After examination by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, this plan has binding force on the transmission system operators.

3.4.2.i.8. Monitoring of grid expansion projects for gas

Pursuant to §15b of the Energy Industry Act, transmission system operators are obliged to produce a progress report with regard to the expansion of the gas transmission system infrastructure; the reports are to be produced every even calendar year, as from 1 April 2017. The report must contain information on progress since the publication date of the previous NDP, and in the event of any delays in implementation in respect of individual projects included in the NDP, the main reasons for and possible consequences of such delays, for example with regard to the provision of capacities, must also be given. The Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways reviews and publishes the progress report and provides all current and potential grid users with an opportunity to submit comments. The results of this consultation are also published by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, and may be incorporated into guidelines for the next NDP process or into other regulatory procedures.

3.4.2.ii. Regional cooperation in this area

The scope of regional cooperation projects and collaboration extends beyond energy transmission infrastructure; the relevant information has been consolidated in Section 3.4.3.vi. for Chapter 3.4. as a whole (Internal energy market dimension).

3.4.2.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Investments in the expansion, reinforcement and optimisation of transmission systems are not only important for Germany's energy transition. They also play a crucial part in driving the EU's internal market forward. The refinancing of these costs is regulated via the Incentive Regulation and the Electricity Network Fee Regulation Ordinance. As a tool, the investment measure is a separate refinancing instrument for essential investments aimed at expansion and restructuring in the transmission network. Certain PCI projects can apply for financial aid from the 'Connecting Europe Facility' (CEF) for construction projects and studies to prepare for those projects. In the past, the German power grid projects 'SuedLink' and 'SuedOstLink' have been subsidised with CEF funds.

3.4.3. Market integration

3.4.3.i. Policies and measures related to the elements set out in Section 2.4.3.

Market integration measures

3.4.3.i.1. Gradual reduction and phase-out of coal-fired power generation based on the recommendations of the Commission on Growth, Structural Change and Employment

In early 2019, the Commission on Growth, Structural Change and Employment put forward extensive recommendations on how the phasing-out of coal-fired power generation can be implemented and financed in a socially responsible manner and in compliance with the environmental goals. The installed generation capacity from coal-fired power plants is to be continuously reduced, with the result that the output of the power plants in the market will be around 15 GW lignite and 15 GW hard coal in 2022, a maximum of 9 GW lignite and 8 GW hard coal in 2030, and zero GW by the end of 2038 at the latest. A secure power supply and affordable electricity prices must continue to be ensured. The recommendations put forward by the Commission on Growth, Structural Change and Employment include a social consensus on how the coal phase-out can be achieved by 2038 at the latest. The Federal Government is implementing this in close coordination with the federal states concerned.

Up to now, more than two thirds of emissions in the energy sector have been caused by coal-fired power plants. To achieve the sectoral goals of the Climate Action Plan, a key measure is therefore the progressive replacement of electricity from fossil fuels with electricity from renewable energy sources, and an overall reduction in the demand for electricity through eligible energy efficiency improvement measures. As of 1 April 2020, there are 18.1 GW of lignite-fired power stations and 18.6 GW of hard-coal power plants in the market. In addition, there are 2.3 GW of hard-coal power plants in the network reserve and 2.7 GW of lignite-fired power stations on standby. The Datteln 4 hard-coal power plant with 1.1 GW will come into regular operation in the early summer of 2020. (Source: REMIT information of 27.5.2020). The key energy policy recommendations made by the Commission on Growth, Structural Change and Employment will be implemented with a draft law on the phasing-out of coal passed by the Federal Cabinet on 29 January 2020. The bill is currently being negotiated in the Bundestag and is expected to be adopted before the summer break. This also contributes significantly to achieving the sectoral goal under the Climate Action Plan.

According to the bill, the details of the phasing out of lignite-based power generation are to be determined as amicably as possible in negotiations with the power plant operators. However, the draft already includes a decommissioning pathway for all lignite-fired power stations over 150 MW.

To end the generation of electricity from hard coal, the bill provides for decommissioning tenders with diminishing maximum prices up to 2026. From 2024, the decommissioning of power plants without compensation will also be mandated in order of their age, within the scope of the contract. From 2027, the progressive and continuous reduction of electricity generation from hard coal will be achieved solely by decommissioning power plants in order of their age, without compensation. Lignite-fired power stations with an output of up to and including 150 MW can in principle also participate in the decommissioning tenders, and will be included in the statutory reduction pathway as from 2030. Both for the tender procedures and for the statutory reduction of electricity generation from hard coal, network security will be checked and taken into account at all times. Under the provisions of the Cogeneration Act, a power plant can also be decommissioned by conversion from coal to low-emission fuel. The relevant amendments to the Cogeneration Act are also envisaged in the draft of the law on the phasing-out of coal. The fossil fuel phase-out is to be comprehensively reviewed in 2022, 2026, 2029 and 2032, inter alia with regard to the security of supply, electricity prices and the contribution to achieving the climate goals.

Within this framework, in 2026, 2029 and 2032 a review will also be carried out to determine whether the reduction and phase-out of coal-fired power generation after 2030 can be brought forward 3 years, so that the end date of 31 December 2035 can be achieved. Approval is no longer to be given for the construction of new coal-fired power plants.

The reduction and phase-out of coal-fired power generation is at the same time reason and condition for the payment of structural change subsidies to the federal states. Taking the lead in the structural change associated with the fossil fuel phase-out is of major importance for the Federal Government. In a first step, the immediate action programme for the lignite regions will support projects that can be implemented quickly and efficiently by the federal states. The draft version of a law on structural enhancements in the coal regions, brought in by the Federal Government by a Cabinet decision of November 2019, supports the regions affected by the fossil fuel phase-out with regard to sustainable and future-focused structural growth. At the time of the preparation of this Plan, the bill is in the parliamentary process. The decisions of the Federal Government based on the key points for implementation of the structural policy recommendations of the climate protection report for a ‘law on structural enhancements in the coal regions’ from May 2019, in particular with regard to security of supply in Southern Germany and the need to conduct a national analysis of the security of supply as a necessary precondition for the establishment of (potentially regional) systematic incentives to investment, will continue to apply.

The gradual reduction and phase-out of coal-fired power generation goes hand in hand with accompanying structural measures. These measures are set out in Section 3.4.3.iv.

3.4.3.i.2. Sectoral coupling

The Federal Government plans to press ahead with sectoral coupling, or in other words the efficient use, both

direct and indirect, of electricity from renewable energies, in order to replace fossil fuels in the areas of heating, industry and transport. Work needs to be done to identify ways of eliminating obstacles to sectoral coupling. The aim is to create a level playing field for the various sectoral coupling technologies. The first prerequisite for properly functioning sectoral coupling is the provision and further development of supra-regional and local energy infrastructure. The Federal Government therefore plans to expand energy infrastructures as needed and develop them further on a cost-effective basis and in line with the principles of the energy transition, in order to render them available for sectoral coupling purposes. Programmes and demonstration projects will be implemented to support these efforts, for example in relation to cost-effective and rapidly achievable options for expanding charging infrastructures, or efficient heating networks based on renewable energies. Fair conditions of competition will also be established so that the market can decide which technologies are most successful and will therefore be used. This incentivises innovation and brings modern technologies to the market. In an ideal situation, efficient sectoral coupling (and therefore decarbonisation) should be driven primarily by the market and facilitated by price signals without lock-in effects. If sectoral coupling is to make a significant contribution to achievement of the goals under the Energy Concept and the Climate Action Plan 2050, framework conditions for the efficient use of electricity from renewables must be improved across all sectors and steps must be taken to provide additional generation capacities and the transport capacities which will then be needed within the electricity transmission and distribution networks.

3.4.3.i.3. Measures in the Action Plan for Reducing Grid Congestion

The new EU electricity market regulation 2019/943 stipulates that at least 70% of electricity transmission capacity must be available for cross-border trading. That means a much bigger transport task for Germany's transmission system. Until the planned, major high-voltage DC transmission lines are put into operation, it can be expected that the requirements imposed at EU level will lead to an intensification of grid congestion in Germany. Article 15 of the EU electricity market regulation stipulates that Member States that submit an action plan can be allowed a transitional period. They do not have to achieve the target of 70% until 31 December 2025. Until then, they must progressively increase their trading capacities on the basis of an upward, linear trajectory. This gives them time to reduce internal congestion through measures in the area of grid expansion and grid optimisation.

A condition for the action plan is that transmission system operators must identify one or more structural bottlenecks for the event that the 70% target for cross-border trading had already been reached upon the entry into force of the regulation on 1 January 2025. The four German transmission system operators identified such structural bottlenecks in Germany in a report to the Federal Network Agency. The Federal Network Agency approved the transmission system operators' report on 28 November 2019, and thus formally opened the way for this action plan.

The Federal Government presented an action plan at the end of 2019. This action plan contains concrete measures with a timetable for reducing the structural grid congestion. The time frame of the measures is 4 years. The action plan thus meets the requirements under Article 15(1) of the EU electricity market regulation. Pursuant to Article 14(7), the action plan may be national or multinational. Due to its central geographic location in Europe, Germany has decided to also include cross-border activities in the action plan.

One set of national measures consists of those aimed at increasing power transmission capacity. These include the extensive, planned grid expansion projects up to 2030. Germany is planning more new kilometres of transmission infrastructure than any other Member State. Measures to accelerate grid expansion are aimed at streamlining and shortening approval procedures, improving incentives for grid operators to undertake line expansion, the application of predictive controlling to allow better monitoring of the progress of grid expansion and enable obstacles to be identified at an early stage, and steps to increase acceptance of grid expansion. Measures to optimise the existing grid include in particular new technologies in the areas of grid elements and grid management, with the aid of which the grids can be more fully utilised, meaning more electricity can be transported.

The other set of measures detailed in the action plan consists of initiatives to improve congestion management. These support the measures that are directly grid-related, thereby facilitating the required increase in cross-border trading until the grid is strengthened. The focus here is on various measures relating to the topic of re-dispatching, including, for example, improved re-dispatching processes for transmission and distribution system operators, and the bringing in of new domestic and foreign potentials in order to make congestion management more effective and cost-efficient overall. In this section the action plan also explains why Germany is claiming an exemption under Article 13(3) of the EU electricity market regulation and is opting for cost-based re-dispatching. Market-side measures aimed at reducing congestion include tighter regional control of the extension of generation circuits, in order to tackle the problem of electricity being generated in locations which are geographically remote from the load centres. With the gradual phasing-out of coal-fired power generation, which Germany is implementing for climate protection reasons, care will be taken to ensure that this is done in as grid-compatible a manner as possible.

Some measures call for cross-border cooperation. Germany is therefore committed to bilateral and multilateral collaborations with neighbouring countries. The regional processes provided for in EU law will still take some time to be implemented. Bilateral and multilateral collaborations help to bridge this period and move forward with electricity trading, to strengthen secure grid management and to reduce grid congestion.

The action plan also provides information on the linear trajectory to the gradual opening of the border in the transition period. Opening at 70% of the transmission capacity of the interconnectors must be accomplished by the end of the transition period, i.e. by 31 December 2025 at the latest. Until then, linear growth trajectories indicate the minimum amount of line capacity that the transmission system operators must keep free for international trading. The starting values of the growth trajectories differ between the regions. They are based on the average trade capacity in 2018 or the average trade capacity in the years 2016-2018, depending on which of the two values is higher.

3.4.3.i.4. Cross-border measures in the Action Plan for Reducing Grid Congestion

Many measures which have a positive impact on grid congestion can only be implemented together with neighbouring countries, for example because they require joint coordinated action. To name one example, cross-border re-dispatching can only be optimised if neighbouring states work closely together. Current studies by Consentec and IFHT show that the optimisation of cross-border re-dispatching can significantly reduce re-dispatching costs for the entire region and that it contributes to meeting the European requirements for electricity trading. There is grid congestion within the European electricity grids which cannot be effectively resolved with purely national measures. For that reason, Germany already cooperates with many neighbouring countries on the re-dispatch processes. These mostly bilateral collaborations should be supplemented by further partnerships. A trilateral cooperation on re-dispatching, which is to be implemented this year, is planned with the Czech Republic and France. In the medium term, cross-border re-dispatching is to be optimised across the entire region. The transmission system operators are currently developing a methodology for this, which will then be approved by the national regulatory authorities. To bridge the intervening period, the existing re-dispatching collaborations are to be continued and, wherever possible, extended.

Measures for improved market coupling

3.4.3.i.5. Creation of a Central and Eastern European Capacity Calculation Region (CORE)

Various initiatives are planned to improve the integration of Germany's bidding zone into European markets. For example, flow-based market coupling (FBMC) was established for the first time between the countries of the Pentalateral Energy Forum (without Switzerland; see Section 3.4.1.ii.) in May 2015. The aim of these flow-based capacity calculations is to improve utilisation of the existing grid infrastructure. Market coupling in this context will initially focus on day-ahead electricity trading. Flow-based market coupling has since become the accepted end goal for almost all EU Member States within the framework of Network Code Capacity Allocation and Congestion Management (CACM). The second stage of the process will therefore be to expand flow-based market coupling to a joint Central and Eastern European Capacity Calculation Region (CORE). This relates back to a decision taken by the Agency for the Cooperation of Energy Regulators (ACER) in November 2016. Work is also being carried out at the borders with Denmark and Sweden to standardise capacity calculations; flow-based market coupling is not yet being used in this connection, however.

3.4.3.i.6. Coupling of intra-day electricity trading

Alongside the cross-border day-ahead market, cross-border intra-day trading is also growing in significance. This is supported by two parallel processes aimed at optimising intra-day trading capacities; the first of these is the XBID (Cross-Border Intra-Day) project, which has connected the intra-day markets in Northern, Western and Southern Europe since June 2018, initially on the basis of conventional capacity allocation. Efforts are also under way to expand this market coupling towards Eastern Europe. The second of these processes is the expansion of flow-based market coupling to cover intra-day trading. Both help to ensure that cross-border electricity markets can exchange flexibility resources at short notice (in almost real time), and therefore respond jointly to short-term changes in generation and demand.

3.4.3.ii. Measures to increase the flexibility of the energy system with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intra-day market coupling and cross-border balancing markets

Measures to ensure adequacy

3.4.3.ii.1. Measures to ensure adequacy of the energy system

The Federal Government's goal is to maintain a functioning Electricity Market 2.0 and jointly guarantee reliability of supply within Europe. The electricity market itself will then ensure that the correct amounts are invested in generation and flexibility. The principle of free price formation is enshrined in the Energy Industry Act. At the same time, market players have been given strong incentives to safeguard their supply of

electricity. These measures have strengthened existing market mechanisms. This makes it possible for the electricity market itself to refinance any additional capacities it needs.

3.4.3.ii.2. Additional measures aimed at achieving a flexible and efficient power supply

These include, for example, new areas of cooperation in connection with the European electricity markets, further development of balancing markets and debates on the future nature of network charges. Various national measures are aimed at building a sound basis for the Electricity Market 2.0. Integration of the wholesale electricity market in Europe should be completed as soon as possible in order to define security of supply at European level, to ensure that sufficient capacities are available in the common internal market in the event of a shortage and to ensure that electricity can in fact be transported across borders. Regional cooperation is a driver of integration between the European electricity markets.

3.4.3.ii.3. Guaranteed energy system flexibility

The Federal Government's aim is to eliminate obstacles to flexibility so that all technologies have similar access to the market. For the first time, all of these obstacles to flexibility were listed and measures for eliminating them discussed in a time-consuming process which culminated in the publication by the Federal Ministry of Economic Affairs and Energy of a green paper ('An electricity market for the energy transition' dated October 2014 (Green Paper on Electricity)) and a white paper (White Paper on Electricity, dated July 2015). Some of these measures were implemented in the Electricity Market Act of July 2016. The findings document 'Electricity 2030: Long-term trends – tasks for the coming years' published by the Federal Ministry of Economic Affairs and Energy was based on this research; it outlined the obstacles to flexibility which still exist or may emerge before 2030, and which measures could be taken to eliminate them.

Measures to ensure flexibility

3.4.3.ii.4. Needs-based grid expansion and modernisation

Well-developed electricity grids are one of the most cost-effective ways to create flexibility. That makes it all the more important to eliminate obstacles in order to avoid any delays in grid expansion and modernisation, thereby increasing the flexibility of the electricity market.

3.4.3.ii.5. Increased integration and flexibility of European electricity markets

The European electricity system allows participants to respond to flexible generation and consumption, thereby reducing overall electricity production costs and capacity demand. Wind and solar electricity are to be integrated into the energy system, in particular on the basis of intra-day trading within Europe (in almost real time). Lead markets for intra-day and day-ahead trading will also be strengthened (for further details, see Section 3.4.3.i. (Measures for improved market coupling)).

3.4.3.ii.6. Fair and system-focused network funding

The aim is for the network fee system to help network users behave in a way which increases the security and cost-effectiveness of the power supply. It must therefore be tailored to a modern electricity system. Investigations must be carried out into ways of eliminating obstacles to market-driven flexibility on the part of generators and consumers without at the same time incentivising inefficient grid dimensioning.

3.4.3.ii.7. Implementation of the 'Use It, Don't Curtail It' concept

Under the 'Use It, Don't Curtail It' scheme (§13(6a) of the Energy Industry Act), cogeneration plant operators in grid expansion areas which are at particular risk of congestion are obliged (upon request by transmission system operators) to reduce the feed-in of cogenerated power if there is congestion in the transmission system, and to generate the heating required using a Power-to-Heat (PtH) facility. This relieves network congestion and avoids the electricity generated from renewables being curtailed (to the extent of the reduction in feed-in from the cogeneration plant and the additional consumption of heating from the PtH facility). The system as a whole also becomes more flexible, since cogeneration plants with the ability to generate heat can move flexibly between the supply and demand side of the electricity market, and the transmission network operators can harness this potential for flexibility when they operate the grid.

3.4.3.ii.8. Flexible cogeneration plants as a transition technology

From today's perspective, new and modernised cogeneration plants are likely to play a key role in GHG reduction between now and 2030, and even beyond that date. In order to do so, they must reduce emissions in the electricity and heating market and respond flexibly to fluctuating renewable feed-ins. The Federal Ministry of Economic Affairs and Energy intends to launch a number of pilot projects involving cogeneration plants, and is therefore issuing calls for tenders for innovative cogeneration systems. In general, these innovative CHP systems are intended to demonstrate how the cogeneration plants of the future will be able to respond with dual flexibility by providing both renewable heat and renewable electricity. During periods when a lot of heat from renewable energies is being fed in, the CHP plant reduces its production of heat and saves fuels and emissions. During times when a lot of electricity from renewable energies is being fed in, the CHP plant reduces its production of electricity and again saves fuels and emissions. If a lot of electricity from renewable energies is available and trading prices are low or negative, the electrical heat generator can also

reduce the burden on the electricity market. The technology converts a rigid and heat-dependent minimum generation system into a system based on flexible demand for electricity. The technology is also used under the 'Use It, Don't Curtail It' scheme in order to resolve acute grid congestion. Combined heat and power generation will be developed further in the future and comprehensively modernised to secure its future within the framework of the energy transition.

3.4.3.ii.9. Optimisation measures relating to re-dispatching

Ever more attention is being paid to the question of how interactions between the electricity market and the electricity grid should be organised to ensure that the system as a whole can be operated safely and cost-effectively, the share of renewable energies in electricity generation can be increased, and sectoral coupling can be further developed. Measures currently planned include:

- Higher level of utilisation of the existing grid in order to increase transport capacities. There is potential for optimisation in the electricity grid in the form of more efficient network utilisation. By consistently implementing cutting-edge technology, higher transport capacities can be achieved. Model-based estimates of potential have shown that by more actively controlling electricity flows using phase shifters in conjunction with weather-dependent overhead line operation, the transport capacity of the grid can be substantially increased. In the future, technological developments and innovative operating control concepts offer further potential for optimisation beyond the current state of the art. Measures to mobilise these optimisation potentials are set out in Germany's action plan for reducing grid congestion.

- More efficient organisation of re-dispatching with a view to the gradual shift of current feed-in management systems to a predictable process with financial and energy-related balancing. The most recent amendment to the Transmission System Expansion Acceleration Act contains a provision stipulating that the current feed-in management system – i.e. the balancing of renewable energy and cogeneration plants – will be converted by 1 October 2021 into a uniform regime together with the re-dispatching. In future, re-dispatching will include not only rules governing intervention in the operation of conventional power plants to eliminate bottlenecks, but also rules for renewable energy and cogeneration plants, so that a systematic balancing of feed-in management by running selected generation circuits will also be possible – in contrast to the exchange procurement that has hitherto been the norm.

- Cross-border re-dispatching. A research project undertaken by E-Bridge, EWL and IFHT on behalf of the Federal Ministry of Economic Affairs and Energy has calculated that the cross-border optimisation of re-dispatching can lower Germany's re-dispatching requirement by around 30%. Germany therefore supports the development of methods for coordinated cross-border re-dispatching and cross-border cost allocation within the framework of code capacity allocation and congestion management (CACM, Articles 35 and 74).

3.4.3.ii.10. Flexibility check

A number of rules are still in place which make it difficult for market players to respond flexibly ('obstacles to flexibility'). These obstacles to flexibility must be eliminated so that all technologies have equal access to the market. Competition between the various flexibility options (expanded electricity networks, flexible power plants and consumers, storage facilities, exchange of electricity with European neighbours) – or in other words Electricity Market 2.0 – is particularly cost-effective in this respect. Advantages should not be given to certain technologies through one-sided funding and derogations. The market itself is best placed to make these decisions. Germany has therefore decided, together with its electricity neighbours, that a flexibility check should be carried out for Germany and the other EU Member States involved. The aim of this check will be to identify and eliminate obstacles to increased flexibility of the electricity market. On the basis of the findings which emerge, it will be possible for potential flexibility resources in Germany and other countries to be identified and integrated into the market.

3.4.3.iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

Renewable energies are now heavily integrated into the electricity market. The reason for this is the mandatory direct marketing of renewable electricity and funding via a sliding market premium. In 2018, 65% of the total installed capacity from renewable energies was directly marketed via this premium. (Onshore wind 95%, Offshore wind 100%). Up to 2030, this share and thus the market integration of renewables will increase further.

Operators or direct marketers of renewable energy installations in the market premium scheme are themselves responsible for the short-term forecasting of their production, and balancing in the event of any differences, and thus assume the same responsibility as conventional power plants. Since 2015, all installations in the direct marketing system have been remotely controllable. When prices are moderately negative, operators and direct marketers have an incentive to curtail or to scale back their systems. They then contribute to system security and are exempted from the surcharge under the Renewable Energy Sources Act, by contrast with installations in the fixed feed-in payment arrangement.

In the next few years, additional revenue options may arise in other markets for installations eligible under the Renewable Energy Sources Act. In particular, systems that can be flexibly controlled which claim no fixed feed-in payment under the Renewable Energy Sources Act can participate in the balancing energy market. In addition, from 2021 the first subsidised installation cohorts will start leaving the Renewable Energy Sources Act system and will be actively involved in the energy markets without funding. A range of business models will be established, which will be financed through instruments such as PPAs.

Producers of electricity from renewable energy sources, providers of demand flexibility, storage facilities and aggregators can in principle operate under the same conditions as conventional producers on all energy markets. By shortening the product and tendering periods and reducing the minimum bid amounts, the conditions of participation on the balancing energy markets have been significantly improved for load management providers and aggregators. Balancing group managers have also been obliged to allow an end consumer to provide secondary control power and minute reserve via an aggregator. Distribution system operators must charge low-voltage suppliers and end consumers a reduced grid fee if a control arrangement that is appropriate for the grid can be agreed with them. This rule is currently used primarily by night storage heating systems and heat pumps. The Federal Government will soon be introducing a stakeholder process by way of further refining the rule, with the aim of offering consumers a stronger incentive to make their flexibility available to the network operator.

With regard to their reference current, electricity storage systems are already exempted, through a series of privileges, from the end consumer fees used to finance the electricity system (surcharge under the Renewable Energy Sources Act, grid fees, etc.). In implementing the Clean Energy Package, the Federal Government will examine whether there are still instances in which double charging for stored energy (at feed-in and at final consumption after withdrawal) is occurring. A Federal Government funding programme for home storage systems set up in connection with new PV installations expired in 2018. Monitoring of the funding programme showed that of the 40,000 new home storage facilities installed in 2018, only 5% took advantage of the funding programme. Further funding of home storage systems by the Federal Government does not therefore seem necessary at present.

3.4.3.iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy-poor consumers, and to improve the competitiveness and contestability of the retail energy market

Healthy competition exists in Germany among providers in the end energy customer sector. Germany's electricity market already numbers more players than almost any other in the EU. According to the 2017 Monitoring Report by the Federal Network Agency and the Federal Cartel Office, no electricity or gas provider holds a dominant market position. The number of electricity and gas providers in Germany has risen steadily over recent years. In 2016, over 1 400 electricity providers and over 1 000 gas providers were present on the country's end customer market. End customer prices for electricity and gas are not subject to state regulation. The market is characterised by free price formation on the basis of competition. On average, over 50 different providers supply domestic customers within a single distribution network area, and in many distribution network areas there are more than 100 different providers. Competitive price formation and market liberalisation will continue to serve as the foundation for a high level of competitiveness in the electricity and gas end customer market.

3.4.3.iv.1. Protection of energy consumers and competitiveness/market integration at national and European level

Germany has put in place many measures to protect consumers. To name one example, providers must comply with various transparency requirements. Consumers can also take their cases to the Schlichtungsstelle Energie e. V. (the arbitration body for energy), which arbitrates on disputes relating to connections to the grid, the supply of energy and the metering of energy (using out-of-court settlements where applicable). The arbitration process is generally free of charge for consumers, and energy supply undertakings are obliged to participate (for a fee); there is a time limit of 3 months, and the process should culminate in a recommendation by the arbitrator. Although these recommendations are not legally binding, many suppliers nevertheless abide by them. In addition, since July 2017, funding has been provided by the Federal Ministry of Justice and Consumer Protection for the body tasked with observing the energy market in the country as a whole. This body carries out targeted observation of the energy market from a consumer perspective with the help of Verbraucherzentrale Bundesverband e. V. and the consumer organisations themselves. It will then be possible to build up an overall picture by gathering together the individual complaints. Consumer protection experts will then be able to identify undesirable developments at an early stage and issue prompt alerts so that consumers do not suffer any further harm. The body tasked with observing the energy market will therefore also help to make the energy transition more cost-effective and more socially just for consumers. The European Commission's proposal for a directive on the internal energy market provides for a bundle of measures relating to the protection of consumers and the strengthening of consumer rights. They are aimed in particular at increasing transparency for consumers; topics covered include additional billing information

during the year (at no charge), minimum requirements for consumption bills and billing information, or the introduction of standards for electricity comparison portals. Once the directive has entered into force, Germany will transpose its provisions into national legislation (unless they are already covered by existing laws).

3.4.3.iv.2. Default and auxiliary supply concept

Domestic customers are also protected through the application of a default and auxiliary supply concept. This stipulates that each domestic customer has a fundamental legal right to be supplied with electricity or natural gas by the relevant default supplier under the published general terms and conditions and at the general prices. The energy supply undertaking obliged to provide the default supply in each case is subject to a one-sided obligation to enter into a contract (provided that the company can reasonably be expected to do so on financial grounds). For example, the default supplier's right to interrupt the supply immediately or terminate its contract with the customer in the event of a delay in payments is limited by law. No minimum contractual term is stipulated for the default supply, and it can be terminated at any time and at short notice by the customer, without providing a reason.

3.4.3.iv.3. Reduction of electricity costs

Concurrently with the introduction of carbon pricing, citizens and the economic sector will benefit from reductions in the electricity price, with the surcharge under the Renewable Energy Sources Act to be progressively paid through a portion of the pricing revenues. This does not affect the payment entitlement for renewable energies under the Renewable Energy Sources Act. Reducing the surcharge under the Renewable Energy Sources Act is intended to provide relief for families and SMEs in particular. This also creates the right incentives for increasing electrification and drives the cross-sector energy transition forward. The further measures under the Climate Protection Programme which could lead to an increase in electricity price components will be implemented by the Federal Government in a sequence of steps that ensures that the electricity price drop is maintained. This does not affect the provisions on electricity price compensation in EU emissions trading. In the Climate Action Plan 2050, the Federal Government decided to review the incentive and the steering effect of government-imposed energy price components in the form of fees, surcharges and taxes. With the Fuel Emissions Trading Act, the Federal Government has made considerable progress in this direction. The government will also examine the suitability of the state-induced price components with a view to the requirements of the energy transition, and put forward a proposal for the further course of action.

3.4.3.iv.4. Change in commuting allowance for long-distance commuters

Commuters who have to travel a long distance to work, especially in rural areas, often do not have access to a developed public transport service, and at present, neither adequate charging infrastructure nor vehicles with the appropriate range are available to enable them to switch to e-mobility in the short term. This will change in the coming years. For this reason, to provide relief for these commuters, as from 2021 the commuter tax relief allowance will be increased to 35 cents from the 21st km, limited until 31 December 2026.

3.4.3.iv.5. Changes in housing allowance, tenancy law and energy law

To ameliorate social hardship with rising heating costs, those receiving housing benefit will be supported through a 10% increase in the benefit amount. In addition, changes to tenancy rights and energy legislation are being examined that will provide for a restricted right to charge the carbon pricing. This will have a dual incentivising effect: for tenants to behave in an energy-efficient way, and for landlords to invest in climate-friendly heating systems and energy-related renovations.

3.4.3.iv.6. Transfer payments

Increased energy costs will be taken into account in the transfer payments in accordance with established procedures.

3.4.3.iv.7. Structural policy supporting measures in connection with the gradual reduction and phase-out of coal-fired power generation

With the delivery of the final report to the Federal Government on 31 January 2019, the Commission had finished its work. It recommended that coal-fired power generation be ended in Germany by 2038 at the latest, and at the same time showed how economic structural change in the affected regions could be successfully managed. On the basis of the final report, the Federal Government is working with the states affected to develop an overall structural policy approach to support the coal regions. On 22 May 2019, the key points for implementation of the structural policy recommendations of the Commission on Growth, Structural Change and Employment were approved by the Federal Cabinet. On 28 August 2019 the Federal Cabinet approved the bill for a 'Structural development act for the coal regions'. The structural development act is another important step towards ensuring that funds can be channelled into these areas and specific projects implemented. It is a strong signal of support for the regions affected by the phasing-out of coal-fired power generation.

To support the structural change, the lignite regions will receive financial aid of up to EUR 14 billion for

particularly important investments until 2038. Of these funds, 43% is earmarked for the Lausitz mining region, 37% for the Rhine mining region and 20% for the Central German mining region. The legal foundations for this funding will be created in the structural development act, to ensure the financial aid can flow in rapidly. The regions can use the grants to improve their economic conditions in a wide variety of areas, such as business-support infrastructure, improvements to local public transport, the broadband and mobility infrastructure, or for environmental protection and landscape management. Further details will now be settled swiftly in an administrative agreement with the lignite-mining states.

The government will also be supporting the regions through further measures in its own jurisdiction, such as expanding research and funding programmes or setting up federal institutions. In addition, the government aims to expand the transport infrastructures of the regions more quickly and intensively. A newly established high-level joint Federal Government / state panel chaired by the Federal Ministry of Economic Affairs and Energy will play a key role in ensuring a rapid flow of projects. A new funding programme, 'STARK', also aims to support the regions with non-investment, structurally effective expenditure. This programme is currently being developed by the Federal Ministry of Economic Affairs and Energy.

Support will also be given to the locations of hard-coal power plants, where coal is of considerable economic importance and which are structurally weak. The hard-coal sector is considered to be highly relevant if it has a value added share of more than 0.2% in a particular administrative district. In addition, the district of Helmstedt, as a former lignite location, can additionally benefit from structural assistance of up to EUR 90 million. Further details of the funding will be regulated in administrative agreements between the government and the states.

3.4.3.v. Description of measures to enable and develop demand response including those addressing tariffs to support dynamic pricing

3.4.3.v.1. Control and system stabilisation through increased cooperation between transmission and distribution system operators and market players

Network operators take decisions based on cost-benefit analyses regarding the network level at which system services are to be provided. The responsibilities of network operators and market players must be clearly defined, and data must be exchanged efficiently and securely. The Federal Government is continuing to work on smart control concepts aimed at ensuring that decentralised generators, storage facilities and loads can take on more system responsibility. There is also an increasing move towards the coordination of system stability at European level.

3.4.3.v.2. Dynamic electricity price agreements and smart meters

Under the revised directive on the internal electricity market, electricity generators should be able to offer dynamic electricity pricing agreements. End consumers who have installed a smart meter will have a legal entitlement to such agreements. Electricity consumers will be obliged to provide end consumers with information about the opportunities, costs and risks associated with a dynamic electricity pricing agreement. The national regulatory authority will monitor market progress in this area. The Member State or national regulatory authority will publish an annual report (covering a period of at least 10 years) on key developments relating to these agreements. Section 40(5) of Germany's Energy Industry Act obliges suppliers to offer an electricity tariff to end consumers which incentivises them to save energy or control energy consumption (insofar as technically feasible and financially reasonable).

3.4.3.v.3. Establishment of a core energy market data register

From early 2019 onwards, it is planned that the Federal Network Agency's core energy market data register will bring together the core data for all market players and grid-based power supply facilities in Germany's electricity and gas market in the form of a uniform online database.

3.4.3.v.4. Smart Meters Operation Act

The Smart Meters Operation Act has formed the legislative basis for the installation and operation of smart meters in Germany since 2016. It stipulates the roll-out of certified devices with a certificate issued by the Federal Office for Information Security, guaranteeing IT security and privacy by design. In order to maximise the benefits, the Smart Meters Operation Act standardises the Smart Meter Gateway as a communication platform for many different use cases (Smart Metering, Smart Grid, Smart Mobility, Smart Home, Smart Services) on the basis of comprehensive protection profiles and technical guidelines. The technical standards are subject to continuous further development along the standardisation roadmap developed by the Federal Ministry of Economic Affairs and Energy / Federal Office for Information Security[3]. Steps have been taken to ensure the efficiency of the roll-out: Statutory maximum price limits guarantee acceptance and cost-effectiveness. The roll-out begins with the assessment by the Federal Office for Information Security of the technical feasibility for each area of application. The precondition for this is that three mutually independent

[3] https://www.bmwi.de/Redaktion/DE/Pressemitteilungen/2019/20190129-roadmap-fuer-intelligente- energienetze-der-zukunft.html

manufacturers of Smart Meter Gateways have successfully passed certification. Two manufacturers are currently certified; further certificates are expected in the near future [subject to updates].

3.4.3.vi. Stronger regional cooperation

3.4.3.vi.1. Pentalateral Energy Form – Internal Energy Market
The aim of the Pentalateral Energy Forum is to achieve closer coupling between the energy markets of the participating countries, to test and implement new forms of cooperation and to gather experience in the field of cross-border cooperation while doing so. Germany participates in the drafting of the Regional Report on the Security of Supply (see also Section 3.3.i.).

3.4.3.vi.2. Electricity neighbours
Germany has been cooperating with its electricity neighbours in this way since 2014, primarily with a view to making the electricity markets more flexible. A further aim is to involve the country's electricity neighbours in the national debate on the energy transition.

3.4.3.vi.3. Cooperation in regional groups within the framework of the Trans-European Energy Networks (Trans-European Energy Networks – TEN-E Regional Groups) – Internal energy market
Germany is regarded as an affected Member State for four primary energy infrastructure corridors for electricity and therefore belongs to the corresponding TEN-E Regional Groups. These include the North Seas Offshore Grid (NSOG), North-South Electricity Interconnections in Western Europe (NSI West Electricity), North-South Electricity Interconnections in Central Eastern and South Eastern Europe (NSI East Electricity) and the Baltic Energy Market Interconnection Plan in Electricity (BEMIP Electricity, which should not be confused with the BEMIP Cooperation Forum described in Section 1.4.).

3.4.3.vi.4. German/French showcase project for cross-border energy system optimisation (Smart Border Initiative)
The German energy agency (dena) and the French energy agency (ADEME) are working together within the framework of the German/French Energy Platform on the implementation of a showcase project for system integration in the form of a cross-border smart grid. The 'Smart Border Initiative' focuses in particular on optimising the management of distribution networks in the Saarland-Lothringen region using a virtual management tool and a new physical connection at distribution network level. The planned smart grid ('Module 1') is also intended to feature interfaces and additional modules relating to e-mobility ('Module 2') and heating/energy efficiency ('Module 3'). dena is responsible for coordinating Germany's involvement in the project, and for negotiating with the project partners involved (primarily public authorities and companies in the energy sector). In 2017, the project was recognised as a project of common interest (PCI) after successfully completing the application procedure. Plans also exist to apply for funding under the 'Connecting Europe Facility' (CEF).

3.4.4. Energy poverty

3.4.4.i. Where applicable, policies and measures to achieve the objectives set out in Section 2.4.4

The Federal Government follows a comprehensive approach to fighting poverty which is not restricted to individual aspects of poverty, such as energy. Costs incurred by households for the purchase of energy are taken into account in the same way as other elements vital for subsistence. The existing legal regulations cover financial support for needy people both over a longer period of time and in specific emergency situations, such as when there is a threat of disruption to the supply. The precise structure of the regulations was explained in Chapter 2.4.4.

3.5. Research, innovation and competitiveness dimension

3.5.i. Policies and measures related to the elements set out in Section 2.5.

The Federal Government revises the relevant regulatory legislation on an ongoing basis in order to create a suitable regulatory foundation which makes it possible to bring innovative energy technologies to the market successfully. It also supports the transfer of research and market preparation through targeted funding measures.

Research

3.5.i.1. Seventh Energy Research Programme of the Federal Government

The Seventh Energy Research Programme of the Federal Government was adopted by the Federal Cabinet in September 2018. It lays the foundation for the energy research activities carried out by the Federal Ministry of Economic Affairs and Energy, the Federal Ministry of Education and Research and the Federal Ministry of Food and Agriculture. The Seventh Energy Research Programme is the outcome of a comprehensive upstream consultation process with stakeholders in the fields of science, economy and civil society. The Seventh Energy Research Programme covers five main topics:

- The energy transition in various consumption sectors: buildings and districts, industry, trade, commerce and services, and mobility and transport. In keeping with the guiding principle of 'Efficiency First', project funding in this area prioritises the efficient use of energy and reduced consumption.

- Energy generation: Wind and solar energy are the stand-out examples in this area, but other regenerative power generation technologies and low-emission thermal power plants also play a key role.

- System integration: the focus in this area is on networks, storage reservoirs and sectoral coupling as a new area of research. Within the framework of the planned national hydrogen strategy, the Federal Government will also be focusing on energy research. The efficient and affordable storage of renewable energies is a crucial research objective.

- Cross-system research topics: these include energy systems analysis, energy-relevant aspects of digitalisation, resource efficiency, carbon technologies and material research, as well as societal considerations.

- Nuclear safety research must be viewed in the context of the nuclear power phase-out.

Particular importance is attached to improving and accelerating the transfer of technology and innovation. To this end, 'real-life energy transition laboratories' will be established as a new pillar of research funding and financially strengthened. These projects are not only designed to be larger and to encompass more topics than previous demonstration projects; they will also provide opportunities (where relevant) for 'regulatory learning'. There is also an industrial policy dimension associated with 'real-life energy transition laboratories': value creation chains relating to key technologies for a low-emission energy system in Germany will be strengthened. Start-ups play a key role in transferring technology and innovation, and their access to research funding will therefore be maximised in future. Networking activities (in particular the Energy Research Networks) and the communication of research will also support the transfer of technology and innovation.

With a view to promoting networking at European and international level, the Seventh Energy Research Programme prioritises bilateral initiatives (particularly under Scientific and Technological Cooperation Agreements), well-established cooperation within Europe (SET Plan, EU framework programmes for research), cooperation under the IEA TCPs, cooperation with other international organisations, and cooperation under the international initiative Mission Innovation. Germany plans to continue its cooperation at international level in the field of nuclear safety research.

3.5.i.2. Avoidance of Climate-Relevant Process Emissions in Industry research initiative

More than one third of industrial emissions – that is, almost 8 per cent of Germany's overall greenhouse gas emissions – are caused by production processes in primary industry. A new research initiative is being launched in the field of industrial process emissions, through which Germany's primary industries will be enabled to research and develop processes and combinations of processes that contribute to the direct avoidance of greenhouse gases in key sectors such as iron and steel, cement and lime, chemicals and non-ferrous metals. In addition to the technological innovations, the funding guidelines also focus on economic conditions and the competitiveness of the methods developed, the optimisation of which is to be investigated by research.

3.5.i.3. Financial industry and climate protection

At the core of this field of action is developing the expertise of a strong and effective research community in Germany in the subject area of finance and climate protection. Under the Federal Ministry of Education and Research funding measure 'Economics of climate change', important current issues and debates will be examined, and specific subject areas and research questions identified in a joint process involving science, the real economy, the financial sector and politics. With the help of Federal Ministry of Education and Research funding, these issues will then be worked on in the medium to long term in broad-based research networks and concomitant networking and dialogue activities. The measure is to be implemented in several components staggered over time.

3.5.i.4. Climate Protection in Agriculture and Forestry research initiative

The aim of the research initiative is to enhance the sink function of soils and forests, develop strategies for land degradation-neutral use of soil and land, and develop climate-friendly farms, equipment and chains of

production. On the basis of existing research findings, innovative, comprehensive and systemic approaches and ways of doing things are to be developed in regions and fields of action that have particularly high and sustainable potential to contribute to climate protection in an effective way and in line with other sustainability targets. Transdisciplinary approaches will be pursued. The main emphases are on the systemic examination of agricultural operations and chains of production, soil management (including enhancement of the sink function (carbon sequestration) and reduction of greenhouse gas emissions, inter alia, when using fertiliser), forest, ACCESS for DPPN (plant-soil interactions to increase productivity and soil fertility, soil as a carbon sink), farming systems of the future, and the further development of sustainable dual and multiple use of land areas.

3.5.i.5. New Bioeconomy Strategy

The aim is to develop sustainably produced, bio-based products and bio-based production methods inter alia through the substitution of fossil-based products and for the recycling / reuse (reprocessing) of consumer goods for new products (cascading use, circular economy). New measures include cutting-edge technologies for the industrial bioeconomy (biohybrid technologies: electrobiosynthesis and photobiosynthesis for carbon use), funding phase 3 of the Zero-CarbFP Alliance (use of high-carbon waste streams as a material for the production of functional biomass and for the manufacture or recovery of recyclable materials using biotechnological processes) and microbial biofactories (carbon use in biotechnology).

3.5.i.6. Future Building programme's model project for experimental building work

The 'Future of construction' research funding is to be supplemented by a model project looking at experimental construction. Technical, architectural and organisational innovations for future-oriented and affordable construction will be trialled in practice, supporting their diffusion into general planning and construction practice. Funding will be offered for the implementation of sustainable, energy-efficient and affordable construction measures which apply technical, organisational or architectural innovations to address social challenges: energy transition, climate and environmental protection, conservation of resources, climate change impacts, demographic change, social participation. As a complement to the research initiative 'Building for the energy transition' (see Section 3.2.ii) under the Seventh Energy Research Programme, and to the 'real-life energy transition laboratories' measure, the model project looking at experimental construction will extend its examination to the entire lifecycle of buildings and to issues such as resource and spatial efficiency, sufficiency, generational fairness, and environmental and health protection.

3.5.i.7. Funding initiative 'Solar Construction/Energy-Efficient City'

Within the framework of the funding initiative 'Solar Construction/Energy-Efficient City', the Federal Ministry of Economic Affairs and Energy and the Federal Ministry of Education and Research will be promoting the energy transition in buildings and urban neighbourhoods. The focus here is on the efficient, system-based energy supply of neighbourhoods across sectors on the basis of renewable energies. The flagship projects address existing, redeveloped and new-build areas. The initiative, launched in mid-2017, has a total funding volume of EUR 120 million.

3.5.i.8. Research and observation of aerosols, clouds and trace gases as part of the European research infrastructure ACTRIS

A research partnership under the name ACTRIS is to be established at European level to research short-lived climate pollutants (SLCP) and airborne pollutants (including fine particulate matter and nitrogen dioxide). The main subject of the studies is the spatial and temporal distribution of these substances. The knowledge gained constitutes an important scientific basis for future policy decisions on measures in the areas of climate protection and air quality management. Measures relating to short-lived climate pollutants have the advantage that, because of the brief retention period of these greenhouse gases in the atmosphere, their impacts on the climate become apparent without significant delays. Use can be made of synergistic effects between climate protection and air quality management. Research institutions from 16 European countries have come together in ACTRIS. Germany is currently an observer. Numerous German research institutions are involved in the process. Closer networking of the leading European research institutions in the field of airborne pollutants and short-lived climate pollutants is in Germany's interests. The Scientific Council has judged the ACTRIS project as positive. The German research institutions involved in the process are characterised by a high level of scientific expertise.

Innovation and competitiveness

3.5.i.9. Further development of CCU/CCS options

Germany has already provided substantial amounts of funding for the further development of many different carbon capture and utilisation (CCU) research and development projects based on renewable energies. The Federal Government has outlined its own funding programmes for carbon capture and utilisation ('CO_2-Plus' and 'CO_2-WIN'); these programmes focus in particular on expanding the feedstock base. Germany also plays an active role in the ERA-Net Cofund ACT (Accelerating CCS Technologies) initiative, which funds large-scale projects as well as projects along the entire process chain of CCS and CCU technologies, i.e. carbon separation, transport, storage and use. Germany does not currently operate carbon storage facilities for

research purposes. Germany is a founding member and chair of the PHOENIX Initiative, which is intended to increase carbon valorisation in a European context. The capture of carbon from the atmosphere (DAC) is attracting more attention and will be funded as a carbon technology under the Seventh Energy Research Programme.

3.5.i.10. Carbon avoidance and utilisation in primary industries programme
The programme focuses on reducing emissions in primary industry.

Carbon Direct Avoidance (CDA):
The programme includes measures for CO_2 avoidance that will be implemented within a single project together with CCU / CCS and are therefore an integral part of a CCU / CCS measure. Innovative technologies that lead to a significant reduction in greenhouse gas emissions in primary industry will be incorporated into this programme.

Carbon Capture and Utilisation (CCU):
Approaches and technologies aimed at facilitating efficient carbon cycle management are also part of the programme; this includes technologies to capture and use CO_2 inter alia from the area of bioeconomy, but in particular also approaches that allow it to re-enter the circulation process after use.

Carbon Capture and Storage (CCS):
The vast majority of studies and scenarios have now confirmed that from today's perspective, CCS technology is vital for the achievement of greenhouse gas neutrality by 2050, because in the medium term it is a comparatively cheap option for reducing otherwise unavoidable process-related emissions created by primary industry. Many reduction strategies aimed at achieving the global temperature targets under the Paris Agreement also rely on what are known as negative emissions; the elements of the entire CCS process chain would also need to be available for this. A broad consortium comprising scientists, company representatives and representatives of NGOs has recently called for the prompt further development of CCS – accompanied by a discourse with the social stakeholders – to ensure the technology is available for these industries from 2030 (Acatech, September 2018); the deep substratum below the North Sea has extensive CO_2 storage capacities. The programme is aimed at facilitating the modification and scaling of carbon capture methods to industrial systems, the modelling and where applicable development of regional, supra-regional and potentially European CO_2 networks and standards for CO_2 flows in transport, European cooperation on the storage of CO_2 in the deep substratum below the North Sea, and a CCS dialogue process in the general context of carbon reduction technologies involving NGOs, associations, companies and the science fraternity. On the subject of CCS, please refer to the CCS report agreed by the Federal Government.

3.5.i.11. EU ETS Innovation Fund: further development of the NER300 programme
Research and development measures: Within the framework of European emissions trading, the NER300 programme (NER: New Entrants' Reserve), which supports investments in innovative low-carbon demonstration projects in the energy sector, has been in existence since 2011. The funding budget is supplied through the sale of 300 million EU ETS certificates. Funding under the NER300 programme focuses on innovative renewable energy technologies and carbon capture and storage technology (CCS). The existing programme is being developed further. In the future it will also encompass the industrial sector and will now be called the 'innovation fund'. The funding also aims to incentivise innovative low-carbon production processes with a demonstration character in the industrial sector, incl. carbon capture and utilisation (CCU), within the EU.

3.5.i.12. National decarbonisation programme

The measure is a funding programme in the area of development, demonstration and market launch. In order to reduce emissions in the industrial sector as far as possible, it is necessary to also substantially reduce or completely eliminate process-related GHG emissions that are unavoidable, or that can be avoided only with difficulty using current technology. For this purpose, key projects in the area of emission-intensive industries will be funded. These projects should address both applied R&D and the testing on an industrial scale and broad market introduction of mature technologies, and also consider their economic viability. The funding programme aims in particular to support the greatest possible reduction of GHG emissions in the production of emission-intensive goods, the optimisation of process chains, the conversion of processes to the use of renewable energy sources and raw materials, the substitution of emission-intensive goods, and technologies for the conversion of hydrogen and the use of CO_2. The funding programme will be implemented by the Competence Centre on climate change mitigation in energy-intensive industries, based in Cottbus. The Competence Centre on climate change mitigation in energy-intensive industries also acts as a think tank and a multisectoral, international and interdisciplinary knowledge platform for the topic of industrial decarbonisation.

3.5.i.13. 'Smart Energy Showcases – Digital Agenda for the Energy Transition' programme (SINTEG)

In parallel to the Energy Research Programme, the SINTEG Programme is aimed at the development and demonstration of solutions to the technical, economic and regulatory challenges posed by the energy transition; over 300 enterprises and other stakeholders will be involved in five large model regions ('showcases'). Priority will be given to safe and efficient procedures which are suitable for the mass market, innovative technologies, and market mechanisms for flexible and smart networks and markets. Digitalisation of the energy sector will be the main focus of attention. A further aim of the programme is to collect experiences from the field as a basis for future development of the legislative framework. This was the motivation behind the Federal Government's inclusion of time-limited 'experimentation options' in the SINTEG Regulation, which entered into force on 21 June 2017. The Regulation provides SINTEG participants with the opportunity to try out new technologies, procedures and business models (e.g. those relating to digitalisation and sectoral coupling) without suffering any economic disadvantages.

3.5.i.14. Act on the Digitalisation of the Energy Transition

Digitalisation is essential for achieving the climate protection goals. The Act on the Digitalisation of the Energy Transition provides the appropriate basis for cross-sectoral digitalisation. The further measures necessary for the implementation of this Act will be taken, principally the further development of the technical standards and the regulatory framework, for example for the better network integration of renewable energies and flexible loads.

3.5.i.15. Research and innovation agenda on the material use of carbon

This measure relates to the use of carbon from industrial emissions as a raw material to support a carbon-neutral circular economy for carbon. In today's world, the use of fossil carbon as a material is at the very heart of the chemical value creation chain. For example, the use of naphtha, obtained from petroleum, results in substantial CO_2 emissions over the entire lifecycle. The efficient use of CO_2 as a source of carbon in conjunction with renewable electricity can pave the way for a circular economy and significantly reduce the carbon footprint of industries and products. The research and innovation agenda is intended to bundle together promising research approaches, identify directions for future research ventures, and support avenues into industrial application.

3.5.i.16. Greater involvement of start-ups in energy research

Reducing energy consumption and greenhouse gas emissions requires moving away from existing technological pathways and developing new, innovative solutions. Start-ups often play a crucial role in the development of innovative ideas and solutions to problems. They are set to play a significant part in the success of the energy transition. However, up to now the conventional instruments and mechanisms of project funding have rarely been tailored to these players. The Federal Government therefore aims to better cater to start-ups with new and modified funding formats in the Seventh Energy Research Programme and to increase their participation in all subject areas of energy research. To achieve this, existing obstacles will be progressively removed: firstly, by expanding the content of the programme to include non-technical innovations (business models, new services) relating to new technical developments, and secondly, by adapting and speeding up the administrative procedures and introducing new, more agile project formats and the networking platform 'Start-ups research network'. Start-ups with innovative ideas for the energy transition will be provided with more straightforward avenues to start joint projects with partners from science and industry and will thus bring new impetus to energy research.

3.5.i.17. Battery research as part of the 'Battery Research Factory' umbrella concept

These measures aim to develop expertise and technology along the battery value-creation chain – from the material manufacture and the manufacturing processes of cell and battery production to the battery systems for various applications (inter alia e-mobility, stationary electricity storage, etc.). The umbrella concept brings together all existing funding measures and programmes on battery research under one roof and builds on existing expertise from established locations throughout Germany. Implementation of the measures is intended to create sustainable structures to lay the foundations for battery cell production using both current concepts with liquid electrolytes and prospective concepts such as solid-state batteries or post-lithium era approaches. The focus of the research work is on increasing energy density and fast charging capability, security and lifespan, as well as aspects of the circular economy such as recycling and the substitution of critical or toxic raw materials. Top-of-the-range battery research activities and the number of battery researchers in Germany are to be increased. The findings will be validated and demonstrated on a large scale in a 'Battery cell research production' process. This will serve to develop a one-of-a-kind innovation pipeline for the battery. Research into other battery concepts for use in stationary storage systems, such as redox flow batteries (e.g. on the basis of organic electrolytes) and their further development will also be funded.

3.5.i.18. Key areas of mobility: A) Urban mobility B) Systemic barriers to innovation in climate protection

The development of sustainable and effective mobility concepts, linked to social and technological innovations on the basis of a systemic perspective. Effective starting points for decarbonisation are to be identified by analysing the interplay of mobility flows, infrastructure networks, value creation chains, urban and spatial planning, and individual and social requirements. The funding aims, on the one hand, at the development and

practical testing of climate-friendly mobility innovations, inter alia in real-life laboratories and (regulatory) experimental spaces. Secondly, it aims to create a solid basis for long-term innovation and transformation management. Two sub-measures:

- urban mobility of people, and
- systemic barriers to innovation for climate protection, linked to the results of the National Platform on Mobility (NPM).

3.5.i.19. Digital Innovation Hub for Climate

Initiation and financing of a Digital Innovation Hub for Climate, focusing on forging connections between industry, science and politics. Strengthening application-oriented research & development in the field of climate protection through exchange on digital innovations and the use of digital technologies in climate protection and the development of business models.

3.5.i.20. Green ICT: research and development for reducing the carbon footprint of digital technologies

The aim is to develop technological solutions to reduce the carbon consumption of digital technologies. There is already considerable potential for climate protection in reducing the energy consumption of information processing and information storage components such as processors or server farms (clouds) and the related communication technologies (ICT). New digital applications are currently emerging, particularly in the area of 'Big Data', the Internet of Things and artificial intelligence, that will further drive the need for computing power for data evaluation. In view of the rapidly growth in use of these technologies in the industrial sector, it is essential that technological solutions be developed to enhance the energy efficiency of ICT. There are joint initiatives with the European Union, for example with the European Processor Initiative (EPI), that need to be expanded.

3.5.ii. Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context

European energy research cooperation

3.5.ii.1. Strategic Energy Technology Plan (EU SET Plan)

Germany plays an active role in shaping the future of European energy research under the EU SET Plan. Its representatives participate in the thematic working groups within which strategies are defined for closer cooperation on various technologies. The outcomes of the relevant working groups feed into the selection and further development of national funding priorities and were taken into account in the Seventh Energy Research Programme. One of the main objectives of the SET Plan is the stepping up of cooperation with other Member States. The Energy Research Programme contains provisions intended to strengthen cooperation at European level, inter alia under the aegis of the SET Plan. The research areas of the SET Plan areas are being dealt with in European cooperation, partly on the basis of the 'Berlin model' (separate funding applications are submitted to the relevant national funding bodies) and, where appropriate, through joint funding announcements. Cooperation of this kind has taken place in recent years with Finland, Austria, Switzerland, the Netherlands and Denmark in particular. For the period 2022-2030, consolidation of the funds and potentially a moderate growth is envisaged. In the relevant Council working groups, Germany is actively driving forward the realisation of implementation plans, developed as part of the SET Plan, relating to 12 technology fields. These are: Photovoltaics, CSP, offshore wind, geothermal energy, consumers, smart cities, energy systems, energy-efficient buildings, energy-efficient industry, batteries, renewable fuels and bioenergy, and CCUS.

3.5.ii.2. European Research Area (ERA-NET) Cofund

The Federal Government is involved in several cooperation projects under ERA-NET Cofund, which is a Horizon 2020 funding instrument that supports partnerships between research institutions. The specific goal is the strategic coordination of national programmes, with a joint call for tenders serving as the basis for funding of transnational research or innovation projects. Cooperation projects are currently under way in the energy sector in the fields of geothermal energy, carbon capture, utilisation and storage (CCUS), networks, and renewable energies (wind energy, photovoltaics, bioenergy).

Regional/bilateral cooperation

In addition to cooperation based on the 'Berlin model', the following individual initiatives have been set up:

3.5.ii.3. Cooperation between the North Sea coastal states in the area of energy research

The Federal Government is involved in cooperation between the North Sea coastal states in the area of energy research with a view to developing internationally accepted standards for the operation of test benches for research and development purposes, inter alia with a view to ensuring that field measurements can be

replaced (at least in part) by test bench measurements in the medium term.

3.5.ii.4. Cooperation on CCUS with other North Sea coastal states

Within the framework of the North Sea Basin Task Force (NSBTF), Germany and the other North Sea coastal states investigate scientific, technical, legal, economic and political issues relating to CO_2 storage below the North Sea and matters relating to the use of CO_2.

3.5.ii.5. Greek/German Research Cooperation and Funding of Early-Stage Researchers

Energy research is one of several pillars of research cooperation between Germany and Greece and has been / will be the subject of two consecutive bilateral funding announcements. Funding is awarded for projects focusing on the production, storage and efficient use of renewable energy, and the sustainable and efficient supply of heating and cooling.

3.5.ii.6. French/German Fellowship Programme

The Fellowship Programme 'Make Our Planet Great Again – German Research Initiative' (MOPGA–GRI) is a funding programme set up by the Federal Government in parallel to the French initiative of the same name. The aim of this programme is to give well-known researchers and promising early-stage researchers from abroad the opportunity to carry out research at German universities and research institutions. The initiative focuses not only on climate and earth systems research, but also on energy research. Five fellows with junior research groups are being funded.

3.5.ii.7. French-German research funding for sustainable energy supply in Europe

Further to a decision taken by the 19th German/French Ministerial Council, a bilateral funding announcement on energy conversion, storage reservoirs and Smart Grids was published in October 2018. Since October 2019, joint research projects have been developing innovations for an efficient, affordable and environmentally sound power supply based on renewable energies for France, Germany and Europe. These projects take a systemic approach not only to technical matters, but also to the economic and societal challenges associated with the energy transition in Europe.

3.5.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Research

3.5.iii.1. Seventh Energy Research Programme

The Seventh Energy Research Programme was adopted by the Federal Cabinet in 2018. Under the Seventh Energy Research Programme, the Federal Government is planning to make around EUR 6.4 billion in total available between 2018 and 2022 for research, development, demonstration and testing in the field of future-proof technologies and concepts. This represents an increase of around 45% compared to the previous period (2013-2017). For the period 2022-2030, it is planned that energy research will be stepped up.

3.5.iii.2. EU Framework Programme for Research and Innovation 'Horizon 2020'

Germany is more committed than any other country to tackling the societal challenge of 'Clean, safe and efficient energy' under Horizon 2020. The Federal Government supports the involvement of German researchers in consortia and their applications for EU funding via the National Contact Point (NCP) for Energy. NCP information and advice campaigns help research and industry stakeholders to make appropriate use of the comprehensive and complex opportunities offered by Horizon 2020. In the interests of ensuring that Europe's ambitious energy and climate goals can be achieved, the range of topics covers not only basic research options, but also technology-oriented development topics and back-up measures for product launches and market share growth. The involvement of citizens (as consumers) and relevant socioeconomic aspects are also playing an increasingly important role in this respect.

Innovation and competitiveness

3.5.iii.3. Boosting Germany's status as a research location for energy storage technology

The Federal Government is planning to provide research funding and subsidies for energy storage technologies with a view to boosting Germany's reputation as a location for battery cell production. Plans also exist to set up a new Fraunhofer Institute for Storage Technologies.

3.5.iii.4. New construction techniques and materials for a low-emission industry

As part of the technology transfer programme for lightweight construction, the Federal Ministry of Economic Affairs and Energy funds the material and industry sector-related transfer of technology and knowledge, having regard to closed cycles with a focus on material efficiency and carbon savings. This is to be funded within the framework of a funding line attached to the Federal Ministry of Economic Affairs and Energy's technology transfer programme for lightweight construction. The resources provided by the Energy and Climate Fund complement the existing funding programme for lightweight construction. Within the scope of

the existing budget monies, supplementary funding will be provided for technology transfer and lightweight construction projects with policy priority and a degree of urgency in their timing which will directly result in significant carbon savings, and at the same time serve the purposes of energy efficiency and climate and environmental protection required under the Energy and Climate Fund Act. The production of basic materials is usually resource-intensive and energy-intensive. Using materials and resources efficiently can therefore not only open up enormous potential for savings and product improvements, but also significantly reduce climate and environmental impacts. The potential contribution of material and resource efficiency to achieving the Paris climate goals has hitherto been given too little attention in national and international climate strategies. If primary resources are not used at all, emissions and resource consumption will immediately be reduced. Recycling and circular, digitally interlinked and closely cooperating value creation chains also open up fresh perspectives and new dimensions for resource and material efficiency. If the associated potentials are to be exploited, designers are needed for new material- and resource-efficient products, processes and business models, as are product manufacturers who are able to incorporate these new scenarios into their product development processes. New design solutions for resource-efficient propulsion systems, system elements and equipment using multifunctional materials can substantially reduce the proportion of greenhouse gas emissions. Under this programme, approaches for a material-efficient and resource-efficient industrial sector are to be developed and implemented jointly with relevant companies and research institutions. The programme follows a holistic implementation strategy that, in addition to funding research and innovations, is also able to include the market introduction and dissemination of new technologies, and if required the provision of the necessary infrastructures. The funding focuses on:

Construction methods that use materials efficiently:
A major driver for increasing material efficiency and resource efficiency is the use of innovative and weight-saving construction and manufacturing techniques. It is crucial that reducing greenhouse gases is factored in at the product design stage. A holistic approach, taking into account the idea of a lifecycle, is therefore vital for measures relating to material efficiency and resource efficiency. The objectives of a low-carbon and resource-efficient circular economy in the industrial sector are pursued in the sense of a lifecycle.

New materials:
New materials enable usage that is precisely tailored to the relevant field of application. This means that resources can be saved and greenhouse gas emissions reduced. In addition, new materials offer the possibility of capturing and sequestrating CO_2 in the long term. For example, high-quality biogenic carbon fibres could be produced by sequestration of carbon (making a dual contribution to climate protection through long-term sequestration of carbon and reducing weight and emissions). Here, too, managing the circulation cycle plays an important role.

3.5.iii.5. 'SME-innovative' research funding initiative (energy efficiency and climate protection)

SMEs provide significant impetus for climate protection and energy efficiency. They are a central pillar for innovation and employment in our country. With 'KMU-innovativ', its innovation programme for SMEs, the Federal Ministry of Education and Research offers small and medium-sized companies (SMEs), as being in the vanguard of technological progress, the opportunity to successfully survive on the market with new products and processes relating to climate protection and energy efficiency. The funding initiative is used by SMEs across Germany. Given the growing importance of the issue of climate protection, in the revised version of the funding guidelines a specific reference has also been included to the Climate Action Plan 2050, in order to mobilise SMEs even more effectively in favour of this topic.

Section B: Analytical basis

4. Current situation and projections with existing policies and measures

The scenario shown here (together with the current policies and measures) will henceforth be referred to as the baseline scenario. In this context, the phrase 'current policies and measures' refers to policies and measures implemented or adopted before 31 December 2017.

The calculations shown here are largely based on the results of the report, 'Energy projections and impact assessments for 2030/2050', which was published by the Federal Ministry of Economic Affairs and Energy on 10 March 2020. The results of the baseline scenarios presented here are categorically not to be taken as adopted by the Federal Government. Scenarios which extend until 2030 and 2040 are fraught with uncertainties. For example, the effects of the spread of the Corona virus on the economy and energy industry could not be foreseen in the available scenario analysis, as these effects only became apparent after the analysis work had been completed.

In general, different developments are predicted in different scenarios depending on the assumptions and methods used, including assumptions regarding the implementation of current policies and measures. This is where the uncertainties which naturally exist for a forecasting period of 10 years or more reveal themselves. Thus the various studies and projections which have been developed for the Federal Government arrive at individually differing results. The Federal Government will therefore also include other scenarios in its future considerations in addition to the present scenarios. It must also be borne in mind that the breakdown by sectors in the system of EU reporting differs from the national system of the Climate Action Plan 2050.

4.1. Projected evolution of the main exogenous factors influencing the energy system and GHG emission developments

4.1.i. Macroeconomic forecasts (GDP and population growth)

The population changes assumed in the projections are based on the updated data in the 13th Coordinated Population Projection by the Federal Statistical Office, higher immigration scenario (Federal Statistical Office 2017). This updated population scenario is based on higher growth at the current margin. The population will reduce in size after 2020. Nevertheless, it will be 3.2% larger in 2030 than in 2010. By 2040, the population will drop to 81.3 million. Changes in household structure mean that the average household size will drop, and the number of households will increase until 2040 (+9.2% compared to 2010).

Macroeconomic developments

A higher economic growth rate than that prescribed in the EU Guidance has been used as a basis for the period through to 2020. The Federal Government's projections also differ from the figures available when analytical work began. The average growth rate in the baseline scenario is 1.7% until 2020, 1.3% until 2025 and 1% between 2025 and 2030. GDP will increase by 32% between 2010 and 2030. The average growth rate assumed for the period 2030-2040 is 0.9%. GDP will rise to EUR 3 744 billion by 2040 (+45% compared to 2010).

4.1.ii. Sectoral changes expected to impact the energy system and GHG emissions

Table B1: Assumptions regarding economic and population growth, GDP in real prices

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
GDP in billion EUR_{2015}	3 355	3 398	3 441	3 485	3 531	3 712	3 355	3 398	3 441	3 485	4 068
GDP in billion EUR_{2016}	3 371	3 414	3 456	3 500	3 547	3 583	3 620	3 657	3 693	3 728	4 087
Population in thousands	83 453	83 434	83 402	83 364	83 316	83 241	83 169	83 080	82 971	82 868	81 293

Sources: GDP figures based on Öko-Institut, Prognos, Fraunhofer Institute for Systems and Innovation Research (2017; extrapolation); population figures based on data from the Federal Statistical Office (13th Coordinated Population Projection – baseline 2016, variant 2-A, increased immigration)

This calculation does not correspond to the Federal Government's current projections. The figures used are slightly below the values for the Federal Government's 2020 spring projection. When analytical work started in autumn 2017, it became clear that growth rates in Germany had been slightly higher than assumed in the

EU Guidance (2016). The projections by the German Bundesbank (2017, Macroeconomic Forecasts 2017/18 and Outlook to 2019) have therefore been used for the period until 2019, followed by the growth rates prescribed in the EU Guidance (with a time lag).

The scenario assumes that value creation in non-energy-intensive sectors of the industry will grow significantly faster than in energy-intensive sectors between now and 2030/2040 (Table B2). The share of energy-intensive sectors in Germany's gross value creation will therefore drop steadily. This does not allow any direct conclusions to be drawn regarding the absolute level of energy consumption and GHG emissions, however. Since value creation is also rising in energy-intensive sectors and production quantities are either not decreasing at all or only decreasing by a negligible amount, companies must become more energy-efficient in order for absolute energy consumption to be reduced.

Table B2: Structural changes – gross value added by manufacturing (industry) including mining by sector, in billion EUR, real prices 2016

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Energy-intensive sectors*	**117**	**118**	**118**	**118**	**119**	**119**	**119**	**119**	**119**	**119**	122
Non-energy-intensive sectors**	**571**	**579**	**587**	**595**	**604**	**611**	**617**	**624**	**630**	**636**	708
Total* **	**689**	**697**	**705**	**714**	**723**	**730**	**737**	**743**	**750**	**756**	830

* Mining; wood, paper, printing; chemicals; glass, ceramics, quarrying; metal production
** excluding coking, mineral oil processing
*** Total value may differ from the sum of the individual values due to rounding.
Source: Extrapolation by Öko-Institut, Prognos, Fraunhofer Institute for Systems and Innovation Research (2017), based on data from the Federal Statistical Office

4.1.iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

ETS carbon prices show the same trends in the scenarios as in the EU's previous baseline scenario from 2016. The certificate price will rise to EUR 35 per tonne of CO_2 by 2030, and EUR 52 by 2040 (real prices, baseline year 2016). The world market energy prices used as a basis are also identical to those in the EU baseline scenario (Table B3). A decoupling of coal and gas prices from oil prices has been observed in recent years. At the same time, energy prices have risen much less rapidly than expected. The scenario assumes that oil, coal and gas prices will continue to rise slightly after 2020. The current effects of the spread of the Corona virus on international energy markets and prices could not be taken into account in this analysis, as the extensive analytical work had already largely been completed by this time and the future effects currently cannot yet be conclusively estimated. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

Table B3: Development in the cross-border prices for crude oil, natural gas and coal during the period and carbon prices 2021 to 2030, real prices 2016

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Brent crude oil in EUR 2016/MWh Hi	49	51	52	53	54	56	57	58	59	60
Hard coal in EUR 2016/MWh Hi	9	10	10	11	11	11	12	12	13	13
Natural gas in EUR 2016/MWh Hi	29	29	29	30	30	31	31	32	33	33
ETS certificates in EUR 2016/EUA	17	19	20	22	23	26	28	30	33	35

Sources: Extrapolation by Öko-Institut, Prognos, Fraunhofer Institute for Systems and Innovation Research 2017

4.1.iv. Technology cost developments

The assumed cost developments for electricity generation and distributed heating technologies are described in Table 4 (costs at the point in time when the technology is put into operation). In the case of technologies which use fossil fuels to generate electricity, no further cost degression is expected after 2020. Investment costs will, however, continue to drop for renewable energies. The largest cost reductions between 2020 and 2030 will be observed for offshore wind (-24%) and roof-mounted PV (-23%). Storage technologies will also drop in price, with the costs for domestic batteries reducing by around one third in the period 2020-2030. Nuclear energy is not an available option in the baseline scenario beyond the phase-out pathway, and so the costs are not shown.

In the case of heat generation in buildings, a cost degression of 0.35% a year is assumed for technologies based on renewable energies. No further reduction in costs is assumed in the case of fossil fuel systems. The costs per kW will drop as the heat output of these systems rises, reducing the specific costs for large buildings.

Table B4: Development of technology costs for electricity and heat generation, euro per kW, real prices

Technologies	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity generation										
Lignite	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800
Hard coal	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500
Natural gas – gas and steam	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000
Natural gas – gas turbines	550	550	550	550	550	550	550	550	550	550
Onshore wind (strong winds)	1 190	1 180	1 170	1 160	1 150	1 140	1 130	1 120	1 110	1 100
Offshore wind	2 440	2 380	2 320	2 260	2 200	2 160	2 120	2 080	2 040	2 000
Photovoltaics – free-standing	640	630	620	610	600	590	580	570	560	550
Photovoltaics – roof-mounted systems	1 090	1 080	1 070	1 060	1 050	1 040	1 030	1 020	1 010	850
Battery (per kWh)	435	420	405	390	375	360	345	330	315	300
Alkaline electrolyser*	862	846	830	813	797	781	765	749	733	717
SOEC electrolyser*[1]	1 947	1 895	1 843	1 790	1 738	1 686	1 634	1 582	1 529	1 477
PEM electrolyser*[2]	1 571	1 531	1 492	1 452	1 413	1 373	1 334	1 295	1 255	1 216
Heat production										
(a) small buildings (12-15 kW)										
Gas-fired	665	665	665	665	665	665	665	665	665	665
Heating oil-fired	800	800	800	800	800	800	800	800	800	800
Biomass	1 365	1 360	1 355	1 351	1 346	1 341	1 337	1 332	1 327	1 323
Heat pumps – air	1 365	1 361	1 356	1 351	1 346	1 342	1 337	1 332	1 328	1 323
Heat pumps – brine	2 264	2 256	2 248	2 240	2 232	2 225	2 217	2 209	2 201	2 194

Technologies	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
(b) large buildings (35-40 kW)										
Gas-fired	385	385	385	385	385	385	385	385	385	385
Heating oil-fired	425	425	425	425	425	425	425	425	425	425
Biomass	800	797	794	791	789	786	783	780	778	775
Heat pumps – air	943	940	937	933	930	927	924	920	917	914
Heat pumps – brine	1 519	1 514	1 509	1 504	1 498	1 493	1 488	1 483	1 477	1 472

*) only in the Climate Protection Programme scenario 2030 (Section 5)
1 SOEC: solid oxide electrolysis cell
2 PEM: proton exchange membrane
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy 2020

The costs per passenger car assumed in the baseline are shown in Table B5. The costs for the fossil fuels used for propulsion purposes in passenger cars will increase slightly over time because of increases in energy efficiency. Technology costs will drop for electric and hybrid drives, primarily as a result of battery development. The costs for electric and hybrid vehicles will remain higher than conventional vehicles until 2030; in the longer term, investment costs for battery electric drive systems could however be much lower than for drive systems based on liquid or gaseous fuels.

Table B5: Changes in technology costs in the passenger car sector in the baseline scenario, vehicle costs in thousand euro, real prices 2016

Technologies	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Petrol	23.1	23.1	23.1	23.2	23.2	23.2	23.2	23.3	23.3	23.3
Diesel	25.4	25.4	25.5	25.5	25.5	25.5	25.6	25.6	25.7	25.7
Hybrid	28.9	28.7	28.6	28.5	28.4	28.3	28.1	28.0	27.9	27.8
Natural gas/bivalent	25.4	25.5	25.5	25.5	25.6	25.6	25.7	25.7	25.8	25.8
Electric	26.0	25.6	25.2	24.9	24.7	24.5	24.4	24.2	24.1	24.0
Plug-in hybrid	27.3	26.8	26.5	26.2	26.0	25.8	25.6	25.5	25.3	25.2

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy 2020

The costs for heat sources and passenger cars postulated here are higher than those used for example by the European Commission in the 2016 reference scenario (PRIMES model). Significant discrepancies can be identified, in particular for heat sources. Potential reasons include the treatment of taxes (the costs for heat sources used in this report include VAT), the performance class under consideration (the costs per kW drop as performance improves), the treatment of structural costs and country-specific price differences.

4.2. Decarbonisation dimension

4.2.1. GHG emissions and removals

4.2.1.i. Trends in current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors

Annual greenhouse gas emissions for the period 2010-2018 are shown in Table B6. The values and sectoral demarcations are taken from the GHG inventory (Federal Environment Agency 2019). In line with international

conventions, LULUCF emissions and international transport emissions are not included in the total. A total of 858 million tonnes CO_2eq was emitted in 2018. This represents a reduction of 31% compared to the baseline year of 1990.

Table B6: Greenhouse gas emissions by sector for 2010 to 2018, in million tonnes CO_2eq

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy-related emissions	**802**	**778**	**785**	**802**	**762**	**767**	**770**	**752**	**720**
Energy industry	356	354	364	367	348	336	333	312	295
Industry	126	123	118	119	118	127	129	132	130
Transport	154	157	155	159	160	163	166	169	164
Private households	107	91	95	101	84	88	89	88	84
Commerce/trade/services, others*	48	43	41	45	42	43	42	42	39
Fugitive emissions	11	11	12	11	10	10	10	10	9
Non-energy-related emissions	**141**	**142**	**140**	**140**	**140**	**139**	**139**	**142**	**138**
Industrial processes	63	62	62	61	61	60	62	66	65
Agriculture	64	65	65	66	67	68	66	66	64
Waste	15	14	13	12	12	11	11	10	10
Total	**942**	**919**	**924**	**942**	**902**	**906**	**909**	**894**	**858**
For information only: LULUCF	-20	-19	-29	-27	-28	-28	-28	-27	-27
For information only: international air and sea transport	33	32	33	33	31	32	35	36	35

*in particular construction and military
Source: GHG inventory, Federal Environment Agency 2020

Annual greenhouse gas emissions can be divided by emissions into ETS and other non-ETS sectors (as shown in Table B7). The level of emissions is currently approximately the same for both sectors (ETS and non-ETS). Emissions from European air transport are also covered by the emissions trading scheme. They are shown separately since they are not relevant to the achievement of national targets. Only domestic air transport is included in calculations for this purpose.

Table B7: Greenhouse gas emissions by ETS and non-ETS for 2010 to 2018, in million tonnes CO_2eq

	2010	2011	2012	2013	2014	2015	2016	2017	2018
ETS emissions without international air transport	**473**	**469**	**473**	**475**	**456**	**454**	**453**	**438**	**422**
Non-ETS emissions	**469**	**451**	**451**	**460**	**437**	**444**	**454**	**467**	**434 provisional**

Total	**942**	**919**	**924**	**942**	**902**	**906**	**909**	**894**	**858**
For information only: emissions from international air transport*	**24**	**23**	**25**	**26**	**25**	**24**	**26**	**29**	**30**

* not relevant to the achievement of national targets

Sources: ETS emissions: German Emissions Trading Authority (2011–2019; VET reports), Non-ETS emissions: Annual reports of the EU ESD inventory reviews, Total emissions: Official reports according to EU MMR (data status 15.1.2020), data for 2019: https://www.umweltbundesamt.de/presse/pressemitteilungen/treibhausgasemissionen-gingen-2019-um-63-prozent

4.2.1.ii. Projections of sectoral developments with existing national and Union policies and measures at least until 2040 (including for the year 2030)

The results by sector for the projections for the baseline are described in Table B8. Total GHG emissions without international transport and LULUCF emissions decrease by 2030 to 731 million tonnes CO_2eq. Compared to 1990, this corresponds to a reduction of approx. 41%. The largest reductions in the period 2015 to 2030 are in the energy sector (-25%) and private households sector (-28%). The reduction in the transport sector and agriculture sector is comparatively small (-9%).

Table B8: Greenhouse gas emissions by sector for 2021 to 2040, in million tonnes CO_2eq

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Energy-related emissions	**703**	**706**	**710**	**707**	**694**	**675**	**658**	**647**	**628**	**615**	**499**
Energy industry	292	299	308	309	302	289	278	273	260	252	192
Industry	116	115	114	113	112	111	110	109	108	106	99
Transport	163	163	162	161	160	158	155	153	151	148	122
Private households	79	76	74	73	71	69	67	66	64	63	51
Commerce/trade/services, others	44	43	42	41	40	40	39	38	37	36	30
Fugitive emissions	9	9	9	9	9	9	9	9	9	8	7
Non-energy-related emissions	**127**	**126**	**124**	**123**	**122**	**121**	**120**	**119**	**118**	**117**	**111**
Industrial processes	56	55	54	53	52	52	51	50	50	49	46
Agriculture	63	63	63	63	63	63	62	62	62	62	61
Waste	8	8	8	7	7	7	6	6	6	5	4
Total	**830**	**831**	**834**	**830**	**816**	**796**	**778**	**766**	**746**	**731**	**611**
For information only: LULUCF	30	29	28	27	26	25	24	23	22	21	20
For information only: international air and sea transport	42	43	44	45	45	46	47	48	48	49	50

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

The projections for annual greenhouse gas emissions subdivided by emissions in the ETS sectors and the other Non-ETS sectors are shown in Table B9. The conventions described for Table B7 apply.

Table B9: Greenhouse gas emissions by ETS and non-ETS for 2021 to 2040, in million tonnes CO_2eq

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
ETS emissions without international air transport	412	419	427	428	420	407	396	390	377	369	306
Non-ETS emissions	418	413	408	402	396	389	383	376	369	363	305
Total	**830**	**831**	**834**	**830**	**816**	**796**	**778**	**766**	**746**	**731**	**611**
For information only: emissions from international air transport*	42	43	44	45	45	46	47	48	48	49	50

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

4.2.2. Renewable energy

4.2.2.i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

The share of renewables in energy consumption is shown in Table B10. Between 2010 and 2018, the share of renewables in gross final energy consumption rose by around five percentage points to 16.5%. Substantial differences can, however, be identified between the various sectors and applications during this period. The main driver for the rising share of renewables in total gross final energy consumption was the electricity sector. The increase in this sector was much more rapid than in the heating and cooling sector. The share of renewables in total fuel consumption dropped in the transport sector (on a national statistics basis). Although fuel consumption rose slightly, the use of biogenic fuels fell from 2012 onwards. The amount of renewable electricity used in the transport sector is still negligible.

Table B10: Share of renewable energy until 2018, as a percentage

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Electricity (Directive 2009/28/EC)	**18.3**	**21.0**	**23.6**	**25.3**	**28.2**	**30.9**	**32.3**	**34.6**	**38.0**
Electricity (national statistics)[1]	**17.0**	**20.4**	**23.5**	**25.1**	**27.4**	**31.5**	**31.6**	**36.0**	**37.8**
Onshore wind	6.2	8.1	8.4	8.5	9.6	12.1	11.3	14.6	15.2
Offshore wind	-	0.1	0.1	0.2	0.2	1.4	2.0	2.9	3.3
Photovoltaics	1.9	3.2	4.3	5.1	6.1	6.5	6.4	6.6	7.7
Hydropower	3.4	2.9	3.6	3.8	3.3	3.2	3.4	3.4	3.0
Biomass	4.7	5.3	6.3	6.6	7.1	7.4	7.5	7.5	7.5
Biogenic fraction of waste	0.8	0.8	0.8	0.9	1.0	1.0	1.0	1.0	1.0

Transport (Directive 2009/28/EC)	**6.4**	**6.5**	**7.3**	**7.3**	**6.9**	**6.6**	**7.0**	**7.0**	**7.9**
Transport (national statistics)[2]	**5.8**	**5.7**	**6.0**	**5.5**	**5.6**	**5.2**	**5.2**	**5.3**	**5.6**
Biodiesel (including HVO and vegetable oil)	4.1	3.8	4.0	3.5	3.6	3.3	3.2	3.3	3.4
Biogenic petrol	1.4	1.4	1.5	1.4	1.4	1.4	1.3	1.3	1.3
Biomethane	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Renewable energies – electricity	0.3	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
Heating and cooling (Directive 2009/28/EC)	**12.1**	**12.6**	**13.4**	**13.4**	**13.4**	**13.4**	**13.0**	**13.4**	**13.6**
Heating and cooling (national statistics)[3]	**12.4**	**12.9**	**14.2**	**14.1**	**14.1**	**13.9**	**13.5**	**13.7**	**14.3**
Biomass and renewable waste	11.5	11.8	12.9	12.8	12.6	12.3	11.9	11.9	12.3
Other renewable energies									
(solar thermal, geothermal, ambient heat)	0.9	1.1	1.2	1.3	1.6	1.6	1.7	1.7	2.0
Total gross final energy consumption (Directive 2009/28/EC)	**11.4**	**12.4**	**13.6**	**13.8**	**14.3**	**15.1**	**14.8**	**15.9**	**16.5**
Total gross final energy consumption (national statistics)	**11.7**	**12.5**	**13.6**	**13.8**	**14.4**	**14.9**	**14.9**	**15.5**	**16.5**

1 with certain deviations from Directive 2009/28/EC (inter alia without standardisation of hydropower and wind power and with total electricity generated from biomass)
2 with certain deviations from Directive 2009/28/EC (inter alia without multiple recognition of biofuels and electricity)
3 with certain deviations from Directive 2009/28/EC (inter alia without grid losses and district heat, and with total final energy consumption from biomass for heating and cooling).
Minor discrepancies are the result of rounding differences.
Source: Federal Environment Agency (2020)

4.2.2.ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

The baseline scenario is predicated on the assumption that certain political instruments which have differing effects on the use of renewables will remain in force, and so the individual sectors show different trends for the period from 2020 onwards. For example, the baseline scenario assumes that the Renewable Energy Sources Act and the Energy Conservation Regulation will continue to apply in their present form. Continued application of the Renewable Energy Sources Act will have a significant impact on the share of renewables in the electricity sector. The assumed future growth of renewables in the baseline scenario is based on the expansion corridor targets outlined in the 2017 version of the Renewable Energy Sources Act. On the basis of the expansion corridor targets, the annual gross increase for onshore wind is expected to be 2 800 MW between now and 2020 and 2 900 MW from 2020 onwards. The annual increase for offshore wind is expected to be 500 MW in 2021 and 2022 and 700 MW between 2023 and 2025. The increase will accelerate to 840 MW a year from 2026 onwards. The Renewable Energy Sources Act 2017 assumes an annual gross increase in photovoltaics of 2 500 MW.

The share of renewables in gross electricity consumption rises in the baseline scenario to 53.7% (53.3% according to national statistics) by 2030. The Federal Government is pursuing the goal of increasing the share in gross electricity consumption to around 65% by 2030. The challenge in this respect is to achieve better

synchronisation of renewables and grid capacities. The measures which need to be implemented within the transmission system in order to ensure that the electricity grids have the necessary capacities in this respect will be investigated when the Network Development Plan 2019-2030 is produced. In autumn 2019, the Federal Government reiterated the 65% target in the Climate Action Programme 2030 and set technology-specific goals for growth, subject to the condition that the planning and approval procedures for onshore wind and grid expansion be accelerated. The Renewable Energy Sources Act will be amended in 2020. For this, the Federal Ministry of Economic Affairs and Energy will put forward a draft and plans to make the necessary adjustments to goals and trajectories within this framework.

Decisive factors affecting actual installed renewable energy capacity include not only the gross expansion referred to above, but also the dismantling of existing plants. Onshore and offshore wind farms are assumed to have a service life of 20 years. The baseline scenario is predicated on the assumption that these plants will not continue to be operated when the guaranteed feed-in tariff is no longer paid. An average service life of 25 years is assumed for photovoltaic systems, with decommissioning operations being distributed evenly over the 10-year period after the end of the 20-year guaranteed feed-in tariff period. In concrete terms, this means that all installed plants will have been decommissioned after 30 years, but the first will be decommissioned after 20 years and the average will be 25 years.[4]

According to the baseline scenario, the share of renewables in the transport sector will gradually increase until 2030 to 15.2% (EU statistics with multiple recognition; national statistics 7.5%). This is due in particular to the increasing use of renewable electricity for e-mobility, which will double in comparison to 2020. Beyond 2030, the share of renewables in the transport sector will rise to 11.1% in 2040 (without multiple recognition). Once again, this is due primarily to the increase in the share of renewable electricity, which will rise significantly by 2040 compared to 2030 as a consequence of the mainstreaming of e-mobility. By way of contrast, the consumption of biogenic fuels will not change significantly during this period. Since energy consumption in the transport sector will drop overall, however, the share of this figure accounted for by biogenic fuels will rise slightly. It should be pointed out, though, that adjustments will have to be made in particular for the period after 2030.

The heating and cooling sector covers space heating, hot water, process heating, process cooling and district heating. The baseline scenario assumes that there will be a moderate increase in the share of renewables in this area of energy consumption, from 15.5% in 2021 to 18,9,2% in 2030 (EU statistics; 19.2% according to national statistics). This share increases to 22.6% by 2040 under the baseline scenario (according to national statistics).

The individual subareas display different trends. There will only be minor changes over this period in the use of renewables for district heating purposes. Biomass (including biogenic waste) will continue to represent the most important source of renewable energy for the generation of piped heat, even though the baseline shows a slight drop in district heat generated using biomass. The drop in the use of biomass to generate heat will be compensated for by an increase in the use of waste heat and geothermal energy. There will also be a slight increase in the generation of heat from solar thermal sources in the longer term. The consumption of renewables to generate decentralised space heating and hot water will increase by 15% between 2020 and 2030. This increase will be chiefly accounted for by biogas, solar thermal and ambient heat, leveraged by means of electric heat pumps. The baseline scenario assumes that biomass is the only renewable source of energy that will be used to generate process heating. Electricity will be the only source of energy used to generate process cooling.

Table B11: Share of renewable energies 2021 to 2040, as a percentage of total sectoral consumption

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Electricity (Eurostat)	**43.1**	**43.8**	**44.6**	**45.7**	**46.8**	**48.3**	**49.6**	**51.0**	**52.6**	**53.7**	**56.4**
Electricity (national statistics)	**42.7**	**43.7**	**44.4**	**45.4**	**46.6**	**48.0**	**49.3**	**50.8**	**52.3**	**53.3**	**56.0**
Onshore wind	16.8	17.0	17.0	17.1	17.4	17.9	18.2	18.7	19.3	19.7	22.9

[4] The contribution of geothermal energy to the generation of electricity from renewables is currently negligible, with a share of approx. 0.1% (Eurostat 2018). According to model calculations, this generation technology will barely gain importance in this period, due to the high costs in comparison to alternative renewable energy sources and will remain at a negligible level. The share of geothermal energy in the gross final energy consumption of electricity is therefore not listed separately. The share of geothermally generated district heating in the gross final energy consumption of heat is subsumed under other renewables together with solar thermal, ambient heat and waste heat from industrial processes.

Offshore wind	5.5	5.8	6.3	6.8	7.3	7.8	8.5	9.1	9.7	10.3	10.9
Photovoltaics	8.3	8.7	9.2	9.6	10.0	10.4	10.8	11.2	11.6	11.9	13.6
Hydropower	3.5	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.6
Biomass	7.6	7.5	7.4	7.4	7.4	7.3	7.2	7.1	7.0	6.7	3.8
Biogenic fraction of waste	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2
Transport (RED II)	**8.2**	**8.8**	**9.4**	**10.0**	**10.7**	**11.4**	**12.3**	**13.2**	**14.2**	**15.2**	**26.9**
Transport (national statistics)	**5.7**	**5.8**	**5.9**	**6.1**	**6.3**	**6.5**	**6.7**	**7.0**	**7.3**	**7.5**	**11.1**
Biodiesel (including HVO and vegetable oil)	3.2	3.1	3.1	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.5
Biogenic petrol	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.6	1.6	1.9
Biogas	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.6
Renewables – electricity	1.0	1.1	1.2	1.4	1.6	1.8	1.9	2.2	2.4	2.6	5.1
PtX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heating and cooling* (Eurostat)	**15.3**	**15.7**	**16.1**	**16.5**	**16.9**	**17.4**	**17.7**	**18.2**	**18.5**	**18.9**	**22.3**
Heating and cooling* (national statistics)	**15.5**	**15.9**	**16.3**	**16.7**	**17.2**	**17.6**	**18.0**	**18.4**	**18.8**	**19.2**	**22.6**
Biomass and renewable waste	12.9	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.4	14.5	15.4
Other renewable energies	2.6	2.8	3.0	3.2	3.4	3.7	3.9	4.1	4.4	4.6	7.2

* Space heating and hot water, cooling and ventilation and process heating and cooling
Note: Discrepancies in totals are the result of rounding differences
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

4.3. Energy efficiency dimension

4.3.1.i. Current primary and final energy consumption in the economy and by sector (including industry, residential, service and transport)

Primary energy consumption dropped by around 8.7% between 2008 and 2018. The period between 2010 and 2018 accounted for 7.7% of this drop. Final energy consumption fell by 2.1% between 2008 and 2018; between 2010 and 2018 final energy consumption fell by 3.7%. Individual final consumption sectors displayed different trends. In industry (other mining and processing), positive volume effects (production, workforce) counteracted increases in energy efficiency, with consumption rising by 0.3% between 2010 and 2018. Commerce, trade and services (CTS) showed a decrease (-12%). Consumption rose by 7% in the transport sector, but dropped by 13% in the private household sector. This significant drop is closely linked to weather conditions during this period. 2010 was a very cold year, which meant that consumption levels for space heating were high. Temperatures were markedly warmer between 2011 and 2018, resulting in a significant drop in the consumption of space heating. There have been no substantial changes in energy consumption in the domestic sector since 2011.

Table B12: Primary energy consumption and final energy consumption (total and by sector), 2008 to 2018, in PJ

	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Primary energy consumption	**14 380**	**14 217**	**13 599**	**13 447**	**13 822**	**13 180**	**13 262**	**13 491**	**13 523**	**13 129**
EEV	**9 159**	**9 310**	**8 881**	**8 919**	**9 179**	**8 699**	**8 898**	**9 071**	**9 208**	**8 963**
Industry[1]	2 587	2 592	2 634	2 587	2 551	2 545	2 548	2 609	2 666	2 601
Transport	2 571	2 559	2 568	2 559	2 612	2 616	2 621	2 690	2 765	2 743
Households	2 558	2 676	2 333	2 427	2 556	2 188	2 302	2 376	2 342	2 320
CTS[2]	1 443	1 483	1 346	1 345	1 460	1 350	1 428	1 396	1 434	1 299

1 Other mining and processing
2 Commerce/trade/services
Sources: Energy data published by the Federal Ministry of Economic Affairs and Energy, 2020

4.3.ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

According to the latest estimates for 2014[5], and depending on the approach used, the power generation potential of CHP is either 173 TWh (microeconomic potential) or 244 TWh (macroeconomic potential). Taking into account the reduction over time in CHP-compatible electricity generation (through the growth in wind and photovoltaics), the CHP potential which can be tapped into will drop below the above values in the long term. Account must be taken of the fact that potential CHP power generation is lower than CHP-compatible power generation. The study commissioned on this topic did not estimate the exact level. From the vantage point of the present, it should also be noted that current energy system studies forecast a faster rise in the use of wind and photovoltaics to generate power than the CHP potential study outlined here. The achievable CHP potential is therefore likely to be somewhat lower in the long term. Table B13 shows the development of cogeneration in the baseline scenario.

Table B13: Development of cogeneration in the baseline scenario until 2040, net electricity from cogeneration in TWh*

	2016	2020	2030	2040
Total	**113**	**120**	**122**	**112**
General supply	48	52	57	56
Industry	33	35	35	35
Fossil CHP plants under 1 MW	8	8	8	8
Biogenic plants (not included in general supply and industry)	23	25	22	12

*using a broad definition of the term ‘plant’ (including the use of heat e.g. to heat fermenters, dry wood, etc.)
Source: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

[5] The study ‘Potential analysis and cost-benefit analysis for cogeneration applications and review of the Cogeneration Act in 2014’ investigated the CHP potential in Germany in order to comply with the requirements imposed by the EU Energy Efficiency Directive https://ec.europa.eu/energy/sites/ener/files/documents/151221%20Mitteilung%20an%20KOM%20EED%20KWK%20Anlage%20Analyse.pdf

4.3.iii. Projections considering existing energy efficiency policies, measures and programmes as described in Section 1.2.ii. for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)

According to the baseline scenario, primary energy consumption will have dropped by 20% by 2030 and by over 28% by 2040, in each case compared to 2010. Final energy consumption will reduce by 10% or 16% over the same period.

Table B14: Baseline scenario – primary energy consumption and final energy consumption (total and by sector), 2021 to 2040, in PJ

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Primary energy consumption	**12 806**	**12 540**	**12 285**	**12 236**	**12 132**	**11 972**	**11 822**	**11 706**	**11 544**	**11 410**	**10 208**
EEV	**8 879**	**8 836**	**8 791**	**8 747**	**8 702**	**8 636**	**8 572**	**8 504**	**8 438**	**8 370**	**7 761**
Industry[1]	2 451	2 431	2 415	2 400	2 385	2 364	2 345	2 323	2 303	2 281	2 161
Transport	2 766	2 776	2 782	2 786	2 789	2 780	2 768	2 755	2 741	2 726	2 464
Households	2 245	2 221	2 195	2 171	2 148	2 126	2 104	2 083	2 065	2 046	1 912
CTS[2]	1 417	1 408	1 399	1 389	1 380	1 367	1 355	1 342	1 330	1 318	1 224

1 Other mining and processing
2 Commerce/trade/services
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

Final energy consumption will drop most markedly in the private household sector, with a decrease of 24% by 2030 (compared to 2010). Annual consumption will drop by an average of 0.8% until 2030, and subsequently slow down. Energy consumption will continue to rise in the transport sector and will only start to drop after 2025. By 2030 it will therefore still be higher than the figure for 2010. In the more distant future, as e-mobility penetrates further into the market, annual consumption will drop significantly, by -1% a year after 2030.

4.3.iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

Research findings concerning the cost-optimal level of minimum requirements for overall energy efficiency in buildings were last updated in the 'Brief report updating and continuing current economic feasibility studies and investigations into flexibility options' (IBH, Institute for Building Services Engineering [Institut für Technische Gebäudeausrüstung, ITG], Institute for Energy and Environmental Research, ecofys). The ideal level is calculated separately for residential and non-residential buildings (from a microeconomic perspective in each case), using not only the energy price development scenario utilised by the Federal Government, but also an alternative scenario in order to carry out a sensitivity analysis. The sensitivity analysis complies with the European criteria for calculating cost optimisation, and (based on these latter) states that the current regulatory standard (Energy Conservation Regulation 2016) is the cost-optimal level at present. The outcome will be forwarded to the European Commission.

4.4. Energy security dimension

4.4.i. Current energy mix, domestic energy resources, import dependency, including relevant risks

Germany's current energy supply is heavily dependent on the consumption of fossil energy sources. In 2018, for example, the energy sources petroleum, gases and coal accounted for around 80% of primary energy consumption (Table B15, based on the Federal Ministry of Economic Affairs and Energy 2020).[6] Most of the remainder was accounted for by renewables (14%), nuclear energy (6%) and other energy sources (<1%).

[6] Only fossil gases; biogases are included under renewable energies.

Net electricity exports are shown as negative figures.

The import dependency of the energy mix results primarily from high consumption of fossil fuels, most of which are imported (Table B16). Lignite represents an exception in this respect, since Germany produces all of the lignite it uses and even exports small quantities. Subsidies for sales of domestic hard coal ended in 2018. The share of hard coal which is imported will therefore rise to 100% from 2019 onwards. Given the liquid global market and international supply structures, the security of supply for imported hard coal is regarded as high. Gas consumption dropped by around 100 PJ between 2010 and 2018, but domestic gas production almost halved during the same period. The share of gas which is imported therefore rose significantly. Germany imports almost all the petroleum it uses. By way of contrast, it produces almost all its renewable energy and nuclear energy on a domestic basis.[7]

Table B15: Primary energy consumption by energy source, 2010 to 2018, in PJ

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hard coal	1 714	1 715	1 725	1 840	1 759	1 729	1 693	1 502	1 428
Lignite	1 512	1 564	1 645	1 629	1 574	1 565	1 511	1 507	1 481
Mineral oils	4 684	4 525	4 527	4 628	4 493	4 491	4 566	4 671	4 452
Gases	3 171	2 911	2 920	3 059	2 660	2 770	3 056	3 159	3 091
Nuclear energy[7]	1 533	1 178	1 085	1 061	1 060	1 001	923	833	829
Renewable energies	1 413	1 463	1 385	1 499	1 519	1 644	1 676	1 797	1 802
Other energy sources	254	267	244	222	237	234	247	243	222
Balance of trade for electricity*	-64	-23	-83	-116	-122	-174	-182	-189	-175
Total	**14 217**	**13 599**	**13 447**	**13 822**	**13 180**	**13 262**	**13 491**	**13 523**	**13 129**

* including small amounts of district heat
Source: Federal Ministry of Economic Affairs and Energy 2020

There was a steady rise in the volume of hard coal imported from the former Soviet states to Germany between 2010 and 2018, with the figure reaching 41% by the end of this period. The former Soviet states and three other countries (the USA (21%), Australia (11%) and Colombia (8%)) account for over 80% of hard coal imports into Germany.

The majority of Germany's mineral oil imports come from Russia (almost 32% in 2019), followed by Great Britain (approx. 12%) and Norway (approx. 11%). The contribution from Africa was approx. 20%, including Libya (approx. 10%) and Nigeria (6%). The share of OPEC member states was approx. 24%. Germany imported approx. 94% of its natural gas requirement; gas imports into Germany in 2019 came almost exclusively from three countries: Russia, Norway and the Netherlands. The Federal Network Agency records these figures as well as transit volumes as part of its monitoring report.

Table B16: Import dependency 2010 to 2018, net imports* as a percentage

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hard coal	77.0	81.6	80.3	86.8	87.3	88.4	94.8	91.9	88.3
Lignite	-1.6	-1.8	-1.9	-1.9	-2.7	-2.6	-1.9	-2.1	-2.2

[7] Eurostat regards nuclear energy as a domestic primary energy source. When examined in this way, the use of nuclear energy to generate electricity does not therefore increase dependency on imports. Only the balance of trade (net quantity) is shown for electricity. No distinction is made between the individual generation technologies.

Mineral oils	97.8	96.3	98.3	97.6	97.8	98.7	98.0	97.0	97.2
Gases	81.3	86.7	85.6	86.8	89.1	88.6	90.2	91.3	95.6
Nuclear energy[8]	0	0	0	0	0	0	0	0	0
Renewable energies	-0.6	0.0	0.5	-0.8	-1.7	-1.4	-1.4	-1.3	0.3
Total	**59.0**	**60.6**	**61.3**	**62.4**	**61.6**	**61.7**	**63.8**	**63.3**	**63.6**

* (Imports minus exports and bunkers) in relation to primary energy consumption
Source: based on Federal Ministry of Economic Affairs and Energy, 2020

4.4.ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

In the baseline projection, primary energy consumption will drop by almost 1 400 PJ between 2021 and 2030. The drop in primary energy consumption for fossil fuels will mainly be driven by the increasing use of renewable energies in the buildings and electricity sectors and the drop in coal and petroleum consumption. The share of hard coal and lignite in electricity generation will see a particularly marked drop, while generation using natural gas will initially increase before falling slightly. This development will essentially be driven by long-term increases in carbon prices under the ETS. Domestic nuclear energy will no longer be used following the nuclear power phase-out from 2023 onwards[8]. The use of renewables will increase significantly by 2030, with the figure up by 13% compared to 2021. Consumption of renewables will only increase slightly between 2030 and 2040. This can be traced back to developments in the energy sector, where not all the existing plants which come offline will be replaced with new plants (particularly in the case of photovoltaics and biomass plants).

Table B17: Primary energy consumption by energy source, 2021 to 2040, in PJ

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hard coal	1 466	1 518	1 568	1 572	1 510	1 427	1 376	1 351	1 246	1 241	1 079
Lignite	1 222	1 224	1 234	1 233	1 224	1 171	1 118	1 101	1 072	1 015	605
Mineral oils	4 539	4 471	4 433	4 396	4 357	4 304	4 249	4 194	4 138	4 083	3 440
Gases	2 889	2 945	2 970	2 959	2 920	2 900	2 869	2 821	2 798	2 758	2 597
Nuclear energy	737	369	0	0	0	0	0	0	0	0	0
Renewable energies	1 959	1 983	1 998	2 029	2 064	2 096	2 124	2 158	2 189	2 207	2 266
Other energy sources	230	230	231	231	231	232	232	232	232	232	231
Balance of trade for electricity*	-236	-200	-148	-184	-175	-157	-145	-151	-131	-126	-11
Total	**12 806**	**12 540**	**12 285**	**12 236**	**12 132**	**11 972**	**11 822**	**11 706**	**11 544**	**11 410**	**10 208**

* including small amounts of district heat
Source: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

The proportion of domestic energy sources is dropping as a result of the nuclear power phase-out[9] and the reduction in lignite use. At the same time, however, consumption of gas remains relatively constant in the baseline scenario until 2025, particularly as a result of the increased use of natural gas to generate electricity. In view of the fact that over 95% of natural gas is imported, total imports will account for around 71% by 2023. With the slowly decreasing consumption of gas, the total import share will also decrease slightly to around 69% in 2030. The energy mix of German electricity imports will reflect the energy mix of the surrounding states

from which Germany obtains electricity. Depending on the market situation, this will include varying proportions of electricity from renewable energies (wind, solar, hydropower, bioenergy) and from conventional energy sources (in particular coal, natural gas and nuclear energy). The proportion of the latter may change due to reduction paths in some neighbouring states.

Table B18: Import dependency 2021 to 2040, net imports* as a percentage

Energy source	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hard coal	100	100	100	100	100	100	100	100	100	100	100
Lignite	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-3
Mineral oils	98	98	98	98	98	98	98	98	98	98	98
Gases	93	94	95	95	95	96	96	96	96	97	98
Nuclear energy[8]	0	0	0	0	0	0	0	0	0	0	0
Renewable energies	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Total	**67**	**69**	**71**	**71**	**70**	**70**	**70**	**70**	**69**	**69**	**68**

* (Imports minus exports and bunkers) in relation to primary energy consumption
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

4.5. Internal energy market dimension

4.5.1. Electricity interconnectivity

4.5.1.i. Current interconnection level and main interconnectors

The trends in electricity trading capacity within the interconnected European grid which are used as a basis for quantitative analysis are aligned with the long-term roadmap set out in the 2015 and 2017 Network Development Plans (NDPs) and the Ten-Year Network Development Plan (TYNDP 2018).

Table B19: Reference scenario – average available trading capacity for Germany and its electricity neighbours, 2020 to 2040, in GW

Exports (from DE to …)	AT	BE	CH	CZ	DK	FR	NL	NO	PL	SE	Total
2020	5	0	2	1	2	3	3	0	0	1	17
2025	5	1	3	1	3	3	4	1	1	1	23
2030	6	1	4	2	4	5	5	1	2	1	31
2035	8	1	4	2	5	5	5	1	2	2	35
2040	8	1	4	2	5	5	5	1	5	2	38

Imports (from … to Germany)	AT	BE	CH	CZ	DK	FR	NL	NO	PL	SE	Total
2020	5	0	4	1	1	4	2	0	1	1	19

[8] Eurostat regards nuclear energy as a domestic energy source.

2025	8	1	4	3	2	4	4	1	2	1	30
2030	8	1	6	3	3	5	4	1	3	1	35
2035	8	1	6	3	4	5	5	1	3	2	38
2040	8	1	7	3	4	5	5	1	3	2	39

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

4.5.1.ii. Projections of interconnector expansion requirements (including for the year 2030)

The interconnector expansion requirements resulting from changes in the structure of domestic generation and consumption and the European internal energy market are reviewed on a 2-yearly basis in the Network Development Plan (NDP). The current NDP outcomes are published at www.netzentwicklungsplan.de and are used for quantitative analysis purposes when drafting the National Energy and Climate Plan.

4.5.2. Energy transmission infrastructure

4.5.2.i. Key features of the existing transmission infrastructure for electricity and gas

Electricity

The German transmission network for electricity currently comprises around 36 000 km of ultra-high voltage lines (220/380 kV). Further details on electricity infrastructure can be found in section 3.4.1.

Natural gas

Germany has a modern and well-developed gas transmission infrastructure. Network expansion measures for the needs-based optimisation and reinforcement of the network, needs-based expansion of the network and to guarantee security of supply are included in the gas network development plan. This must be produced by the transmission system operators (see section 2.4.2 and further below).

4.5.2.ii. Projections of network expansion requirements up to at least 2040 (including for the year 2030)

Electricity

For expansion of the electricity network, reference should be made to the statements in section 2.4.2.

Natural gas

In the gas network development plan 2018-2028 the transmission system operators present the results of the network development planning including the information obtained during public consultations. The gas network development plan is based on the scenario framework developed by the transmission system operators and confirmed by the Federal Network Agency on 12 December 2017 (cf. Section 2.4.3 iii). The Federal Network Agency approved the gas network development plan 2018-2028 on 20 December 2018. Consequently, this plan is binding for the transmission system operators. It includes a total of 156 measures with an investment volume of approx. EUR 7 billion. Associated with this is the new construction of 1 364 km of gas pipelines and additional compressor capacity of 499 MW.

The transmission system operators are currently drawing up the gas network development plan for 2020-2030. They will consider inter alia the capacity requirements of the three possible LNG projects of private investors in Brunsbüttel, Stade and Wilhelmshaven (see Section 2.3.ii). Publication of the consultation documents for the gas network development plan 2020-2030 is planned for May 2020. After a market consultation and the subsequent review, the transmission system operators will submit the draft of the gas network development plan 2020-2030 to the Federal Network Agency on 1 July 2020 for review. Please refer to the statements in section 2.4.2.

4.5.3. Electricity and gas markets, energy prices

4.5.3.i. Current situation of electricity and gas markets, including energy prices

Changes in cross-border prices and consumer prices for natural gas are closely linked to trends in the world market price. Following a significant increase between 2010 and 2012, the cross-border price fell to below 2010 levels after 2015, reaching 1.6 cents/kWh in 2019. The consequences of this development for individual consumer groups differed somewhat. The prices paid by households did not change significantly between 2010 and 2016, but major corporate customers saw prices drop. This was particularly true for energy-hungry companies.

Consumer electricity prices rose between 2010 and 2019 for most consumer groups, by around 4 cents/kWh on average. Industrial customers which consume a lot of energy and occupy a privileged position represented an exception to this rule. The prices paid between these companies between 2010 and 2016 remained almost constant at 5 cents/kWh. This consumer group is exempt from the surcharge under the Renewable Energy Sources Act.

4.5.3.ii. Projections of development with existing policies and measures until at least 2040 (including for the year 2030)

Table B20 shows the results of price projections for baseline scenarios investigated. It should be noted that taxes, surcharges and fees are levied on the final consumer prices for natural gas and electricity. These price components refinance grid infrastructure and the growth of renewable energies, for example. Other refinancing routes are, however, conceivable in the interests of climate protection and considerations relating to energy policy and (in particular) distribution policy. Against this backdrop, long-term trends in final consumer prices for fuels and electricity depend on various factors, including (global) price and cost developments, and are correspondingly uncertain. The results must be viewed and considered against this background.

As PtX products are not used in the baseline scenario, the prices indicated here are purely hypothetical. Instead of a cost degression resulting from learning curves and synergy effects, only a low cost degression was estimated for the electrolysers, which only reflects the general technical progress.

Table B20: Gas and electricity prices by consumer group and prices for PtX for 2021 to 2040, in cents/kWh

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Natural gas											
Cross-border price	2.9	2.9	2.9	3	3	3.1	3.1	3.2	3.3	3.3	3.6
Households	8.6	8.7	8.8	8.9	9.1	9.2	9.3	9.5	9.6	9.8	10.6
Industrial band I2	6.4	6.5	6.6	6.8	6.9	7	7.2	7.3	7.5	7.6	8.5
Industrial band I4	4.8	4.8	4.9	5	5.1	5.2	5.3	5.4	5.6	5.7	6.4
Industrial band I6	3.8	3.8	3.9	4	4.1	4.2	4.3	4.4	4.5	4.6	5.3
Electricity											
Households	33	33	33	33	33	33	32	32	31	31	31
Commerce, trade, services	24	24	25	25	24	24	23	23	23	22	22
Industry non-privileged/non-energy-intensive	19	20	20	20	20	19	18	18	18	17	17
Industry, privileged/ energy-intensive	6	6	7	7	7	7	7	7	7	7	9

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
PtX											
PtDiesel	42	42	42	42	42	42	42	42	42	43	38
PtHEL	41	41	41	41	41	41	41	41	41	42	37
PtGas (methane)	37	36	36	36	36	36	37	36	36	36	35

real prices (baseline 2016)
Industrial consumer groups:
Industrial band I2: 1 000 GJ < consumption < 10 000 GJ
Industrial band I4: 100 000 GJ < consumption < 1 000 000 GJ
Industrial band I6: Consumption > 4 000 000 GJ
Sources: Natural gas: Öko-Institut, Prognos, Fraunhofer Institute for Systems and Innovation Research (2017); electricity and PtX prices: Prognos (2020)

4.6. Research, innovation and competitiveness dimension

4.6.i. Current situation of the low-carbon-technologies sector and (where possible) its position on the global market (analysis to be carried out at Union or global level)

The energy transition forms part of a macroeconomic modernisation strategy that will trigger extensive investments in the German economy. Innovative business models offer major opportunities in this respect. The energy transition is beneficial in that it opens up new opportunities for innovation and fresh market potential. Digitisation of the energy transition also has a concomitant impact. Many German companies reap benefits from trade in new and innovative energy technologies.

A recent research project looked more closely into the position of German companies on the international market for energy technologies (Lehr et al. 2019)[9]. Measurement of the global trade volume as the sum of imports by country of origin shows that global trade in energy technology goods in the period 2000-2017 has almost quadrupled. Trade in Europe during the same period has tripled.

Energy technology goods represent a major category of German exports. Low-emission technologies are manufactured in the economic sectors that are already responsible for significant proportions of German exports, some of which already occupy a dominant position in world markets. These include industries for producing motor vehicles and vehicle parts, mechanical engineering, production of electronics and electrical equipment, and the chemical industry. The share of energy technology goods (as defined here) in the volume of German exports has risen since 2000 from approx. 6.2% to around 8.9% in 2017. In 2017, this corresponded to exports valued at approx. 128 billion USD. Of this, exports to Europe amounted to 67 billion USD.

Looking at the trade shares of the respective countries, it can be seen that German manufacturers of energy technology goods hold a more or less constant share in a growing world market. On average, this share is around 13.8%. German industry thus maintains a significant market share in measurement, control and regulation instruments, for example, or for goods for rational energy supply.

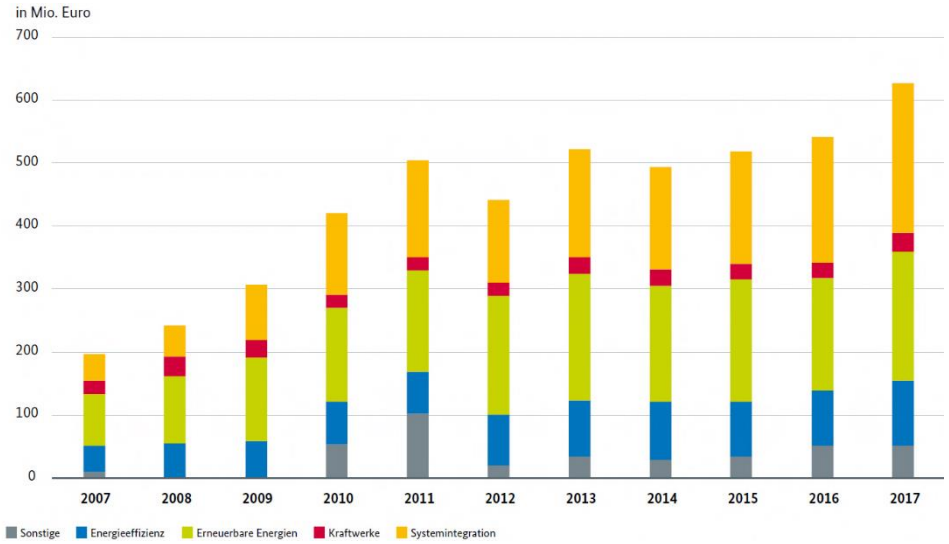
4.6.ii. Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

Public spending on energy research has more than doubled over the past 10 years. In 2019, EUR 1.15 billion was paid out under the Federal Government's Energy Research Programme, which provides both direct project funding and institutional funding for the Helmholtz Association of German Research Centres. According to data reported by the federal states, the latter spent a total of around EUR 282 million of their own funds on energy research in 2017. The Federal Government's medium-term financial plan provides for energy research funding of EUR 1.301 billion under the Seventh Energy Research Programme for 2020. The Federal Government is striving to ramp up energy research in the period between 2020 and 2030.

Figure B1: Overview of non-nuclear project funding areas under the Federal Government's Energy

[9] The research is based on official trade statistics. In this, individual product items cannot be clearly assigned to the energy technology goods or low-emission technologies; they can also be used for other purposes (problem of multiple-use). The results could therefore be estimated in detail at their absolute values

Research Programme (adjusted for inflation, baseline year 2010)



in Mio. Euro	in million euro
Sonstige	Others
Energieefizienz	Energy efficiency
Erneuerbare Energien	Renewable energies
Kraftwerke	Power plants
Systemintegration	System integration

Research and development spending by private businesses can only be estimated. In 2018, companies invested around EUR 223 million in the development of innovative energy technologies within the framework of publicly funded energy research projects alone. Third-party funding is also granted to universities and research institutions engaged in collaborative projects. According to Stifterverband Wissenschaftsstatistik, private businesses spent a total of around EUR 69 billion on internal R&D in 2017. Of this figure, around EUR 2.5 billion was spent on the area 'Energy'. Based on this figure, Stifterverband estimates that on a pro rata basis around 16 000 people were employed as research and development personnel in the field of energy research in 2017 (FTEs).

Table B21: Patents applied for/granted in the Federal Republic of Germany where the party applying for the patent/granted the patent is based in Germany, in selected fields defined by the WIPO IPC Green Inventory for 2017, evaluated by the German Patent and Trade Mark Office (as at: June 2018)

Field of technology	Patent applications published in 2017	Granted patents published in 2017
Alternative energy production	820	567
Energy conservation	961	507
Total	**1 770**	**1 062**

Sources: German Patent and Trade Mark Office 2018

4.6.iii. Breakdown of current price elements that make up the three main price components (energy, network, taxes/levies) Industry electricity prices

Electricity prices for industrial enterprises vary greatly. According to the latest research by the Federal Network Agency, the majority of electricity prices for industrial enterprises (annual demand: 24 GWh) not covered by the statutory exemptions fell within a bandwidth of 14.11-17.65 cents/kWh (without VAT) on the reference date of 1 April 2019. Average prices were around 15.98 cents/kWh Table B22 shows the individual price components. At 4.34 cents/kWh, the costs of energy procurement and sales represent only a small

proportion of the total price.

Table B22: Electricity price components for industrial customers

Electricity price components for industrial customers on the reference date of 1 April 2019	cents/kWh (arithmetic mean)
Energy procurement and sales (including margin)	4.34
Network charges	2.32
Surcharge under the Renewable Energy Sources Act	6.41
Surcharge under the Cogeneration Act	0.28
Concession fee	0.11
Surcharge pursuant to §19 of the Regulation on Electricity Grid Access Charges	0.061
Offshore levy	0.416
Interruptible loads surcharge	0.005
Electricity tax	2.05
Total value	**15.98**

* Industrial customers with presumed consumption of 24 GWh per year without discounts
Source: Federal Network Agency / Federal Cartel Office (2020)

However, if electricity consumers fulfil the conditions of the rules in the corresponding regulations and laws, there will be reductions in the various levies and fees (see Table 22b). If all reduction possibilities are fulfilled, the price component that the supplier cannot influence could fall from over 11 cents/kWh to less than 1 cent/kWh.

Table B23: Possible discounts for industrial customers* in cents/kWh

Price survey of 1 April 2019	Assumed value	Possible reduction	Remaining amount
Renewable Energy Sources Act levy	6.41	-6.09	0.32
Electricity tax	2.05	-2.05	0.00
Net network charge	2.32	-1.86	0.46
Other surcharges	0.76	-0.64	0.12
Concession fee	0.11	-0.11	0.00
Total of cost items that cannot be influenced (by the electricity supplier)	**11.65**	**-10.74**	**0.90**

* Industrial customers with presumed consumption of 24 GWh per year
Source: Federal Network Agency / Federal Cartel Office (2020)

Electricity prices can differ substantially between individual companies. Factors which play a role in determining prices include individual purchase quantities and profiles. Regional differences also exist, for example in relation to network charges. Differentiated relief rules (including the surcharge under the

Renewable Energy Sources Act and the electricity tax) mean that – under certain circumstances – companies which incur particularly high electricity costs in connection with their production activities and have a strong presence on the international market are asked to pay less. These relief rules play a significant role in preserving Germany's status as an industrial location, and therefore serve a macroeconomic function. Guaranteeing the international competitiveness of German industry represents a priority for the Federal Government. The ongoing goal is to avoid companies moving to countries with lower environmental standards or energy levies (carbon leakage) and to safeguard closed value creation chains and industrial jobs in Germany on a long-term basis.

4.6.iv. Description of energy subsidies, including for fossil fuels

The following subsidies currently exist in Germany, which also – directly or indirectly – subsidise fossil fuels.

Table B24: Overview of indirect and direct subsidies according to the Federal Government report on subsidies

No	Name of subsidy	Amount of tax loss in 2018 in EUR	Objective of the measure	Period / time limit
1	Subsidies for the sale of German hard coal for electricity generation, for sale to the steel industry and to compensate for costs resulting from capacity adjustments	967 300 000	Ensuring the socially and regionally acceptable phasing out of German hard-coal mining at the end of 2018. Due to the tendency toward negative impacts of hard-coal mining on climate protection and conservation of resources, support for sales from hard-coal mining in Germany was reduced and completely removed at the end of 2018. In recent years more money has been spent in particular on decommissioning and the clean-up of legacy pollution sites, making it possible to mitigate the adverse environmental impacts of hard-coal mining.	Ended on 31.12.2018
2	Granting of transition monies to workers employed in the hard-coal mining sector	90 400 000	Ensuring the socially and regionally acceptable phasing out of German hard-coal mining at the end of 2018. The subsidy reflects the social responsibility of the Federal Government and the federal states in the context of the arrangement for ending subsidised hard-coal mining.	Limited until 2027
3	Electricity price compensation	210 000 000	Subsidies to electricity-intensive companies to compensate for increases in the price of electricity resulting from emissions trading. The measure guarantees the competitiveness of industry and safeguards jobs.	Limited until 31.12.2020
4	Tax advantages for agriculture and forestry enterprises (agricultural diesel)	467 000 000	Agricultural enterprises receive a discount for taxed diesel fuel, if this has been used for land management or land-related stock farming. The subsidy maintains independent supply and guarantees the competitiveness of German agriculture and forestry.	Limited until 31.12.2020

5	Tax advantages for energy products that are used to power gas turbines and combustion engines in supported systems pursuant to §3 Energy Tax Act (electricity generation, combined heat and power generation, gas transport and gas storage)	Tax revenue is effectively not decreased by the tax advantages.	The measures maintain the security of supply with electricity, heat and gas, and guarantee the competitiveness of German industry. In addition, subsidising of inputs to the generation of electricity aims to avoid double taxation.	Limited until 31.12.2022
6	Tax advantages for energy products that are used in the creation of energy products to maintain operation (manufacturers' privilege)	342 000 000	With regard to domestically produced energy products, the subsidy is prescribed on a mandatory basis by EU Directive 2003/96/EC. For bought-in energy products, an optional energy tax reduction is provided which will be implemented from 2018 with the relief on the minimum tax rate under EU legislation.	unlimited
7	Energy tax concession for certain processes and procedures	483 000 000	The subsidy exempts particularly energy-intensive processes and procedures from energy tax. The support guarantees the competitiveness of German industry and protects against carbon leakage.	unlimited
8	Energy tax concessions for electricity generation	2 003 000 000	The measure avoids double taxation for electricity generation.	unlimited
9	Complete energy tax relief for combined heat and power generation	203 000 000	The measure conserves resources, aids air pollution control and the reduction of greenhouse gas emissions by means of the simultaneous and highly efficient generation of electricity and heat in cogeneration plants	Limited until 31.3.2022
10	Partial energy tax relief for combined heat and power generation	90 000 000	The measure conserves resources, aids air pollution control and the reduction of greenhouse gas emissions by means of the simultaneous and highly efficient generation of electricity and heat in cogeneration plants	Limited until 11.3.2022
11	Energy tax concessions for companies in the manufacturing sector and agricultural and forestry companies	154 000 000	The support guarantees the international competitiveness of German industry, safeguards jobs and protects against carbon leakage.	Limited until 31.12.2022
12	Energy tax concessions for companies in the manufacturing sector in special cases (peak balancing)	159 000 000	With the regulation, energy-intensive companies receive a tax break so as not to burden them beyond an acceptable threshold with regard to their international competitiveness. The purpose of the regulation is to protect against carbon leakage. As a result of the requirement to introduce energy management systems, incentives are offered to increase energy efficiency and thus a contribution to the protection of resources is made.	Limited until 31.12.2022

13	Electricity tax concessions for companies in the manufacturing sector and agricultural and forestry companies	990 000 000	The support guarantees the international competitiveness of German industry, safeguards jobs and protects against carbon leakage.	Limited until 31.12.2022
14	Electricity tax concessions for certain processes and procedures	807 000 000	The subsidy exempts particularly electricity-intensive processes and procedures from electricity tax. The support guarantees the competitiveness of German industry and protects against carbon leakage.	unlimited
15	Electricity tax concessions for companies in the manufacturing sector in special cases (peak balancing)	1 561 000 000	With the regulation, energy-intensive companies receive a tax break so as not to burden them beyond an acceptable threshold with regard to their international competitiveness. The purpose of the regulation is to protect against carbon leakage. As a result of the requirement to introduce energy management systems, incentives are offered to increase energy efficiency and thus a contribution to the protection of resources is made.	Limited until 31.12.2022
16	Tax concessions for liquid gas and natural gas used as fuel	126 000 000	Gas fuels substitute liquid fossil fuels and contribute to diversification of the energy supply. The purpose of the support is to conserve resources and protect the climate for the establishment of natural and liquid gas in the fuel market.	Limited until 31.12.2022/31.12.2026
17	Energy tax concessions for machinery and vehicles used exclusively for goods handling in ports	25 000 000	The subsidy promotes the outsourcing of road and maritime traffic, which can have a favourable effect on the environment.	Limited until 31.12.2022
18	Tax concessions for energy products used in domestic aviation	584 000 000	The subsidy guarantees Germany's status as a place to do business. Taxation would lead to refuelling abroad and to migration to foreign airports close to the borders, without leading to any additional benefit for the climate.	unlimited
19	Tax concessions for energy products used in inland waterway transport	141 000 000	The purpose is to harmonise the conditions of competition of the shipping circulating on other waterways with the tax exemption applicable to the Rhine river valley under international agreements.	unlimited
20	Tax concessions for local public transport	71 000 000	Through the strengthening of local public transport over distances of up to 50 km, a contribution is made to climate-friendly mobility.	Limited until 31.3.2022
21	Electricity tax concessions for rail transport operations and trolleybus transportation	111 000 000	The subsidy supports environmentally friendly modes of transport (railways and trolleybuses) as opposed to private transport.	Limited until 31.3.2022
22	Electricity tax relief for shore-side electricity for water craft	2 000 000	The subsidy of shore-side electricity reduces air pollution in German ports.	Limited until 16.7.2020, extension applied for

Further detailed information can be found in the current 27th Federal Government report on subsidies: https://www.bundesregierung.de/breg-de/suche/27-subventionsbericht-des-bundes-1702786 .

5. Impact assessment of planned policies and measures

5.1. Impacts of planned policies and measures described in Section 3 on the energy system and GHG emissions and removals including a comparison to projections with existing policies and measures (as described in Section 4)

5.1.i. Projections of the development of the energy system and GHG emissions and removals as well as, where relevant, of emissions of air pollutants in accordance with Directive (EU) 2016/2284 under the planned policies and measures at least until 10 years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures

Greenhouse gas emissions must be reduced by at least 55% by 2030 using suitable strategies and measures (see also Section 2.1.1.). In addition, primary energy consumption must fall by 30% by 2030 compared to 2008, as Germany's contributions to the EU energy targets, 30% and the share of renewables in the gross final energy consumption must amount to 30% in 2030.

The present impact assessment analysing the planned strategies and measures is based on a scientific scenario which depicts a possible future development of the energy system in Germany. The scenario presented below is based on the baseline scenario (see Section 4)[10]. It also takes account of the planned ongoing measures (see Section 3). It is assumed that the exogenous factors described influence energy-system and GHG emissions development in unmodified form (see Section 4.1).

As the baseline scenario includes those policies and measures implemented or adopted before 31 December 2017, the scenario investigated below takes into account the policies and measures initiated since then, primarily the resolutions of the Federal Government's Climate Action Programme 2030 of autumn 2019 and the resulting specific legislative changes and measures[11]. Henceforth this scenario will be referred to as 'Climate Action Programme scenario 2030'. The subject of the scenario analysis is the estimation of the total reduction effect of the climate protection programme 2030.

The results of the scenario presented here are categorically not to be taken as adopted by the Federal Government. Scenarios which extend until 2030 and 2040 are fraught with uncertainties. For example, the effects of the spread of the Corona virus on the economy and energy industry could not be foreseen in the available scenario analysis, as these effects only became apparent after the analysis work had been completed. In principle, the scenario is based on measures already adopted and finalised. Measures that have not yet been finalised or which will be decided at a later date could not be taken into account systematically.[12]

In general, different developments are predicted in different scenarios depending on the assumptions and methods used, including assumptions regarding the implementation of planned policies and measures. This is where the uncertainties which naturally exist for a forecasting period of 10 years or more reveal themselves. Thus the various studies and projections which have been developed for the Federal Government arrive at individually differing results[13]. The Federal Government will therefore also include other scenarios in its future considerations in addition to the present scenarios. It must also be borne in mind that the breakdown by sectors in the system of EU reporting differs from the national system of the Climate Action Plan 2050.

Greenhouse gas emissions

The projections of greenhouse gases in the Climate Action Programme scenario 2030 are described in Table

[10] The scenario analysis was published as a study under Prognos (2020): Energiewirtschaftliche Projektionen und Folgenabschätzungen 2030 [Energy projections and impact assessments for 2030], https://www.bmwi.de/Redaktion/DE/Publikationen/Wirtschaft/klimagutachten.html

[11] In order, as required, to depict in the projections a point at least 10 years further on from the period recorded in the plan (2021-2030), i.e. at least 2040, a development was modelled in the underlying scenario with which the currently valid target of reducing greenhouse gas emissions by at least -80% to -95% by 2050 could on average be achieved. As this development reaches even further into the future, the projection for this could naturally not be backed up with specific individual measures.

[12] The 'National Platform Future of Mobility' set up by the Federal Government, which involves representatives from politics, business and civil society, is currently working out an assessment of the report from Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020) with regard to the transport sector. In this context investigations are also being made into how the measures already taken in the transport sector can be further accelerated and extended.

[13] For the estimation of the reduction effect on greenhouse gases of the Climate Action Programme 2030, a further report for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Environment Agency was drawn up in addition to the primarily cited report for the Federal Ministry of Economic Affairs and Energy (Prognos et al. (2020)): https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2020-03-05_climate- change_12-2020_treibhausgasminderungswirkungen-klimaschutzprogramm-2030.docx_.pdf

B25. According to this, GHG emissions without international transport and LULUCF emissions decrease by 2030 to 598 million tonnes CO_2eq. Compared to the baseline year 1990 with its emissions level of 1251 million tonnes CO_2eq, this corresponds to a reduction of 52%, i.e. GHG emissions have been reduced by more than half compared with 1990.

Table B25: Greenhouse gas emissions by sector for 2021 to 2040, in million tonnes CO_2eq

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Energy-related emissions	**693**	**672**	**651**	**634**	**613**	**592**	**572**	**548**	**520**	**485**	**217**
Energy industry	288	275	263	255	246	235	226	214	197	176	62
Industry	115	114	112	109	105	103	101	99	97	94	45
Transport	161	159	157	154	152	147	142	137	131	125	63
Private households	77	74	72	69	66	63	61	58	56	53	26
Commerce/trade/services, others	42	41	39	38	37	35	34	33	31	30	19
Fugitive emissions	9	9	9	9	9	8	8	8	8	7	4
Non-energy-related emissions	**127**	**125**	**124**	**122**	**121**	**119**	**117**	**116**	**114**	**112**	**94**
Industrial processes	56	55	55	54	53	52	52	51	50	49	36
Agriculture	63	62	62	61	61	60	60	59	59	58	54
Waste	8	8	7	7	6	6	6	6	5	5	3
Total	**820**	**797**	**775**	**756**	**734**	**711**	**689**	**664**	**634**	**598**	**311**
For information only: LULUCF	29	28	10	9	7	6	4	13	12	10	2
For information only: International air and sea transport	42	43	43	44	45	46	47	47	48	49	43

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

In comparison to the baseline, greenhouse gas emissions in 2030 will fall by around 133 million tonnes CO_2eq in the Climate Action Programme scenario.

With the report's estimated reduction to 593 million tonnes CO_2eq as a result of the Climate Action Programme 2030, 95% of the Federal Government's envisaged total reduction of -55% in comparison to 1990 is expected to be achieved. Achievement of the overall target thus appears possible, as since the Climate Action Programme 2030 was adopted, there has been ongoing exploration of further measures that could not be taken into account in the Climate Action Programme 2030 scenario, for example, programmes such as 'Use of hydrogen in industry' or 'CO_2 prevention in raw materials industries'. At the same time, however, it should be emphasised that the current projections are based on measures that have already been adopted but that are still being finalised and implemented. The Federal Climate Protection Law will create transparency and planning security and ensure the possibility of a timely efficiency review of compliance with the climate goals. The Federal Climate Protection Law will also set up a national monitoring process, allowing progress to be verified and adjusted if necessary.

A second, parallel report[14] on the overall effects of the Climate Action Programme 2030 comes to similar

[14] Öko-Institut (2020) Reduction effect on greenhouse gases of the climate protection programme 2030. Short report.

conclusions with largely identical outline data and some other different assumptions and model approaches. Table B26 sets out the spread of results of both reports to allow an estimate of the total greenhouse gas emissions for the years 2025 and 2030.

Table B26: Range of total greenhouse gas emissions in million tonnes CO_2eq

	2025	2030
Total greenhouse gas emissions	731-734	598-614

Source: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020), Öko-Institut (2020) [15]

The estimated reduction due to the measures of the Climate Action Programme 2030 are reflected in various ways in the projections for the annual greenhouse gas emissions in sectors subject to ETS and in the other non-ETS sectors. According to these, emissions decrease in the ETS sectors more markedly than in the other sectors. Emissions from European air transport are also covered by the emissions trading scheme. They are shown separately since they are not relevant to the achievement of national targets. Only domestic air transport is included in calculations for this purpose.

Table B27: Greenhouse gas emissions by ETS and non-ETS for 2021 to 2040, in million tonnes CO_2eq

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
ETS emissions without international air transport	410	397	384	375	363	352	342	329	311	288	132
Non-ETS emissions	410	400	391	381	371	359	348	335	323	310	180
Total	**820**	**797**	**775**	**756**	**734**	**711**	**689**	**664**	**634**	**598**	**311**
For information only: emissions from international air transport*	31	32	33	33	34	34	35	36	36	37	32

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

Renewable energies

In the calculation of the Climate Action Programme scenario 2030, a variable renewable energy capacity is defined which is based on the target of the Climate Action Programme 2030 (see Section 2.1.2). In this scenario, according to EU statistics, this results in a total energy generation from renewables of 371 TWh. The share of renewables in the underlying gross electricity consumption (591 TWh) amounts to 63%. The Federal Government aims to increase the share of renewables in the gross electricity consumption to 65% by 2030 with regard to a gross electricity consumption of 580 TWh (see Section 2.1.2) and will support attainment of the target using appropriate measures and monitor the growth of renewable energies and the gross electricity consumption in a monitoring programme.

According to the Climate Action Programme scenario, the share of renewables in the transport sector will increase significantly by 2030. Without multiple weighting, the share will increase to 11.6% by 2030 (baseline: 7.5%). According to the current scenario calculation, this is mainly due to the increasing use of renewable electricity for e-mobility, which will increase five-fold in comparison to 2020[16]. The use of electricity will increase due to the mainstreaming of e-mobility, as will the share of electricity which is generated by renewable energies in the transport sector.

The heating and cooling sector covers space heating, hot water, process heating, process cooling and district heating. The Climate Action Programme scenario assumes that there the share of renewables in this area of

[15] In comparison to this, according to the estimate of the Öko-Institut et al. (2020), emissions in the ETS sector are 269.1 million tonnes CO_2eq in 2030 and in the non-ETS sector 342.5 million tonnes CO_2eq.

[16] Beyond 2030, the share of renewables in the transport sector will rise to about 36% in 2040 (without multiple recognition). Once again, this is due primarily to the increase in the share of renewable electricity, which will approximately triple by 2040 compared to 2030.

energy consumption will increase from 15.8% in 2021 to 23.9% in 2030. In the baseline scenario their share will increase to 18.9% by 2030. The use of renewables for district heating purposes over this period will increase considerably. Biomass (including biogenic waste) will continue to represent the most important source of renewable energy for the generation of piped heat, even though the target scenario shows a slight drop in district heat generated using biomass. At the same time, however, waste heat, geothermal energy and ambient heat (used via high capacity heat pumps) will be increasingly used for district heating purposes. The consumption of renewables to generate decentralised space heating and hot water will increase by 15% between 2020 and 2030. This is primarily due to the ambient heat used in buildings by heat pumps. The use of solar thermal energy will also rise (inter alia due to the promotion of bivalent systems with gas), as will the use of biomass. Biomass (solid and gaseous) is the only renewable source of energy that will be used to generate process heating. Electricity will be the only source of energy used to generate process cooling.

Table B28: Share of renewable energies in the respective total sectoral consumption, 2021 to 2040

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Electricity (Eurostat)	**43.5**	**45.3**	**47.6**	**49.7**	**51.4**	**53.7**	**55.3**	**57.2**	**59.7**	**62.7**	**85.7**
Electricity (national statistics)	**43.0**	**45.3**	**47.7**	**50.0**	**51.5**	**53.3**	**54.6**	**56.9**	**59.4**	**62.7**	**80.7**
Onshore wind	17.0	18.0	18.8	19.7	20.3	20.5	20.6	21.2	22.1	23.1	28.0
Offshore wind	4.9	5.3	5.8	6.3	6.7	7.4	8.0	9.2	10.5	12.8	25.6
Photovoltaics	8.9	9.9	10.9	11.9	12.7	13.6	14.4	14.9	15.4	15.9	19.3
Hydropower	3.5	3.5	3.6	3.6	3.5	3.5	3.5	3.5	3.5	3.5	2.9
Biomass	7.6	7.6	7.4	7.4	7.3	7.2	7.0	6.9	6.8	6.4	4.0
Biogenic fraction of waste	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9
Transport (RED II)	**8.2**	**9.0**	**10.0**	**11.2**	**12.7**	**14.7**	**16.8**	**19.6**	**22.9**	**27.0**	**95.9**
Transport (national statistics)	**5.7%**	**5.9%**	**6.2%**	**6.5%**	**7.1%**	**7.8%**	**8.5%**	**9.4%**	**10.4%**	**11.6%**	**35.5%**
Biodiesel (including HVO and vegetable oil)	3.1%	3.1%	3.0%	3.0%	2.9%	3.0%	3.1%	3.2%	3.3%	3.3%	4.3%
Biogenic petrol	1.4%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	2.1%
Biogas	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%	0.4%	0.4%	0.5%	1.2%
Renewables – electricity	1.1%	1.3%	1.5%	1.8%	2.2%	2.6%	3.1%	3.7%	4.5%	5.5%	19.6%
PtX	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.4%	0.5%	0.6%	0.6%	8.3%
Heating and cooling* (Eurostat)	**15.8%**	**16.6%**	**17.4%**	**18.2%**	**19.4%**	**20.3%**	**21.1%**	**21.9%**	**22.8%**	**23.9%**	**46.8%**
Heating and cooling* (national statistics)	**16.0%**	**16.8%**	**17.7%**	**18.5%**	**19.7%**	**20.6%**	**21.4%**	**22.2%**	**23.1%**	**24.2%**	**47.9%**
Biomass and renewable waste	13.3%	13.7%	14.2%	14.6%	15.1%	15.5%	15.8%	16.0%	16.3%	16.7%	28.8%
Other renewable energies	2.7%	3.1%	3.5%	3.9%	4.5%	5.1%	5.6%	6.2%	6.7%	7.5%	19.0%

* Space heating and hot water, cooling and ventilation and process heating and cooling
Note: Discrepancies in totals are the result of rounding differences
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

Primary energy consumption and final energy consumption

Table B29 shows the development of primary energy consumption and final energy consumption in the Climate Action Programme scenario. The primary energy consumption decreases until 2030 to 10 372 PJ. In the baseline scenario the figure is 11 410 PJ. Compared with 14 380 PJ in 2008, primary energy consumption in the Climate Action Programme scenario decreases by 28% by 2030. The envisaged reduction of primary energy consumption by 30% in the period 2008-2030 will thus only narrowly be missed, according to the calculations. The stakeholder process 'Roadmap Energy Efficiency 2050' begun in connection with the Energy Efficiency Strategy will see the development of further energy efficiency measures which will supplement the National Energy Efficiency Action Plan (NEEAP 2.0) for the period up to 2030. In addition, the necessary adjustments for energy saving will be determined in the near future. This will be based on the annual monitoring report of NEEAP. With the NEEAP monitoring reports, the Federal Government has recorded the primary and final energy savings and greenhouse gas (GHG) savings of the major efficiency measures since 2015. This monitoring will be continued and in future will include the measures of NEEAP 2.0. The results of the NEEAP 2.0 monitoring report will be used by the Federal Government as the basis for the ongoing target achievement checks in the area of energy efficiency policy. At the same time, they are the basis for the possible adjustment and further development of NEEAP 2.0 in the decade 2021 to 2030. A first fundamental assessment will take place in 2023. Final energy consumption in this scenario is 7 765 PJ in 2030. In the baseline scenario the figure is 8 370 PJ. In the period from 2008 to 2030, final energy consumption in the Climate Action Programme scenario decreases by 15%.

Table B29: Baseline scenario – primary energy consumption and final energy consumption (total and by sector), 2021 to 2040, in PJ

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Primary energy consumption	**12 704**	**12 263**	**11 838**	**11 688**	**11 518**	**11 315**	**11 127**	**10 904**	**10 655**	**10 372**	**8 283**
EEV	**8 792**	**8 697**	**8 613**	**8 516**	**8 400**	**8 273**	**8 155**	**8 024**	**7 900**	**7 765**	**6 477**
Industry[1]	2 424	2 389	2 356	2 323	2 262	2 226	2 189	2 152	2 116	2 076	1 716
Transport	2 740	2 731	2 722	2 710	2 695	2 658	2 617	2 573	2 526	2 477	1 984
Households	2 224	2 185	2 157	2 118	2 092	2 055	2 030	1 997	1 973	1 943	1 660
CTS[2]	1 405	1 392	1 378	1 365	1 351	1 335	1 318	1 302	1 285	1 269	1 117

1 Other mining and processing
2 Commerce/trade/services
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

The decrease in final energy consumption is spread across the sectors in different ways: While final energy consumption in transport increases by 4% by 2030 compared to 2008, consumption in private households reduces significantly (-24%). Decreases in consumption are also observed in industry (-20%) and in commerce, trade and services (-12%).

Table B30: Primary energy consumption by energy source, 2021 to 2040, in PJ

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hard coal*	1 392	1 318	1 218	1 131	1 043	977	877	862	831	786	219
Lignite	1 240	1 145	1 070	1 051	1 029	982	969	883	761	604	0

Mineral oils	4 512	4 408	4 341	4 268	4 193	4 087	3 980	3 868	3 754	3 637	2 290
Gases	2 850	2 922	2 965	2 951	2 874	2 838	2 818	2 745	2 681	2 615	1 613
Nuclear energy	735	367	0	0	0	0	0	0	0	0	0
Renewable energies	1 969	2 031	2 087	2 155	2 226	2 281	2 325	2 389	2 456	2 546	3 746
Other energy sources	232	232	233	233	233	233	233	233	233	233	216
Balance of trade for electricity**	-229	-164	-79	-106	-81	-86	-80	-82	-69	-65	21
Total	12 704	12 263	11 838	11 688	11 518	11 315	11 127	10 904	10 655	10 372	8 283

* In spite of the phase-out of hard coal in electricity generation, in this projection hard coal is used beyond 2038 in the industry sector (coke in steel production, hard coal in cement and lime kilns). The long investment cycles and high specific energy costs in these raw materials industries mean that switching to alternative production processes and fuels takes place slowly.
** including small amounts of district heat
Source: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

Table B30 shows the projection results in the Climate Action Programme scenario 2030 for the energy source structure of primary energy consumption. It changes significantly over time compared to the baseline scenario. The consumption of hard coal and lignite gradually reduces in line with the phase-out schedule. Compared to the baseline scenario, the decrease to 2030 amounts to -36.7 and -40.5% respectively. By comparison, the consumption of natural gas falls by -5.2% and that of petroleum by -10.9%. In contrast, the consumption of renewable energies rises by 15.4%. With the decommissioning of the last nuclear power station in 2022, consumption of nuclear energy ceases as per the baseline.

Air pollutants

The following emissions of air pollutants were calculated on the basis of the German emissions report 2018 and the development of emissions factors projected in the National Air Pollution Control Programme (in accordance with the new NEC [National Emission Ceiling] Directive (EU) 2016/2284). In addition, the activity data of the above-mentioned Climate Action Programme scenario 2030 (Prognos, 2020) were retained in order to guarantee consistency with the GHG projections.

The planned policies and measures of the Climate Action Programme have some significant effects on German air pollutants emissions (see tables below): In particular, the (largely energy-related) emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) will decrease more strongly during the period up to 2030 than as a result of technical emission-reducing measures alone. This also applies for emissions of particulate matter ($PM_{2,5}$); although the reduction is less here, inter alia because the combustion of solid biomass leads to higher specific emissions than for example the combustion of gas or oil. Emissions of volatile hydrocarbons (NMVOC) are largely independent of energy policy measures. Ammonia emissions may rise, unless an expansion of biogas production is compensated by agricultural reduction measures (e.g. rapid incorporation of fermented substrates).

Table B31: NO_x and NMVOC-emissions by sector for the years 2020 to 2030, in kilotonnes

	NO_x			NMVOC		
	2020	2025	2030	2020	2025	2030
Energy-related emissions	**801.3**	**581.4**	**419.2**	**231.0**	**207.8**	**188.1**
Energy industry	260.3	205.8	141.3	157.7	134.5	114.8

Industry	72.8	59.4	50.8	10.2	8.7	6.9
Transport	335.4	209.5	141.5	6.6	6.1	5.7
Private households	49.7	44.5	39.1	46.1	42.7	40.9
Commerce/trade/services, others	82.0	61.1	45.4	19.5	15.4	11.7
Fugitive emissions from fuels	1.1	1.1	1.1	73.3	73.3	73.3
Non-energy-related emissions**	**212.9**	**214.0**	**215.1**	**212.9**	**214.0**	**215.1**
Industrial processes	84.2	85.1	86.2	580.6	582.2	596.6
Agriculture**	128.1	128.3	128.3	206.7	204.6	202.6
Waste	0.6	0.6	0.6	0.2	0.2	0.2
Total notifiable emissions	**1 016.9**	**798.2**	**637.3**	**1 018.8**	**995.1**	**986.7**
Total emissions subject to obligatory reduction	**889.0**	**670.1**	**509.1**	**812.2**	**790.6**	**784.2**

**NO_x and NMVOC emissions in categories 3B and 3D (agriculture) do not have to be reduced
Source: Federal Environment Agency, using activity data from Prognos (2020) inter alia

Table B32: $PM_{2.5}$ and SO_2 emissions by sector for the years 2020 to 2030, in kilotonnes

	$PM_{2.5}$			SO_2		
	2020	2025	2030	2020	2025	2030
Energy-related emissions	**56.8**	**47.1**	**41.3**	**237.8**	**141.2**	**97.3**
Energy industry	8.1	6.0	4.2	**181.0**	**105.5**	**67.6**
Industry	2.5	1.7	1.5	36.1	21.3	17.9
Transport	21.6	19.9	19.1	**1.6**	**1.5**	**1.3**
Private households	17.1	14.3	12.8	**13.5**	**11.2**	**8.9**
Commerce/trade/services, others	7.5	5.1	3.7	**2.5**	**1.7**	**1.6**
Fugitive emissions from fuels	1.0	1.0	1.0	**3.1**	**3.1**	**3.1**
Non-energy-related emissions	**35.3**	**35.3**	**35.1**	**77.4**	**65.3**	**66.1**
Industrial processes	25.0	25.0	24.9	**77.3**	**65.2**	**66.0**
Agriculture	4.6	4.6	4.5	**-**	**-**	**-**
Waste	5.7	5.7	5.7	**0.1**	**0.1**	**0.1**
Total reportable emissions subject to compulsory reduction	**93.0**	**83.3**	**77.4**	**315.3**	**209.7**	**166.7**

Sources: Federal Environment Agency, using activity data from Prognos (2020) inter alia

Table B33: NH_3 emissions by sector for the years 2020 to 2030, in kilotonnes

	NH_3		
	2020	2025	2030
Energy-related emissions	**15.7**	**14.0**	**12.3**
Energy industry	15.6	14.0	12.3
Industry	2.3	1.9	1.5
Transport	0.8	0.7	0.6
Private households	1.3	1.1	0.8
Commerce/trade/services, others	0.6	0.4	0.4
Fugitive emissions from fuels	0.0	0.0	0.0
Non-energy-related emissions**	**598.0**	**500.5**	**424.4**
Industrial processes	12.2	12.2	12.3
Agriculture**	582.3	484.8	408.6
Waste	3.5	3.5	3.5
Total notifiable emissions	**613.7**	**514.5**	**436.7**
Total emissions subject to obligatory reduction	**559.8**	**514.5**	**436.7**

**NH_3 emissions from the storage and production of plant-based fermentation residues are not subject to compulsory reduction up to and including 2020
Source: Federal Environment Agency, using activity data from Prognos (2020) inter alia

5.1.ii Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply

With the Climate Action Programme 2030, German is laying down decisive measures to achieve the 2030 targets. The Federal Climate Protection Law provides a strategic framework for this with the year-by-year and sector-by-sector determination of emission budgets. The gradual introduction of CO_2 pricing for the transport and heating sectors sets systematic incentives for investments in low-emission and energy-efficient technologies. The Energy Efficiency Strategy in turn identifies efficiency potentials across all sectors, thus making it possible to set up and further develop targeted funding programmes. At the same time, the financial resources provided for this purpose will be massively increased. Due to the multiple interactions of individual strategies and measures, the integrated effect of the programme can only be calculated in this way and not as the sum of the effects of individual measures. Individual aspects are examined in more detail below:

Within a policy area, planned strategies and measures can support existing ones. For example, where previously limited funding is being continued, e.g. for heating networks, this contributes to continuity and helps the establishment of the existing programme.

For funding measures within a policy area, overlapping may occur in the assistance for planned and existing programmes; as a consequence, individual programmes may not completely achieve their specific potential for saving energy and reducing greenhouse gases. In designing the planned measures, the Federal Government ensures that these fit in well with the existing funding landscape and set complementary priorities where they are currently required. Moreover, existing subsidies, for example in funding for construction, are repackaged in order to achieve greater transparency and effectiveness.

For measures for saving energy, e.g. in the buildings sector or in industry, rebound effects may occur.

Immediately effective energy saving due to a measure is set against partially increased energy consumption. For example, tenants of a renovated building may heat their apartments to a higher temperature than prior to the renovation and thus use up part of the expected energy saving.

The interactions of energy efficiency measures are mathematically considered in the calculation of savings effects via individual interaction factors. Annex III of the NECP gives a corresponding overview. A description of how the additionality of the relevant measures has been ensured can be found in the description of the measures under Methodological Aspects.

In the area of the energy sector, with the gradual phasing out of coal-fired power generation and the accelerated growth of renewable energies, two major and ground-breaking strategic measures have been launched which are closely connected: The gradual reduction of fossil-fuel electricity generation from lignite and hard coal will be replaced by additional renewable electricity. This will maintain the security of supply.

For strategies and measures between different policy areas, a range of overlapping policy approaches and systemic connections are relevant. Four of these are highlighted below:

Increased electrification in transport and in heating and cooling contributes significantly to the substitution of fossil fuels and thus to effective decarbonising in these sectors. This strategy of sectoral coupling is essential for achieving the reduction of greenhouse gases in these sectors that are difficult to decarbonise and meeting the overarching climate goals. Measures such as the funding of e-mobility or the roll-out of heat pumps lead to increased demand for electricity. If overall an additional demand occurs which is covered by fossil fuel generation capacity, this leads to additional challenges for reaching the targets in the area of conversion, whether for the growth targets for renewable energies or the decarbonisation of electricity generation.

The overarching Energy Efficiency Strategy 2050 provides for energy efficiency measures that are intended to help address existing barriers to the realisation of efficiency potentials (e.g. lack of information, low motivation of stakeholders, red tape for financing). The Energy Efficiency Strategy therefore supports large efficiency funding programmes (such as the Federal subsidy for efficient buildings (BEG) and the Fuel Emissions Trading Act (BEHG)).

The Fuel Emissions Trading Act (BEHG) introduces a system for national CO_2 pricing for the heating and transport sectors. This national emissions trading system links the participating sectors with each other. The market mechanism implemented in it will ensure over the long term that the measures in one sector also affect the resulting market price as well as the developments and strategies in another sector. The national CO_2 pricing for emissions outside the EU ETS will make sustainable biomass more economically attractive as an energy source in various, sometimes competing, energy applications, such as electricity generation, biofuels or thermal recycling in industry and buildings. The sustainable potential for biomass use in Germany is limited, and this also applies for imported biomass, so it is important to channel the scarce biomass into efficient types of application using strategies and measures. A process of dialogue is currently in planning for bioenergy, in which criteria and measures for the distribution of biomass across the sectors will be analysed and discussed. In addition, the CO_2 pricing established by the BEHG can also be levied on the affected companies. Any negative effects will be absorbed by appropriate carbon leakage measures; a corresponding regulation will be drawn up. The double taxation of companies already affected by the EU ETS will be avoided by means of a regulation which is currently still in preparation.

5.1.iii. Assessment of interactions between existing policies and measures and planned policies and measures, and between those policies and measures and Union climate and energy policy measures

As a matter of principle, policies and measures of the Federal Government will always be developed and concluded with regard to the existing and planned measures of the European Union. This also applies for the areas of energy and climate. In these areas it is important to achieve positive interactions between individual measures. Resulting synergies and spill-over effects are important, because they can support and accelerate the achievement of national and European energy and climate targets.

Thus with the governance system for the energy union and for climate protection and the associated EU legal acts in the legislative package ‘Clean energy for all Europeans’, the EU has created a European framework for the national policies and measures of the EU member states. The Federal Government has taken this framework into account in formulating its measures in the Climate Action Programme 2030 and with the Federal Climate Protection Law. Many of the measures in the Climate Action Programme 2030 and the measures of the Federal Energy Efficiency Strategy 2050 are specifically aimed at supporting the achievement of European targets in the area of climate and energy.

Some aspects of the Climate Action Programme 2030 are examined in more detail below, with regard to their

interaction with EU climate and energy policy measures.

The national trade in certificates for fuel emissions supplements the EU emissions trading, because it includes the transport and heating sectors. In the heating sector, BEHG includes the emissions from heat generation in the buildings sector and in energy and industrial plants outside the EU emissions trading system. In the area of transport, the system also includes emissions from the combustion of fossil fuels, but not intra-European air travel, which is subject to the EU ETS. EU ETS and BEHG complement each other usefully in the heating sector. Through national emissions trading, a price is put on heating-related CO_2 emissions that were not previously captured by the EU ETS. This creates a market-oriented instrument for reducing CO_2 emissions in the heating and buildings sector.

The Energy Efficiency Strategy 2050 (EffSTRA) will give impetus to the further development of the successful EU efficiency instruments Eco-Design and Energy Labelling, making sure that they are equipped with ambitious specifications. This includes both a commitment to the inclusion of further product groups (e.g. commercial ovens, commercial steam cookers and commercial tumble dryers) in the regulation as well as the further conceptual development of these instruments for suitable product groups toward a systematic approach. EffSTRA thus also takes possible rebound developments into consideration for product development. Finally, EffSTRA trends also extend to the acceleration of internal decision making on the Eco-Design and Energy Labelling instruments and the submission of new work programmes.

In the area of travel, EU fleet targets and national measures, such as, in particular, purchase premiums for electric vehicles, supplement and reinforce each other. While it is true that some sources also mention an increase in windfall effects, others see the purchase premiums as a necessary precondition for the realistic achievement of fleet values without economic disruption in the automotive industry. The relationship of the Eurovignette Directive (for the CO_2 differentiation of heavy goods vehicle toll) to national emissions trade must be tested, so that double taxation of the goods forwarding industry as a result of emissions trading is avoided. On one hand, this may be linked to slightly lower economic efficiency. On the other hand, passenger car and heavy goods vehicle traffic can be influenced separately, which might simplify the achievement of other political targets, such as a simpler maintenance of affordable individual mass mobility. There is at present no EU framework for the funding of overhead cable infrastructures; this will be vital for the national funding of these technologies and their cross-border networking in the medium term.

5.2. Macroeconomic and, to the extent feasible, health, environmental, employment and education, skills and social impacts including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in Section 3 at least until the last year of the period covered by the plan, including a comparison to projections with existing policies and measures

The implementation of the planned policies and measures of the Climate Action Programme adopted at the end of 2019 has affected overall economic growth in many ways. This overall economic development in Germany is currently – at the time of submission of the German National Energy and Climate Plan – characterised by the far-reaching economic consequences resulting from the pandemic and the necessary measures for containing and combating it. Key data on total economic development will, in the near future at least, develop otherwise than had been expected at the end of 2019 and at the time of the subsequent scenario analysis. The projections below could not take account of the current developments during the pandemic. However, the projections and statements basically fulfil the requirements of the Governance regulation. Any changes will be communicated at the earliest opportunity, possibly in the NECP progress report.

Effects on the national economy and on education, skills and social impacts

In comparison to the baseline (see Section 4), the Climate Action Programme scenario produces a positive overall economic effect. The price-adjusted gross domestic product (GDP) in 2030 is approximately 1.4% higher than in the baseline scenario (Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020). The key reasons for this expansionary effect are the higher investments used to implement the Climate Action Programme 2030 (see Section 5.3), and at the same time the lower electricity prices in the Climate Action Programme scenario 2030 (see Section 5.4). Table B34 shows the estimates for the absolute changes of the individual components of GDP. The higher investments in equipment and buildings compared to the baseline are reflected in the increased investments due to the Climate Action Programme 2030. Various factors are responsible for the rise in consumption. These include the comparatively low electricity price, the low energy costs which increase over time and higher employment and wages linked to the increasing GDP.

As a result of the expansive effect on the overall economy, the demand for imports is higher, although imports of fossil fuels are increasingly lower than in the baseline. In contrast, exports fall slightly because the price competitiveness drops slightly with rising wages. Increasing export opportunities for climate protection products are not assumed in the projections.

Table B34: Changes in GDP and its components in the Climate Action Programme scenario – scenario compared to baseline

Absolute deviation of the price-adjusted GDP and its components in billion EUR_{2016}	2020	2025	2030
GDP	8.9	48.4	51.3
Private consumption	2.9	20.9	24.5
State consumption	0.0	0.4	2.2
Equipment	5.7	23.4	35.6
Buildings	2.9	8.3	12.4
Exports	1.1	0.0	-7.7
Imports	3.8	5.3	14.5

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

As a result of the GDP growth, which is higher than the baseline, higher employment can also be assumed. According to the projections, the number of people employed will grow by 0.5% in 2030. This corresponds to approximately 185 000 additional people employed, although the impact on employment will vary in individual sectors. The relative growth is thus not as large as for GDP. This is because an element of the higher economic performance leads to higher wages and consequently higher productivity, with a comparatively lower additional demand for employment. Employee compensation will be 3% higher than the baseline in 2030; with price adjustment the figure will be 1.7%. The cost of living index changes only slightly in the Climate Action Programme scenario 2030. However, because of the introduction of CO_2 prices and higher capital costs for the additional investments in 2030, it lies 1.3% higher than in the baseline. The inflation rate is thus a good 0.1% per year higher than in the baseline. The positive development in the labour market contributes to higher hourly wages and employee compensation. In contrast to this we see lower electricity prices and the first energy savings.

Social impacts including aspects of just transition

Employment is changing, particularly in the energy sector. In addition to current questions of structural change and employment in the coal-mining areas, since 2000 there has been a gradual but perceptible shift in employment away from the classic, mostly conventional energy sectors towards renewables. This applies particularly if the employment effects in the sectors with a demand for investment in energy transition are also considered (German Institute for Economic Research, German Aerospace Centre, Institute of Economic Structures Research 2019). Such a development is a logical consequence of the proposed decarbonisation of the energy system in Germany and will continue.

In the area of transport, changes to employment and value creation can be expected as a result of the transition from conventional drive systems to alternative drive systems. However, these changes cannot yet be fully estimated at present. To date, only a few comprehensive studies have been carried out into the overall effects on the national economy. Depending on the scenario design and the assumptions made, various conclusions can be drawn from the study results regarding the future development of employment in the German automotive industry. Furthermore, it should be borne in mind that numerous comparisons with the status quo alone are of limited value, as many developments, including demographic changes, take place in parallel. Because of the range of the results, there is still a need for differentiated studies on the gross and net effects of employment and value creation caused by the transition to alternative drive systems.

Some areas of the German economy have recently shown occasional bottlenecks of skilled workers, particularly for professionally qualified staff. These are already a consequence of the demographic change and could slow down overall economic growth and hamper innovation. Whether and to what extent the economic sectors relevant for the implementation of the Climate Action Programme 2030 may be affected by this is the subject of investigation. After an initial study[17] there are signs of shortages of skilled workers in professional groups related to energy transition, such as technical and building professions. Particularly for building professions, however, there is no uniform picture: The shortage of skilled workers varies considerably according to the category, level of performance and region; in some federal states there are no bottlenecks or only signs of them. It is also difficult to form a complete picture of professional groups related to energy transition and the share of the energy transition for employment. As the implementation of the energy transition also contributes to employment via the supply chain, there is also an indirect requirement for qualified skilled workers here.

End-user expenditure or final consumption costs are suitable indicators for the cost-effectiveness or affordability of energy (EWK 2012, 2019). End-user expenditure primarily consists of the purchased quantities and the prices paid, including fees, charges and taxes which have to be paid on the product (Institute of Economic Structures Research, 2017). End-user expenditure for final consumption costs can be calculated on the basis of the energy balance or its review. An overall economic consideration of energy expenditure can provide information about the affordability of energy in general. For this purpose, the aggregated information about all end consumers is reviewed.

Table B35 shows the development of end-user expenditure at current prices for the Climate Action Programme scenario[18]. The BEHG and the reduction of the surcharge under the Renewable Energy Sources Act have been taken into account. The expenditure for electricity rises considerably between 2020 and 2025, then remains almost unchanged until 2030 because of the reduction of the surcharge under the Renewable Energy Sources Act and the resulting largely stable, sometimes slightly decreasing electricity prices. Expenditure for electricity shows an above-average increase, because the importance of electricity increases significantly in the scenario with climate protection. Expenditure for heating also increases slightly until 2030. By contrast, end-user expenditure in the transport sector decreases (for liquid and gaseous fuels). Electricity consumption in transport is included in the end-user expenditure for electricity. Important factors for the overall total are that the price of electricity varies only slightly between the two scenarios, while the prices of fossil fuels increase sharply due to CO_2 pricing.

Table B35: End-user expenditure in the Climate Action Programme scenario 2030 – scenario

Changes in end-user expenditure for energy in billion EUR (current prices)	2020	2025	2030
Total	214.6	222.3	221.6
Electricity	85.1	97.2	97.9
Heating	58.0	63.5	73.6
Transport	71.5	61.6	50.1
Share of GDP in Climate Action Programme scenario	6.0%	5.4%	4.7%
Share of GDP in baseline scenario	6.0%	5.7%	5.1%

Source: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

Finally, a comparison of the evolution of expenditure with the evolution of value creation gives an indication of the sustainability of energy expenditure for the national economy. Overall, end-user expenditure increases, but in relation to GDP it declines from 6.0% in 2020 to 4.7% in 2030. Economic performance increases more

[17] Institute of Economic Structures Research (2018), Possible bottlenecks for the energy transition. Institute of Economic Structures Research, Osnabrück. October 2018.
[18] Price adjustments are waived, because the prices for heating and transport increase sharply as a result of the CO_2 price in the Climate Action Plan scenario, which can lead to distortions in price adjustments in comparison to the baseline.

strongly and more rapidly in the scenario with climate action than expenditure for energy. Compared to the baseline, the share of GDP is lower.

Effects on the environment and health

The existing and planned policies and measures will have a positive impact on the environment and health, as well as synergy effects for a sustainable energy sector. For example, if fewer fossil fuels are burned and Germany phases out the commercial use of nuclear energy at the end of 2022, a reduction in environmental pollution and in health risks for people, animals and the natural environment can be assumed[19]. At the same time it is important to exclude harmful effects on the environment and health by continuing to expand renewable energies and other technological developments. To take account of this problem, the Federal Government has set the target of integrating environmental impact into the monitoring process for the energy transition.

Today, energy conversion processes are responsible for a large part of air pollution in Germany. In addition to greenhouse gases, air pollutants are released in all sectors where fossil and biogenic fuels are burnt[20]. Material discharges from the energy sector into the environment also have an effect on human health. For example, nitrogen dioxide (NO_2), a by-product of processes in furnaces and combustion motors, is an irritant gas which damages the airways and reinforces the irritant effect of other pollutants so that respiratory or cardiovascular diseases can occur. Particulate matter also has a negative effect on human health. The measures of the Climate Action Programme are aimed at reducing these emissions, and thus the burdens for humans and nature, in many areas. Projections for individual air pollutants are shown in Section 5.1.

Furthermore, the most efficient use of raw materials and a sustainable use of land make a significant contribution to climate protection, because the extraction, processing and transport of fuels and energy systems, including the upstream chains, is associated with the use of land. The challenge is to minimise this use of space and avoid a lasting deterioration of soils and the loss of agricultural land.

Table B36 shows the selected environmental effects in Germany from the use of bioenergy as a result of the planned policies and measures (International Institute for Sustainability Analysis and Strategy 2020). Possible analyses of environmental effects of other uses of fossil and renewable energies will be given at the next possible opportunity, such as in the NECP progress report. In addition to the effects on the consumption of minerals and ores and on the use of land, the effects on the consumption of water are also shown. These estimates are in turn based on the projections of the Climate Action Programme scenario (see Section 5.1.i) and the baseline scenario (see Section 4.2).

Table B36: Selected environmental effects in Germany from the use of bioenergy in the Climate Action Programme scenario compared to the baseline

Use of raw materials and land by the use of bioenergy	2020	2030	2030 (baseline)
Water (in thousand tonnes)	18	25	25
Ores (in thousand tonnes)	13	16	22
Minerals (in thousand tonnes)	3 049	1 660	3 150
Land use (in thousand hectares)	1 603	681	1 276

Source: International Institute for Sustainability Analysis and Strategy (2020)

The use of water up to 2030 increases in both scenarios compared to 2020. The use of minerals in the period up to 2030 decreases by almost half in the Climate Action Programme scenario. A similar decrease up to 2030 also occurs in comparison with the baseline. In contrast, the use of ores increases up to 2030; however, not as strongly as in the baseline. The utilisation of land by bioenergy use shrinks significantly up to 2030. Also in comparison to the baseline, existing policies and measures result in lower land utilisation up to 2030.

[19] In addition to the effects on the environment and health of nuclear plants in normal use, potential contamination in the case of incidents or damage must be considered. Serious accidents occur rarely, but can have far-reaching consequences. By phasing out the use of nuclear energy for generating electricity, risks from the release of radioactive substances will be limited. The safe final storage of radioactive waste will contribute to minimising the radiological consequences of using nuclear energy over long periods.
[20] The switch to electrical and other drive systems will allow greenhouse gas emissions and pollutant emissions which occur in transport as a result of the burning of fuels to be avoided or partially transferred from this area to the electricity sector, where measures for reducing pollutants can be taken in a more focused way.

In addition to these effects of national policies and measures on the utilisation of raw materials and land within Germany, the effects induced outside the borders of Germany can also be considered. The induced water use for bioenergy abroad in 2030 in the Climate Action Programme scenario is many times higher than domestic water use. The reason for this is inter alia the higher importance of irrigation abroad. The induced use of ores is also significantly higher abroad in 2030 than direct use in Germany. The opposite development is projected for minerals in 2030. Land use abroad in 2030 is only slightly higher than land use in Germany (International Institute for Sustainability Analysis and Strategy 2020). For all four indicators, use of raw materials and land for bioenergy in the Climate Action Programme scenario in 2030 is markedly lower than in the baseline scenario. With the exception of ores, this difference represents up to a half. The planned policies and measures thus contribute significantly to the reduction of the use of raw materials and land depicted.

In addition to the named environmental effects, other effects on human and animal health can be linked to the energy system and planned policies and measures. These include noise emissions or effects on biodiversity and the living conditions of flora, fauna and people (where these have not already been addressed by a sustainable use of land). Further insights into such possible effects will be notified at the next possible opportunity, such as in the NECP progress report.

5.3. Overview of necessary investments

5.3.i. Existing investment flows and assumptions concerning future investments in connection with the planned policies and measures

Making a success of the energy transformation and simultaneously providing a modern and efficient infrastructure will require increased investment in the coming years. Over the last two decades, the energy sector has already made high levels of investment in the transformation of the energy system. However, households and businesses in Germany have also made significant investments in areas of end energy demand.

The energy sector includes the provision of fuels, the operation and maintenance of energy generation, storage and distribution plant and trade in final energy. This applies both to fossil fuels and increasingly to renewable energy sources. In these areas of the energy sector, EUR 25.7 billion[21] was invested in 2018 (German Institute for Economic Research, German Aerospace Centre, Institute of Economic Structures Research 2019). The majority of this was in investments for providing electricity and heating, at EUR 13.3 billion. Approx. EUR 9.9 billion was invested in infrastructure for the distribution of final energy (electricity, gas, heating) in 2018. The remaining investments were made in the areas of storage (gas, electricity, heating) (EUR 0.7 billion) and equipment for supplying fuels (coal, mineral oil, petroleum, natural gas as well as biomass and biofuels) (EUR 1.5 billion)[22].

Investments made in the area of final energy demand concern mainly the heating and transport areas. Expenditure for energy-related building renovation is an important factor here. EUR 46.3 billion was invested here in 2017 (Federal Ministry of Economic Affairs and Energy 2019). Energy-related building renovation is one of the central measures for increasing energy efficiency; investments in other areas of energy efficiency can only be incompletely recorded to date.

Investments within the framework of existing measures are predominantly made by private households and businesses. Only in individual areas, such as public electricity and heat supply, are public providers direct investors in the conversion of the energy system. At the same time, the public sector is making significant financial means available to support private investments.

In order to describe future investments in connection with planned policies and measures, a model-based socio-economic impact assessment was carried out, building on projections for the energy system (see Section 5.1.i), to illustrate the differences in investments between the Climate Action Programme scenario 2030 and the baseline. Table B37 shows the difference in annual investments in the Climate Action Programme scenario 2030, which compared to the baseline are largely made in addition. Sector boundaries emerge from the data analysis of existing investment flows.

According to the impact assessment, the differential investments in 2030 in the conversion sector amount to EUR_{2016} 16.7 billion. The additional investments in renewable energies and networks dominate here. In 2030, the final demand sectors account for a total of EUR_{2016} 26.1 billion in additional investments. These are made

[21] Nominal prices, excluding tax
[22] The figures shown are estimates based on official statistics and available studies. In total, data availability is very variable between the different technologies and sectors.

predominantly in industry, transport, private households and to a comparatively small extent in commerce, trade and services. Altogether, the additional investments in 2030 amount to around EUR$_{2016}$ 42.8 billion.

Table B37: Additional investments in the Climate Action Programme scenario 2030 compared to the baseline

billion EUR$_{2016}$	2020	2025	2030	Cumulated 2021-2030
Area of conversion	**2.0**	**10.1**	**16.7**	**95.2**
Conventional equipment	0.0	0.4	0.5	4.7
Renewable energies equipment	1.5	5.4	8.5	49.0
Networks	0.5	2.5	6.0	27.4
Energy storage facilities	0.0	0.1	0.1	1.0
Refineries	0.0	0.1	0.0	0.5
PtX equipment in Germany	0.0	1.5	1.7	12.6
Final demand sectors	**6.4**	**18.1**	**26.1**	**184.0**
Private households	2.0	5.9	6.6	57.0
Commerce, trade and services	1.5	3.4	3.2	32.2
Industry	2.8	5.2	8.9	55.9
Transport	0.1	3.5	7.3	38.9
Total	**8.4**	**28.1**	**42.8**	**279.2**

Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy (2020)

According to this scenario analysis, the additional investments resulting from planned policies and measures in the area of conversion add up to EUR$_{2016}$ 95.2 billion in the period 2021-2030. In the final demand sectors, the figure is EUR$_{2016}$ 184 billion in the same period. In total, the additional investments in the Climate Action Programme scenario thus amount to EUR$_{2016}$ 279.2 billion up to 2030. A comparable investigation of the Climate Action Programme by Öko-Institut et al (2019) arrives at similar results. For the period 2018 to 2030, cumulated differential investments compared to a baseline amount to between EUR$_{2010}$ 240 and 270 billion.

It should be noted that these figures refer to the additional investments. No statements can be made on this basis concerning the amount of ongoing investment flows connected with current policies and measures. In an overall assessment, however, these investment flows must be included.

In addition to the overarching individual analysis presented, there are also parallel estimates of future investments in individual sectors. German transmission system operators in the area of gas plan to invest approx. EUR 7.0 billion in the expansion of their gas infrastructure up to 2028 (investment volume of the compulsory gas network development plan 2018-2028).

For an analysis of the investments required for the electricity transmission infrastructure, the national network development plan (NDP) is relevant. On the basis of past network development plans, statutory provision has already been made in the Federal Requirements Planning Act and the Energy Line Expansion Act for 65 projects with a total of approximately 7 700 km of transmission infrastructure which is urgently needed, around 900 km of which are interconnectors. Germany will amend the Federal Requirements Planning Act in light of confirmation of the 2019-2030 Network Development Plan in 2020. In addition to the grid expansion projects already set out in the Federal Requirements Planning Act and the Energy Line Expansion Act, further grid expansion projects with a length of just under 3 600 km are required by 2030 in accordance with the 2019-2030 Network Development Plan, including new interconnector projects. The refinancing of necessary investments in the expansion, reinforcement and optimisation of the transmission system is regulated nationally via the Incentive Regulation and the Electricity Grid User Charge Ordinance. As a tool, the

investment measure is a separate refinancing instrument for essential investments aimed at expansion and restructuring in the transmission network. In addition, certain PCI projects can apply for financial subsidies for construction projects and studies concerning their preparation from the 'Connecting Europe Facility' (CEF). In the past, the German power grid projects 'SuedLink' and 'SuedOstLink' have been subsidised with CEF funds.

5.3.ii. Sector and market-related risk factors or obstacles in the national or regional context

Investments in climate protection and in a future-proof energy system in Germany cannot be considered in isolation in an overall economic growth vacuum. This was true even before the beginning of the coronavirus pandemic. Intended investments and the implementation of planned policies and measures can be hampered or at least slowed down by possible economic or structural bottlenecks.

The continuous investments amounting to several billion in the last few years can be seen as an indication that such risks of bottlenecks did not have great relevance until now. For example, public funding programmes, such as that of the KfW in particular, counteract possible financing bottlenecks for companies and private households, so that microeconomic investments which are (also) macroeconomically reasonable do not stop.

Moreover, sufficient raw materials must continue to be available so that the production of vital (investment) goods for climate protection and the energy transition is not restricted. The same applies for an adequate number of skilled workers, so that planned investments can be efficiently implemented. In addition it must be ensured that overarching effects such as rebound effects at the energy demand level and lock-in effects (path dependencies) for certain infrastructure investments do not limit an efficient implementation of energy transition investments and their effectiveness (cf. Institute of Economic Structures Research 2019).

The lack of planning security hampers investments in climate protection and in a future-proof energy system. The Federal Government's Climate Action Programme 2030 for the implementation of the Climate Action Plan 2050 therefore also contains measures to create planning security. These include in particular CO_2 pricing. This will be introduced in Germany from the beginning of 2021 with the Fuel Emissions Trading Act (BEHG) for the areas of heating and transport with a reliable price path. In addition, in the view of the Federal Government, the existing European emissions trading (for energy and industry) will be supplemented with a moderate European minimum price. The minimum price ensures that the price of the certificate can no longer arbitrarily fall even when demand is low. This creates planning security for climate investments in the ETS sectors.

A key determining factor in investment activity is the amount of state-regulated price components. Against this background, the Federal Government had embedded a test of the incentive and steering effect of government-instigated energy price components in the form of charges, levies and taxes in the Climate Action Plan 2050. With the resolutions on the introduction of the BEHG, the Federal Government intends that at the same time as the introduction of CO_2 pricing, citizens and the economy will be relieved of some of the electricity price burden. This will also set the right incentives for increasing electrification, and promote the cross-sectoral energy transition

5.3.iii. Analysis of additional public grants and resources to close loopholes discovered in section ii

Where the measures of the Climate Action Programme are financed by public funding, this will be largely enshrined in the 2020 budget of the Energy and Climate Fund (EKF). The Energy and Climate Fund thus remains the central financial instrument for energy transition and climate protection in Germany. Up to 2030, total funding (i.e. together with funding measures outside the EKF) at the three-digit billion level will be made available for climate protection and energy transition.

The federal states spend significant resources from the European Regional Development Fund (ERDF) for the promotion of climate protection and also plan to do this for the next financial period. In regions that are particularly heavily affected by structural change, such as coal-mining regions, future measures can also be funded by the new EU Just Transition Fund (JTF) which can be further reinforced by the allocation of funding from the ERDF and the European Social Fund. The JTF will provide financial assistance to regions particularly heavily affected by structural change, such as coal-mining regions, to achieve the climate goals. In future, the EU can thus receive financial support for innovations and the strengthening of competitiveness from the JTF in addition to funding from the established structural funds. The JTF will thus help to harmonise economy and ecology and enable support for structural change that complies with the principles of social justice.

Where planned policies and measures are continued and reinforced on the basis of existing measures, the current financing mechanisms are generally also continued, such as the financing of renewable energies in electricity generation via a levy or the funding of energy-related building renovation by means of national public funding programmes. It is currently not possible to say whether and to what extent individual EU

financing mechanisms will be used to finance necessary investments in Germany.

5.4. Effects of the planned policies and measures described in Section 3 on other member states and regional cooperation at least up to the last year of the validity period of the plan with a comparison to the projections for the current policies and measures

5.4.i. Where possible, effects on the energy system in neighbouring or other member states in the region

Electricity

The continuing expansion of power lines within Germany and to the neighbouring states and the continuing expansion of renewable energies in all European states will – by current estimates – lead to an increasing harmonisation of electricity systems in Germany and its neighbouring countries. The inter-regional exchange of electricity will contribute to better integration of volatile electricity generation, particularly from wind and PV, in the system as a whole, thus improving the security of supply in the entire region. At the same time, the efficiency of the electricity system in all countries will increase due to an inter-regional exchange of back-up capacities (power stations, storage facilities, load flexibility).

Natural gas

By 2030, climate protection programmes and decarbonisation efforts could already lead to decreases in the use of gas, particularly natural gas, in terms of primary and end energy. The reasons for this could lie in the reducing requirement for end energy in buildings due to energy-related renovations and growing shares of renewables, while the use of gas in smaller volume areas of conversion (power stations, district heat) could tend to increase. Depending on changes in demand in neighbouring countries, this could also lead to higher transit shares, due to the transit function of Germany.

5.4.ii. Effects on energy prices, utilities and the integration of the energy market

Energy prices

In both the baseline scenario and the Climate Action Programme scenario, fuel prices for natural gas, petroleum and hard coal are based on the EU baseline scenario 2016 and therefore follow the recommendations of the European Commission. These do not take account of the measures taken during the spread of the corona virus or its impact. Independently of this, it should primarily be assumed that decreasing demand for fossil fuels due to climate protection measures leads to falling energy prices. At the same time, increasing demand for bioenergies and hydrogen leads to rising prices. The effects of national measures on the international fuel markets should be estimated as low.

There is a slightly stronger influence – particularly on electric neighbouring countries – for electricity prices. A central measure of the Climate Action Programme is the phasing out of coal-fired power generation. At the same time, electricity generation from renewable energy sources is increasing. With high EU ETS prices, an increasing share of renewable energies in gross electricity consumption leads in the long term to falling wholesale prices in Germany and in other member states. As the procurement costs play a central role in the level of end customer electricity prices, there are direct effects on consumers.

Table B38 summarises the energy prices that formed the basis for the projection for the Climate Action Programme scenario or were calculated on the basis of this. In general it should be noted that taxes, surcharges and fees are levied on the final consumer prices for natural gas and electricity. These price components refinance grid infrastructure and the growth of renewable energies, for example. In the interests of climate protection and considerations relating to energy policy and (in particular) distribution policy, it is, however, possible to conceive of other detailed refinancing routes which differ from the refinancing routes that are directly or implicitly assumed in this model. Against this backdrop, long-term trends in final consumer prices for fuels and electricity depend on various factors, including (global) price and cost developments, and are correspondingly uncertain.

For gas prices, there is a price rise for all consumer groups which is reflected in the slight increase in international gas prices. In addition, the increase can be traced back to the initially moderate CO_2 pricing. For this reason, the prices are partly above the level of the baseline scenario (see Table B38).

The development of electricity prices is characterised by the demand for electricity during the implementation

of a stronger sectoral coupling for heat and transport. At the same time, the decrease in fees achieved by income from CO_2 pricing for fossil fuels contributes to a decrease in electricity prices. As a result, the prices remain stable or decrease slightly. Compared to the baseline without the Climate Action Programme, consumer groups mainly profit from comparatively low electricity prices, which until now did not enjoy any exemptions from charges on electricity prices.

In this projection for the Climate Action Programme scenario, PtX products will not be used until the late 2020s. However, a stronger cost degression than in the baseline scenario has been assumed where no PtX products are used.

Table B38: Prices by consumer group and prices for PtX by sector for 2021 to 2030, in cents/kWh

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Natural gas										
Cross-border price	2.9	2.9	2.9	3	3	3.1	3.1	3.2	3.3	3.3
Households	9.1	9.3	9.5	9.7	10	10.3	10.9	11.5	12.1	12.6
Industrial band I2	6.4	6.5	6.6	6.8	6.9	7	7.2	7.3	7.5	7.6
Industrial band I4	4.8	4.8	4.9	5	5.1	5.2	5.3	5.4	5.6	5.7
Industrial band I6	3.8	3.8	3.9	4	4.1	4.2	4.3	4.4	4.5	4.6
Electricity										
Households	32	33	33	33	33	32	32	31	31	31
GHD	24	24	25	24	24	24	23	23	23	22
Industry, non-privileged/non-energy-intensive	19	20	20	20	19	19	18	18	18	17
Industry, privileged/energy-intensive	6	6	7	7	7	7	7	7	7	7
PtX*										
PtDiesel	40	40	39	39	38	38	37	36	36	35
PtHEL	39	39	38	38	37	37	36	35	35	34
PtGas (methane)	36	36	35	35	34	34	33	33	32	32
PtH2 (imported)	30	30	29	28	27	27	26	25	24	24

* Data for PtX excluding tax, electricity procurement case: wind/PV stand-alone solution industrial band I2: 1 000 GJ < consumption < 10 000 GJ
Industrial band I4: 100 000 GJ < consumption < 1 000 000 GJ
Industrial band I6: Consumption > 4 000 000 GJ
Sources: Natural gas: Öko-Institut, Prognos, Fraunhofer Institute for Systems and Innovation Research 2017; electricity prices: Prognos 2020

Utilities

Currently in the European electricity system there are overcapacities of around 80 to 90 GW. This estimate is based on an external report for the Federal Ministry of Economic Affairs and Energy. The report shows that if the integration of the European electricity market continues to develop as planned, conventional power stations can be successively reduced without affecting the current level of security of supply in the European electricity system until 2030. In addition, the Federal Ministry of Economic Affairs and Energy carries out regular monitoring of the security of supply in the area of grid-based supply of electricity and natural gas.

Integration of the energy market

A central point for the integration of the energy market is the further extension of trading capacities between member states. The direct and indirect network expansion measures aimed at in the Climate Action Programme create a basis for further reinforcement of electricity trading with electricity neighbour countries. Increasing cross-border trade helps to better integrate renewable energy sources in the electricity system and to use adjustable capacities and flexibility options more efficiently and to harmonise wholesale electricity prices. This enables electricity system costs to be reduced in all countries. The energy mix of German electricity imports will reflect the energy mix of the surrounding states from which Germany obtains electricity. Depending on the market situation, this will include varying proportions of electricity from renewable energies (wind, solar, hydropower, bioenergy) and from conventional energy sources (in particular coal, natural gas and nuclear energy[23]). The proportion of the latter may change due to reduction paths in some neighbouring states.

The significance of (net) energy imports of individual energy sources in relation to the relevant primary energy consumption does not change substantially up to 2030 due to the measures of the Climate Action Programme. Table B39 shows the development of net imports in the Climate Action Programme scenario. Changes to the baseline (cf. Section 4.4.ii; Table B39) are minimal. The middle of the decade onward will see a small extension of the first production capacities for electrolytically generated hydrogen in Germany, which will be used exclusively in mineral oil refineries. The increasing final energy consumption of hydrogen in the transport sector will be covered exclusively by imports from abroad until 2030. Domestic production capacities will be built up only slowly in the following years.

Table B39: Import dependency 2021 to 2030, net imports* as a percentage

Energy source	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Hard coal	100	100	100	100	100	100	100	100	100	100
Lignite	-2	-2	-2	-2	-2	-2	-2	-2	-3	-3
Mineral oils	98	98	98	98	98	98	98	98	98	98
Gases	93	94	95	95	95	96	96	96	96	96
Nuclear energy[14]	0	0	0	0	0	0	0	0	0	0
Renewable energies	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Total	**66**	**68**	**70**	**69**	**68**	**68**	**67**	**67**	**66**	**66**

* (Imports minus exports and bunkers) in relation to primary energy consumption
Sources: Prognos, Fraunhofer Institute for Systems and Innovation Research, Institute of Economic Structures Research, International Institute for Sustainability Analysis and Strategy, 2020

5.4.iii. Possible effects on regional cooperation

Electricity

Regional cooperation is expected to become increasingly important in the electricity system. The more closely national electricity systems are interconnected, the greater the importance of regular exchange between the states at regional level. Firstly, this enables a more intensive exchange of information than would be possible at European level. Secondly, region-specific aspects can be addressed better at regional level and suitable solutions found.

Thirdly, new, innovative, cross-border approaches to the operation of the electricity system that are absolutely essential in a system undergoing fundamental change can most easily be tried out in the context of regional cooperation. Joint learning curves can thus be organised before the tested measures go on to become the European standard.

[23] Eurostat regards nuclear energy as a domestic primary energy source. When examined in this way, the use of nuclear energy to generate electricity does not therefore increase dependency on imports. Only the balance of trade (net quantity) is shown for electricity. No distinction is made between the individual generation technologies.

Natural gas

In Germany and many of its neighbouring states there are intensive efforts to decarbonise the remaining gas requirements. By 2030 this may mean that the current pipeline infrastructure, where it is to be used for transporting hydrogen in future, will also have to be tested and if necessary upgraded across national borders to accommodate hydrogen admixtures; other pipelines could be completely converted for hydrogen transportation. This will require more extensive bilateral and regional coordination to achieve the corresponding cost-efficient upscaling.

Petroleum

Since 1995, the consumption of fuel oil has more than halved in Germany. The new measures of the Climate Action Programme 2030 and the many incentive programmes to increase energy efficiency, particularly in the area of housing, substantially support this trend and will lead to a sharp decrease in the consumption of fuel oil over the next few years. This move away from oil consumption for heating has led on the one hand to the development of environmentally sound fuel technologies, and on the other to the need to develop new potentials such as ‘Power to Heat’ or new fuels for the future (e.g. E-fuels). At the same time, the significance of regional/international cooperation will increase. Particularly against the background of the development of new technical usage systems for fuel oil and new developments of fuels for the future, cross-border cooperation takes on greater relevance. It is sufficient to develop solutions for new heating systems or drive systems on a national level while these hypotheses are still being discussed at laboratory level. If developments achieve market readiness, an international cooperation is essential in order for them to become established on the market.

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List of parameters and variables to be reported in Section B of the National Plan

The following projection dates between 2020 and 2040 refer to the baseline and estimate with the Climate Action Programme 2030 in Section B, Chapters 4 and 5 of the plan. Some are provisional findings by Prognos AG. Individual indicators may still need to be supplemented and updated.

Table C1.1: Population, in million persons

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Population	82, 438	81 752	82 176	83 458	83 316	82 868	82 179	81 293

Source: Federal Statistical Office, model values
1 From 2011: Updated results based on the 2011 census.

Table C1.2: GDP in billion EUR

Indicator	Unit	2005	2010	2015	2020	2025	2030	2035	2040
GDP	Billion EUR	2 288	2 564	3 030	3 523	4 139	4 807	5 605	6 425
GDP	Billion EUR_{2015}	2 621	2 780	3 030	3 287	3 506	3 685	3 875	4 039
GDP	Billion EUR_{2016}	2 652	2 813	3 066	3 325	3 547	3 728	3 921	4 087

Sources: Federal Statistical Office, model values

Table C1.3: Sectoral gross value added (including main industrial, construction, services and agriculture sectors), in million EUR (real, based on 2016)

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Agriculture and forestry, fisheries	19 526	23 322	22 262	22 162	22 303	22 268	22 416	22 512
Manufacturing	704 778	754 539	829 346	899 829	947 766	982 940	1 023 372	1 061 288
A Manufacturing without construction	584 936	629 630	699 433	762 648	806 311	839 696	877 894	915 694
1. Mining and quarrying	4 494	5 091	4 261	3 382	2 702	2 177	1 811	1 544
2. Processing	520 041	553 874	624 224	681 185	722 882	755 095	791 677	828 360
a. Manufacture of foodstuffs and beverages, tobacco products	42 185	43 648	43 788	46 491	46 925	47 011	47 485	47 850
b. Manufacture of textiles, clothing, leather products and shoes	8 640	7 802	7 402	7 189	6 862	6 511	6 257	6 053
c. Trade in wooden products, paper and printed products	25 072	24 756	25 755	25 760	25 916	25 778	25 821	25 832

d. Manufacture of coke and refined petroleum products	5 013	3 830	3 548	4 349	3 285	2 531	2 021	1 655
e. Manufacture of chemical products	42 601	45 374	45 837	49 650	52 323	54 014	55 906	57 797
f. Manufacture of pharmaceutical products	20 656	22 178	23 277	27 431	29 570	31 364	33 353	35 370
g. Trade in rubber, plastic, glass and ceramic products and similar	39 429	41 166	45 960	49 314	51 482	52 885	54 592	56 225
h. Metal production and processing, manufacture of metal products	66 615	65 000	75 450	78 228	80 842	82 304	84 285	86 370
i. Manufacture of computer, electronic and optical products	18 164	27 103	38 119	45 282	52 151	58 375	64 872	71 396
j. Manufacture of electrical equipment	41 722	44 115	42 491	44 614	46 747	48 127	49 750	51 394
k. Manufacture of machinery	93 714	89 138	96 732	104 351	114 979	124 036	133 746	143 606
l. Vehicle construction	88 315	103 883	135 848	156 845	168 412	177 525	187 440	197 247
m. Manufacture of furniture and other products; repair and installation of machinery	38 730	39 512	41 159	42 225	44 634	46 514	48 623	50 631
B Construction	122 379	125 798	129 983	137 181	141 455	143 244	145 479	145 594
Services	1 660 257	1 757 403	1 908 561	2 085 007	2 229 230	2 357 618	2 497 161	2 619 592

Sources: Eurostat, Federal Statistical Office, model values

Table C1.4 Number of households, in thousand persons

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Households	39 178	40 301	40 774	41 567	41 838	42 127	42 337	42 181

Source: Federal Statistical Office, model calculation

Table C1.5 Size of households (number of persons per household)

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Household size	2.10	2.03	2.02	1.98	1.96	1.93	1.90	1.88

Sources: Federal Statistical Office, model calculation

Table C1.6 Disposable income of households, in billion EUR, nominal prices

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Disposable income (expenditure)	1 417	1 526	1 724	2 045	2 346	2 677	3 042	3388

For information: Disposable income (adjusted)	1 680	1 842	2 104	2 500	2 876	3 281	3 721	4142

Sources: Federal Statistical Office, model calculation by GWS

Table C1.7: Number of passenger kilometres over all modes of transport, in million Pkm

Indicator	2005	2010	2015	2020	2025	2030
Carriage of passengers						
Bus	90 742	89 611	91 214	92 034	89 623	85 956
Motorised two-wheel vehicle	16 757	16 384	15 361	15 325	15 532	15 535
PKW	858 891	886 495	920 365	940 948	953 671	953 864
Rail	92 130	100 172	106 763	115 511	120 516	124 008
Air[1]	170 145	194 346	221 405	268 380	309 914	350 012

Sources: TREMOD UBA, model calculation
1 Outbound transport

Table C1.8: Freight transport tonne-kilometres over all modes of transport apart from international maritime transport, in million tkm

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Freight transport								
Heavy goods vehicles (from 3.5 tonnes)	402 690	440 600	465 599	514 992	564 287	595 881	628 082	655 178
Rail	100 542	110 852	128 450	138 966	152 579	161 460	166 094	169 078
Domestic navigation	64 096	62 278	55 315	62 671	69 734	74 762	79 935	84 539
Air[1]	7 201	10 773	11 425	14 091	16 142	18 266	20 796	23 437

Source: TREMOD UBA, model calculation
1 Outbound

Table C1.9: International oil, gas and coal fuel import prices, in EUR2016/GJ

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Crude oil	9	11	8	13	15	17	17	18
Natural gas	5	6	6	8	8	9	10	10
Hard coal for power plants	3	3	2	3	3	4	4	4
Synthetic crude				100	98	96	93	90

Sources: Model calculation

Table C1.10: EU ETS carbon price, in EUR_{2016}/EUA

Source	2005	2010	2015	2020	2025	2030	2035	2040

CDC Climat (Daily spot EUA) + from 2012 EEX emission spot primary market auction	25	16	8	16	23	35	44	52

Sources: EU baseline scenario 2016

Table C1.11: Assumed EUR-USD exchange rate

Indicator	2005	2010	2015	2016	2020	2025	2030	2035	2040
USD for EUR 1	1.25	1.33	1.11	1.11	1.14	1.15	1.16	1.18	1.19

Sources: model calculation

Table C.1.12: Number of heating and cooling degree days

Indicator	2000	2005	2010	2015	2020	2025	2030	2035	2040
Heating degree days	2 782	3 137	3 611	3 044	3 024	3 008	2 993	2 979	2 967
Cooling degree days	No information	168	145	164	168	173	177	182	186

Sources: PRIMES based on various sources, inter alia based on Eurostat, and ODYSSEE database, for extrapolation based on E3MLab

Table C2.1.1: Indigenous production by fuel type (all energy products: coal, crude oil, natural gas, nuclear energy, renewable energy sources) in ktoe – baseline

	2000	2005	2010	2015	2020	2025	2030
Solid fuels	60 600	56 458	45 906	43 004	30 599	29 833	24 768
Crude oil and petroleum products	4 391	5 103	3 672	3 540	2 159	1 877	1 632
Gas	15 800	14 334	11 113	6 335	4 896	3 314	2 274
of which natural gas	15 800	14 334	11 113	6 335	4 896	3 314	2 274
Nuclear energy	43 750	42 061	36 201	23 636	17 530	0	0
Renewable energies	8 983	17 957	30 874	39 778	47 318	49 679	53 082
of which: hydropower	1 869	1 689	1 802	1 632	1 777	1 777	1 777
wind energy	804	2 388	3 314	6 932	11 311	12 407	14 856
solar thermal energy	111	260	481	663	883	1 135	1 376
photovoltaics	5	110	1 009	3 330	3 992	4 999	5 866
biomass	4 692	8 743	13 472	12 354	12 899	12 002	11 680
biogas	557	1 090	4 360	7 510	8 249	8 559	8 094
Waste	1 681	1 845	3 906	4 252	5 489	5 528	5 539
waste (renewable)	709	1 845	2 334	2 994	3 341	3 414	3 454

Sources: Eurostat, model calculation

Table C.2.1.1 new: Indigenous production by fuel type (all energy products: coal, crude oil, natural gas, nuclear energy, renewable energy sources) in ktoe – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030
Solid fuels	60 600	56 458	45 906	43 004	30 796	25 140	14 921
Crude oil and petroleum products	4 391	5 103	3 672	3 540	2 159	1 877	1 632
Gas	15 800	14 334	11 113	6 335	4 876	3 292	2 251
of which natural gas	15 800	14 334	11 113	6 335	4 876	3 292	2 251
Nuclear energy	43 750	42 061	36 201	23 636	17 533	0	0
Renewable energies	8 983	17 957	30 874	39 778	46 800	53 547	61 189
of which: hydropower	1 869	1 689	1 802	1 632	1 777	1 777	1 777
wind energy	804	2 388	3 314	6 932	10 717	13 639	18 312
solar thermal energy	111	260	481	663	895	1 391	2 014
photovoltaics	5	110	1 009	3 330	4 076	6 420	8 095
biomass	4 692	8 743	13 472	12 354	12 851	12 080	11 730
biogas	557	1 090	4 360	7 510	8 325	8 985	8 418
Waste	1 681	1 845	3 906	4 252	5 534	5 571	5 566
waste (renewable)	709	1 845	2 334	2 994	3 345	3 409	3 436

Sources: Eurostat, model calculation

Table C2.1.2: Net imports by fuel type, in ktoe – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels (total)	21 688	25 977	31 639	36 072	34 948	35 473	29 104	29 185	25 332
Crude oil and petroleum products (total)	126 068	120 271	110 180	106 076	107 341	102 524	96 211	88 631	81 238
Gas, total	56 865	68 822	68 494	65 196	64 102	66 439	63 607	62 233	60 900
Electricity, total	263	-393	-1 286	-4 152	-5 527	-4 178	-3 003	-2 480	-267
PtX	0	0	0	0	0	0	0	0	0
Total	204 884	214 678	209 028	203 192	200 863	200 258	185 918	177 568	167 204

Sources: Eurostat, model calculation

Table C2.1.2 – new: Net imports by fuel type, in ktoe – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels (total)	21 688	25 977	31 639	36 072	35 456	24 336	18 276	6 503	5 220

Crude oil and petroleum products (total)	126 068	120 271	110 180	106 076	110 147	101 530	88 396	71 334	55 685
Gas, total	56 865	68 822	68 494	65 196	63 513	65 502	60 671	54 516	39 090
Electricity, total	263	-393	-1 286	-4 152	-5 542	-1 938	-1 550	-266	492
PtX	0	0	0	0	0	40	387	1 883	4 266
Total	204 884	214 678	209 028	203 192	203 187	189 086	165 808	133 577	104 323

Sources: Eurostat, model calculation

Table C2.1.3: Dependency on imports from third countries, in per cent – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	25.6	31.7	40.0	45.4	53.3	54.3	54.0	61.6	63.0
Crude oil and petroleum products	94.6	97.3	96.8	96.5	98.0	98.2	98.3	98.4	98.5
Gas	79.1	79.6	81.2	90.1	92.9	95.2	96.5	97.5	98.2

Sources: Eurostat, model calculation

Table C2.1.3: Dependency on imports from third countries, in per cent – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	25.6	31.7	40.0	45.4	53.5	49.2	55.1	35.6	99.9
Crude oil and petroleum products	94.6	97.3	96.8	96.5	98.0	98.1	98.1	98.0	97.7
Gas	79.1	79.6	81.2	90.1	92.9	95.2	96.4	97.2	97.1

Sources: Eurostat, model calculation

Table C2.1.4: Main import sources for main energy carriers (including gas and electricity) – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	Poland	Poland	Russia	Russia	No information	No information	No information	No information	No information
Crude oil and petroleum products	Russia	Russia	Russia	Russia	No information	No information	No information	No information	No information
Gas	Russia	Russia	Russia	Russia	No information	No information	No information	No information	No information

Source: Eurostat

Table C2.1.5: Gross domestic consumption by fuel type source, in ktoe – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	84 828	81 841	79 076	79 415	65 547	65 307	53 871	47 375	40 205
of which: coal	84 828	81 841	79 076	79 415	65 547	65 307	53 871	47 375	40 205

Crude oil and petroleum products	131 076	124 586	113 187	109 862	109 155	104 068	97 522	89 739	82 173
Gas	71 853	77 782	75 905	65 154	68 998	69 753	65 881	63 821	62 040
of which: natural gas					68 712	69 468	65 597	63 540	61 759
Nuclear energy	43 750	42 061	36 201	23 636	17 530	0	0	0	0
Derived heat	-3	-6	-6	-3	0	0	0	0	0
Renewable energy including renewable waste	8 983	18 757	31 268	39 929	46 932	49 299	52 714	53 906	54 126
Electricity	263	-393	-1 286	-4 152	-5 527	-4 178	-3 003	-2 480	-267
Waste – non-renewable	1 681	1 845	3 906	4 252	5 489	5 528	5 539	5 553	5 526
Total	342 434	346 476	338 250	318 093	308 124	289 777	272 523	257 915	243 803

Sources: Eurostat, model calculation

Table C2.1.5 new: Gross domestic consumption by fuel type source, in ktoe – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	84 828	81 841	79 076	79 415	66 252	49 476	33 197	18 244	5 223
of which: coal	84 828	81 841	79 076	79 415	66 252	49 476	33 197	18 244	5 223
Crude oil and petroleum products	131 076	124 586	113 187	109 862	109 178	100 150	86 874	70 049	54 686
Gas	71 853	77 782	75 905	65 154	68 341	68 635	62 447	55 007	38 530
of which: natural gas					68 150	68 444	62 262	54 820	38 364
Nuclear energy	43 750	42 061	36 201	23 636	17 533	0	0	0	0
Derived heat	-3	-6	-6	-3	0	0	0	0	0
Renewable energy including renewable waste	8 983	18 757	31 268	39 929	46 413	53 163	60 817	73 368	89 468
Electricity	263	-393	-1 286	-4 152	-5 542	-1 938	-1 550	-266	492
Waste – non-renewable	1 681	1 845	3 906	4 252	5 534	5 571	5 566	5 298	5 169
Total	342 434	346 476	338 250	318 093	307 710	275 097	247 738	223 583	197 834

Sources: Eurostat, model calculation

Table C2.2.1: Gross electricity generation, in GWh – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Gross electricity generation	576 543	620 199	631 038	646 484	655 258	632 658	609 517	601 393	577 046

Sources: Eurostat, model calculation

Table C2.2.1 new: Gross electricity generation, in GWh – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Gross electricity generation	576 543	620 199	631 038	646 484	654 581	610 416	608 809	659 311	701 350

Sources: Eurostat, model calculation

Table C2.2.2: Gross electricity generation by fuel, in GWh – baseline

	2005	2010	2015	2020	2025	2030	2035	2040
Coal	288 143	262 897	272 200	229 098	234 870	186 686	161 191	130 056
Natural gas	73 960	90 352	63 017	73 851	94 364	84 900	87 251	94 376
Petroleum products	11 998	8 741	6 209	7 440	4 607	4 214	3 705	3 185
Nuclear energy	163 055	140 556	91 786	67 294	0	0	0	0
Renewable[1]	70 181	111 580	194 706	257 996	278 774	313 269	328 449	328 242
Other	12 862	16 912	18 566	19 580	20 043	20 448	20 797	21 187
Total	620 199	631 038	646 484	655 258	632 658	609 517	601 393	577 046

Sources: Eurostat, model calculation
1 including pumped-storage plants and battery storage

Table C2.2.2 new: Gross electricity generation by fuel, in GWh – Climate Action Plan scenario

	2005	2010	2015	2020	2025	2030	2035	2040
Coal	288 143	262 897	272 200	232 399	168 067	104 197	53 034	0
Natural gas	73 960	90 352	63 017	73 708	106 571	100 703	103 341	79 118
Petroleum products	11 998	8 741	6 209	6 987	4 097	3 384	2 604	1 757
Nuclear energy	163 055	140 556	91 786	67 306	0	0	0	0
Renewable[1]	70 181	111 580	194 706	252 069	309 642	378 967	482 183	603 953
Other	12 862	16 912	18 566	22 112	22 039	21 559	18 150	16 522
Total	620 199	631 038	646 484	654 581	610 416	608 809	659 311	701 350

Sources: Eurostat, model calculation
1 including pumped-storage plants and battery storage

Table C2.2.3: Share of combined heat and power generation in electricity and heat generation – baseline

	2005	2010	2015	2020	2025	2030	2035	2040
Share in electricity generation	12.6%	13.2%	12.2%	13.9 %	14.7%	15.7%	15.8%	16.3%
Share of electricity generation including plants not officially recorded*	No information	No information	17.0%	19.2 %	20.6%	20.0%	15.9%	12.9%
Share in heat generation**	No information	No information	No information	73.3 %	72.2%	72.2%	70.5%	68.8%

Source: Eurostat, model calculation

* Source for 2015: Report evaluation of cogeneration (Prognos et al., 2019)
** Share of heat from public cogeneration plants in district heat from non-industrial power stations

Table C2.2.3 new: Share of combined heat and power generation in electricity and heat generation - Climate action Plan scenario

	2005	2010	2015	2020	2025	2030	2035	2040
Share in electricity generation	12.6%	13.2%	12.2%	13.9%	14.9%	14.8%	12.2%	10.0%
Share in heat generation**	No information	No information	No information	72.6%	64.0%	59.6%	50.4%	45.4%

Source: Eurostat, model calculation
** Share of heat from public cogeneration plants in district heat from non-industrial power stations

Table C2.2.4: Capacity of electricity generation by source, including retirements and new investment, in MW – baseline

	2005	2010	2015	2020	2025	2030	2035	2040
Installed net capacity								
Hydropower	5 210	5 407	5 589	5 742	5 742	5 742	5 742	5 742
Biomass	2 352	5 460	7 467	7 563	7 019	6 226	4 581	3 621
Nuclear energy	20 340	20 430	10 800	8 107	0	0	0	0
Lignite	20 680	21 340	21 419	17 910	17 037	15 197	11 077	9 141
Hard coal	27 640	28 390	28 654	21 867	19 158	1 7956	15 986	12 551
Petroleum	5 500	5 900	4 196	1 424	1 129	1 030	1 006	810
Gas[1)]	20 600	23 800	28 359	24 086	25 164	28 617	29 507	33 492
Onshore wind	18 248	26 823	41 297	56 031	55 455.38	60 082	64 111	67 319
Offshore wind	0	80	3 283	7 704	10 804	15 004	18 210	15 700
Solar	2 056	18 006	3 9224	49 873	61 968	71 880	74 498	82 927
Total	122 626	155 636	190 288	200 307	203 476	221 733	224 718	231 303
Increase/decrease								
Hydropower	20	67	9	0	0	0	0	0
Biomass	192	587	207	50	-17	-336	-145	-97
Nuclear energy	-90	0	-1 268	-1 402	0	0	0	0
Lignite	-90	280	351	-757	0	-659	-465	-532
Hard coal	-2 720	1 130	2 444	-413	0	0	-96	-1 815
Petroleum	-100	700	-40	-265	-19	0	0	-17
Gas	1 200	700	-660	393	-157	1 000	510	420
Onshore wind	1 830	1 126	3 677	2 042	735	875	-1 023.5	2 531

Offshore wind	0	45	2 289	0	700	840	354	-1 070
Solar	960	7 440	1 324	2 491	2 295.2	1 213.2	731.3	2 775.7
Total	1 202	12 075	8 333	2 139	3537	2 933	-134	2 196

Sources: Working Group on Renewable Energy Statistics, Federal Ministry of Economic Affairs and Energy, Federal Network Agency, model calculation

1) Model values excluding network and capacity reserves

Table C2.2.4 new: Capacity of electricity generation by source, including retirements and new investment, in MW – Climate action Plan scenario

	2005	2010	2015	2020	2025	2030	2035	2040
Installed net capacity								
Hydropower	5 210	5 407	5 589	5 742	5 742	5 742	5 742	5 742
Biomass	2 352	5 460	7 467	7 563	7 019	6 226	5 222	4 262
Nuclear energy	20 340	20 430	10 800	8 107	0	0	0	0
Lignite	20 680	21 340	21 419	17 910	14 452	9 096	7 858	0
Hard coal	27 640	28 390	28 654	22 300	9 991	8 003	0	0
Petroleum	5 500	5 900	4 196	1 424	1 129	1 002	885	527
Gas[1)]	20 600	23 800	28 359	24 086	26 926	36 250	37 146	40 836
Onshore wind	18 248	26 823	41 297	54 832	62 037	70 899	82 009	98 846
Offshore wind	0	80	3 283	7 696	10 796	19 996	34 799	51 350
Solar	2 056	18 006	39 224	51 568	81 013	97 924	120 044	146 358
Total	122 626	155 636	190 288	201 228	219 104	255 137	293 704	34 7921
Increase/decrease								
Hydropower	20	67	9	128.75	0	0	0	0
Biomass	192	587	207	50	-17	-336	-45	-97
Nuclear energy	-90	0	-1 268	-1 402	0	0	0	0
Lignite	-90	280	351	-757	-304	-2 231	-954	0
Hard coal	-2 720	1 130	2 444	20	-956	-313	0	0
Petroleum	-100	700	-40	-265	-19	0	0	-189
Gas	1 200	700	-660	393	541	2 000	509	313
Onshore wind	1 830	1 126	3 677	2 042	2 480	2 620	823	-163
Offshore wind	0	45	2 289	200	700	3 512	1 311	2 151
Solar	960	7 440	1 324	3 892	5 795	1 713	5 231.3	5 642
Total	1 202	12 075	8 333	4 302	8 220	6 965	6 875	7 657

Sources: Working Group on Renewable Energy Statistics, Federal Ministry of Economic Affairs and Energy, Federal

Network Agency, model calculation
1) Model values excluding network and capacity reserves

Table C2.2.5: Heat generation from thermal power generation, in ktoe – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Emissions from conventional thermal power generation	6 480	8 663	8 604	7 705	8 361	8 483	8 560	8 386	8 167

Sources: Eurostat, model calculation

Table C2.2.5 new: Heat generation from thermal power generation, in ktoe – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Emissions from conventional thermal power generation	6 480	8 663	8 604	7 705	8 277	7 717	7 302	6 399	5 798

Sources: Eurostat, model calculation

Table C2.2.6: Heat generation from combined heat and power plants (including industrial waste heat), in ktoe

	2005	2010	2015	2020	2025	2030	2035	2040
Heat production	15 582	16 139	15 997	No information	No information	No information	No information	No information

Source: Eurostat

Table C2.2.7: Cross-border interconnection capacities for electricity, in GW

	2005	2010	2015	2020	2025	2030	2035	2040
Import capacity, electricity	No information	No information	No information	19.8	28.9	34.1	36.7	37.2

Sources: model calculation

Table C2.3.1: Fuel inputs to thermal power generation, in ktoe – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels[1]	67 127	66 011	60 467	61 281	50 179	51 216	41 037	35 323	28 733
Crude oil and petroleum products	1 421	2 646	1 864	1 388	1 502	851	768	654	535
Gas	12 278	18 581	20 321	14 088	13 314	13 858	13 677	13 508	13 497
All products	85 665	94 531	96 886	95 108	91 663	95 712	86 410	80 878	73 890

Sources: Eurostat, model calculation
1) Solid fuels excluding waste

Table C2.3.1 new: Fuel inputs to thermal power generation, in ktoe - Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	67 127	66 011	60 467	61 281	48 256	34 160	20 342	10 685	0
Crude oil and petroleum products	1 421	2 646	1 864	1 388	1 324	678	554	422	266

Gas	12 278	18 581	20 321	14 088	13 462	17 917	16 887	16 393	12 669
All products	85 665	94 531	96 886	95 108	87 526	63 986	54 607	53 165	49 487

Sources: Eurostat, model calculation
1) Solid fuels excluding waste

Table C2.3.2: Fuel inputs to other conversion processes, in ktoe – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Refineries	119 606	128 292	105 033	102 801	102 261	98 527	92 438	84 392	76 559
Coking plants	8 483	7 540	8 316	8 504	6 600	6 458	6 331	6 228	6 140

Sources: Eurostat, model calculation

Table C2.3.2: Fuel inputs to other conversion processes, in ktoe – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Refineries	119 606	128 292	105 033	102 801	103 063	95 469	82 876	63 864	47 279
Coking plants	8 483	7 540	8 316	8 504	6 614	6 180	5 570	3 157	2 353

Sources: Eurostat, model calculation

Table C2.4.1: Primary and final energy consumption, in ktoe – baseline

	2005	2010	2015	2020	2025	2030	2035	2040
Gross domestic consumption	346 476	338 250	318 093	308 124	289 777	272 523	257 915	243 803
Primary energy consumption	321 617	315 155	295 930	285 386	268 065	251 923	238 163	224 792
Final energy consumption	219 695	223 023	212 681	212 973	207 855	199 923	192 485	185 366

Sources: Eurostat, model calculation

Table C2.4.1 new: Primary and final energy consumption, in ktoe – Climate Action Plan scenario

	2005	2010	2015	2020	2025	2030	2035	2040
Gross domestic consumption	346 476	338 250	318 093	307 710	275 097	247 738	223 583	197 834
Primary energy consumption	321 617	315 155	295 930	284 949	253 248	227 001	203 986	179 612
Final energy consumption	219 695	223 023	212 681	211 859	200 632	185 453	169 639	154 703

Sources: Eurostat, model calculation

Table C2.4.2: Final energy consumption per sector, in ktoe – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Industry	59 675	62 333	61 676	59 005	56 968	54 474	52 858	51 616
Households	63 499	63 363	54 115	54 208	51 309	48 861	47 116	45 656

Commercial and Public Services	30 610	31 574	28 066	29 539	28 669	27 450	26 428	25 585
Transport	62 284	61 089	63 155	65 733	66 624	65 108	62 266	58 852
Freight transport	18 963	19 068	20 028	22 369	23 199	23 189	23 225	22 989
Carriage of passengers	43 321	42 021	43 127	43 364	43 425	41 919	39 041	35 863
Agriculture	3 091	3 199	4 100	4 488	4 285	4 029	3 818	3 657
Total	219 695	223 023	212 681	212 973	207 855	199 923	192 485	185 366

Sources: Eurostat; TREMOD; model calculation

Table C2.4.2: Final energy consumption per sector, in ktoe – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Industry	59 675	62 333	61 676	58 735	54 027	49 586	44 440	40 994
Households	63 499	63 363	54 115	53 766	49 955	46 399	43 287	39 641
Commercial and Public Services	30 610	31 574	28 066	29 359	28 038	26 365	24 835	23 194
Transport	62 284	61 089	63 155	65 526	64 380	59 165	53 386	47 397
Freight transport	18 963	19 068	20 028	22 323	22 050	20 264	19 339	18 319
Carriage of passengers	43 321	42 021	43 127	43 203	42 330	38 901	34 047	29 078
Agriculture	3 091	3 199	4 100	4 473	4 231	3 937	3 692	3 477
Total	219 695	223 023	212 681	211 859	200 632	185 453	169 639	154 703

Sources: Eurostat; TREMOD; model calculation

Table C2.4.3: Final energy consumption by fuel, in ktoe – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	9 193	10 040	10 357	9 700	9 306	8 992	8 813	8 696
Crude oil and petroleum products	89 615	82 893	81 048	80 596	77 326	72 192	66 190	60 219
Gas	55 136	56 431	51 764	50 400	47 726	44 886	42 581	40 387
Derived heat	10 645	11 253	9 529	9 832	10 142	10 129	10 143	10 091
Renewable energies	9 909	15 707	14 679	16 409	17 666	18 530	19 366	20 168
Electricity	44 919	45 746	44 278	44 402	44 029	43 528	43 719	44 121
Waste (non-renewable)	276	953	1 026	1 618	1 589	1 537	1 499	1 465
Total	219 695	223 023	212 681	212 973	207 855	199 923	192 485	185 366

Sources: Eurostat, model calculation

Table C2.4.3 new: Final energy consumption by fuel, in ktoe – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	9 193	10 040	10 357	9 692	8 854	7 835	4 811	3 342
Crude oil and petroleum products	89 615	82 893	81 048	80 190	73 195	61 776	47 691	34 408
Gas	55 136	56 431	51 764	49 475	43 284	37 779	30 201	19 415
Derived heat	10 645	11 253	9 529	10 013	10 536	10 720	10 691	10 591
Renewable energies	9 909	15 707	14 679	16 541	19 026	20 899	25 428	31 135
Electricity	44 919	45 746	44 278	44 274	43 957	44 382	45 949	47 131
Waste (non-renewable)	276	953	1 026	1 654	1 625	1 563	1 265	1 149
PtX	0	0	0	20	154	499	3 603	7 531
Total	219 695	223 023	212 681	211 859	200 632	185 453	169 639	154 703

Sources: Eurostat, model calculation

Table C2.4.4: Final non-energy consumption, in ktoe – baseline

	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	243	354	361	377	337	299	267	239
Crude oil and petroleum products	21 947	19 838	18 527	19 649	18 683	17 663	16 885	16 211
Gas	2 472	2 392	2 372	2 712	2 693	2 638	2 599	2 562
Total	24 662	22 585	21 260	22 737	21 712	20 600	19 752	19 012

Sources: Eurostat, model calculation

Table C2.4.4 new: Final non-energy consumption, in ktoe – Climate Action Plan scenario

	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	243	354	361	377	337	299	267	239
Crude oil and petroleum products	21 947	19 838	18 527	19 649	18 683	17 663	16 618	15 944
Gas	2 472	2 392	2 372	2 735	2 829	2 775	2 711	2 039
Total	24 662	22 585	21 260	22 760	21 849	20 737	19 596	18 222

Sources: Eurostat, model calculation

Table C2.4.5: Primary energy intensity of the overall economy (domestic consumption by GDP), in toe/EUR$_{2016}$ – baseline

	2005	2010	2015	2020	2025	2030	2035	2040
Primary energy intensity	0.121	0.112	0.097	0.094	0.082	0.074	0.066	0.060

Sources: Eurostat, model calculation

Table C2.4.5: Primary energy intensity of the overall economy (domestic consumption by GDP), in toe/EUR$_{2016}$ – Climate Action Plan scenario

	2005	2010	2015	2020	2025	2030	2035	2040
Primary energy intensity	0.121	0.112	0.097	0.094	0.078	0.066	0.057	0.048

Sources: Eurostat, model calculation

Table 2.4.6: Final energy intensity by sector – baseline

Indicator	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Industry	toe/thousand euro	0.10	0.10	0.09	0.07	0.06	0.06	0.05	0.05
Residential buildings	toe/m²	0.018	0.018	0.015	0.014	0.013	0.012	0.012	0.011
Freight transport	toe/Mtkm	33.01	30.53	30.31	30.61	28.90	27.27	25.95	24.66
Carriage of passengers	toe/Mpkm	35.26	32.65	31.83	30.51	29.37	27.60	25.47	23.27
Services	toe/thousand euro	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01

Sources: Calculation based on Eurostat and model calculation

Table 2.4.6 new: Final energy intensity by sector – Climate Action Plan scenario

Indicator	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Industry	toe/thousand euro	0.10	0.10	0.09	0.07	0.06	0.05	0.05	0.04
Residential buildings	toe/m²	0.017	0.017	0.014	0.013	0.012	0.011	0.010	0.009
Freight transport	toe/Mtkm	33.01	30.53	30.31	30.55	27.46	24.37	22.38	20.39
Carriage of passengers	toe/Mpkm	35.26	32.65	31.83	30.39	28.79	26.02	22.73	19.43
Services	toe/thousand euro	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01

Sources: Calculation based on Eurostat and model calculation

Table C2.5.1: Electricity prices by type of consumption sector, in EUR$_{2016}$/kWh – baseline

Indicator	2010	2015	2020	2025	2030	2035	2040
Domestic customers (including VAT)	0.262	0.290	0.308	0.331	0.310	0.297	0.307
Non-household customers							
CTS (average value of CTS 1 and CTS 2)*	0.174	0.209	0.227	0.244	0.224	0.213	0.219
Industrial 3 (1 000 MWh, e.g. machine building)	0.114	0.150	0.172	0.187	0.165	0.152	0.157
Industrial 4 (10 000 MWh, e.g. Automotive supplier)	0.098	0.134	0.154	0.169	0.147	0.134	0.139
Industrial 5 (industrial business, 100 000 MWh per year, high voltage level)	0.090	0.121	0.141	0.156	0.134	0.121	0.126
Industrial 6 (100 000 MWh, e.g. chemicals)	0.053	0.040	0.056	0.070	0.077	0.086	0.089

Sources: Model

* CTS1 or CTS2: Service industry with electricity supply of 50 MWh or 200 MWh per year. Prices excluding VAT

Table C2.5.1 new: Electricity prices by type of consumption sector, in EUR$_{2016}$/kWh – Climate action Plan scenario

Indicator	2010	2015	2020	2025	2030	2035	2040
Domestic customers (including VAT)	0.262	0.290	0.306	0.312	0.278	0.296	0.304
Non-household customers							
CTS (average value of CTS 1 and CTS 2)*	0.174	0.209	0.226	0.228	0.197	0.212	0.217
Industrial 3 (1 000 MWh, e.g. machine building)	0.114	0.150	0.171	0.171	0.137	0.151	0.154
Industrial 4 (10 000 MWh, e.g. Automotive supplier)	0.098	0.134	0.154	0.153	0.119	0.133	0.136
Industrial 5 (industrial business, 100 000 MWh per year, high voltage level)	0.090	0.121	0.141	0.140	0.106	0.120	0.122
Industrial 6 (100 000 MWh, e.g. chemicals)	0.053	0.040	0.056	0.074	0.076	0.088	0,087

Sources: Model

* CTS1 or CTS2: Service industry with electricity supply of 50 MWh or 200 MWh per year. Prices excluding VAT

Table C2.5.2: National retail fuel prices, in EUR$_{2016}$/Mtoe – baseline

	2000	2005	2010	2015	2020	2025	2030	2035	2040
'Super'-grade petrol	1 608	1 831	2 012	1 824	1 999	2 020	2 032	1 982	1 950
Diesel	1 144	1 441	1 570	1 396	1 732	1 806	1 868	1 859	1 861

Sources: Energy data published by the Federal Ministry of Economic Affairs and Energy, extrapolation of model estimate

Prices including tax and CO_2 pricing

Table C2.5.2: National retail fuel prices, in EUR$_{2016}$/Mtoe – Climate Action Plan scenario

	2000	2005	2010	2015	2020	2025	2030	2035	2040
'Super'-grade petrol	1 608	1 831	2 012	1 824	1 999	2 162	2 453	2 584	2 613
Diesel	1 144	1 441	1 570	1 396	1 732	1 952	2 300	2 477	2 543

Sources: Energy data published by the Federal Ministry of Economic Affairs and Energy, extrapolation of model estimate

Prices including tax and CO_2 pricing

Table C2.6.1: Energy-related investment costs compared to GDP

No information can be provided for this indicator

Table C2.7.1: Gross final consumption of energy from renewable sources and share of renewable energy in gross final energy consumption and by sector (electricity, heating and cooling, transport) in GWh – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040

Absolute in GWh								
Gross electricity production	63 702	110 337	180 650	238 664	260 758	289 348	301 153	293 202
Final consumption of energy for heating and cooling	102 877	166 365	169 062	35 603	40 108	45 828	53 556	59 409
Final consumption of energy for transport[1)]	22 503	35 539	32 611	182 295	197 179	209 091	217 978	227 137
Gross final energy consumption[2)]	189 082	312 241	382 324	456 562	498 045	544 266	572 688	579 748
share in percentage								
of gross electricity consumption[2)]	10.6	18.3	30.9	41.7	46.8	53.7	57.1	56.4
of final energy consumption for heating and cooling[2)]	7.7	12.1	13.4	14.9	16.9	18.9	20.6	22.3
of final energy consumption for transport[2)]	4.0	6.4	6.6	8.5	10.7	15.2	21.1	26.9
of gross final energy consumption[2)]	7.2	11.7	14.9	18.8	21.1	24.2	26.5	28.0

Sources: Eurostat, model calculation

1) Consumption of biogenic fuels and electricity from renewable energies in the transport sector

2) Pursuant to EU-RL 2009/28/EC, from 2025 weighting/standardisation pursuant to EU-RL 2018/2001

Table C2.7.1 new: Gross final consumption of energy from renewable sources and share of renewable energy in gross final energy consumption and by sector (electricity, heating and cooling, transport) in GWh – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Absolute in GWh								
Gross electricity production	63 702	110 337	180 650	239 884	285 364	335 505	411 464	489 653
Final consumption of energy for heating and cooling	102 877	166 365	169 062	182 646	214 851	241 557	305 521	381 304
Final consumption of energy for transport 1)	22 503	35 539	32 611	35 911	42 545	60 348	85 665	121 806
Gross final energy consumption[2)]	189 082	312 241	382 324	458 441	542 760	637 410	802 651	992 763
share in percentage								
of gross electricity consumption[2)]	10.6	18.3	30.9	41.5	51.4	62.7	73.4	85.7
in final consumption of energy for heating and cooling[2)]	7.7	12.1	13.4	15.1	19.4	23.9	33.8	46.8
Final consumption of energy for transport[2)]	4.1	6.4	7	8.6	12.7	26.9	52.7	95.9

of gross final energy consumption [2)]	7.2	11.7	14.9	19.0	24.0	30.7	42.5	58.1

Sources: Eurostat, model calculation

1) Consumption of biogenic fuels and electricity from renewable energies in the transport sector

2) Pursuant to EU-RL 2009/28/EC, from 2025 weighting/standardisation pursuant to EU-RL 2018/2001

Table C2.7.2 Electricity and heat generation from renewable energy in buildings (as defined in Article 2(1) of Directive 2010/31/EU) in ktoe

No information can be provided for this indicator

Table C3.1: Comparison of ETS and non-ETS emissions, in Mt CO_2eq – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
ETS	476	473	454	417	420	369	337	306
Non-ETS	517	469	444	423	396	363	332	305
LULUCF	-12	-20	-28	30	26	21	20	20

Source: German Emissions Trading Authority (2011–2019; VET reports), Annual reports of the EU ESD inventory reviews, EU MMR, model calculation

Table C3.1 new: Comparison of ETS and non-ETS emissions, in Mt CO_2eq – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
ETS	476	473	454	422	363	288	216	132
Non-ETS	517	469	444	413	367	306	242	178
LULUCF	-12	-20	-28	29	7	10	6	2

Source: German Emissions Trading Authority (2011–2019; VET reports), Annual reports of the EU ESD inventory reviews, EU MMR, model calculation

Table C3.2: GHG emissions by sector – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Energy-related emissions	**832**	**802**	**767**	**711**	**694**	**615**	**557**	**499**
Energy industry	379	356	336	297	302	252	223	192
Industry	115	126	127	117	112	106	102	99
Transport	161	154	163	163	160	148	136	122
Private households	112	107	88	80	71	63	56	51
Commerce/trade/services, others	48	48	43	45	40	36	33	30
Fugitive emissions	16	11	10	9	9	8	8	7
Non-energy-related emissions	**161**	**141**	**139**	**128**	**122**	**117**	**113**	**111**
Industrial processes	76	63	60	56	52	49	47	46
Agriculture	64	64	68	63	63	62	61	61

Waste	21	15	11	9	7	5	5	4
Total	**993**	**942**	**906**	**839**	**816**	**731**	**670**	**611**
For information only: LULUCF	-13	-20	-28	30	26	21	20	20
For information only: Internat. air and sea transport	30	33	32	41	45	49	50	50

Sources: Federal Environment Agency (2020), model calculation

Table C3.2 new: GHG emissions by sector – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Energy-related emissions	**832**	**802**	**767**	**712**	**613**	**485**	**360**	**217**
Energy industry	379	356	336	300	246	176	128	62
Industry	115	126	127	117	105	94	68	45
Transport	161	154	163	162	152	125	95	63
Private households	112	107	88	79	66	53	40	26
Commerce/trade/services, others	48	48	43	44	37	30	23	19
Fugitive emissions	16	11	10	9	9	7	6	4
Non-energy-related emissions	**161**	**141**	**139**	**128**	**121**	**112**	**101**	**94**
Industrial processes	76	63	60	57	53	49	41	36
Agriculture	64	64	68	63	61	58	56	54
Waste	21	15	11	8	6	5	4	3
Total	**993**	**942**	**906**	**841**	**734**	**598**	**462**	**311**
For information only: LULUCF	-13	-20	-28	29	7	10	6	2
For information only: Internat. air and sea transport	30	33	32	41	45	49	45	43

Sources: Federal Environment Agency (2020), model calculation

Table C3.3: GHG intensity of the economy, in kg CO_2eq/euro GDP_{2016} – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
CO_2 intensity of the overall economy	0.374	0.335	0.296	0.252	0.230	0.196	0.171	0.149

Sources: model calculation

Table C3.3 new: GHG intensity of the economy, in kg CO_2eq/euro GDP_{2016} – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
CO_2 intensity of the overall economy	0.374	0.335	0.296	0.253	0.207	0.160	0.118	0.076

Sources: model calculation

Table C3.4.1: GHG intensity of electricity and district heating generation, in t CO_2eq/toe – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
GHG intensity electricity	481	446	424	354	378	316	276	240
GHG intensity district heat	3 049	3 013	2 948	2 806	2 690	2 537	2 516	2 465

Sources: model calculation

Table C3.4.1: GHG intensity of electricity and district heating generation, in t CO_2eq/toe – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
GHG intensity electricity	479	443	424	358	302	199	129	41
GHG intensity district heat	3 049	3 013	2 948	2 830	2 524	2 245	1 901	1 556

Sources: model calculation

Table C 3.4.2: GHG intensity of consumption sectors, in t CO_2eq/toe – baseline

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Industry	1.9	2.0	2.1	2.0	2.0	2.0	1.9	1.9
Industry including processes	3.2	3.0	3.1	2.9	2.9	2.9	2.8	2.8
Transport	2.6	2.5	2.6	2.5	2.4	2.3	2.2	2.1
Private households	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1
Commerce/trade/services, including agriculture	3.3	3.1	3.3	3.2	3.1	3.1	3.1	3.1

Sources: model calculation

Table C 3.4.2: new: GHG intensity of consumption sectors, in t CO_2eq/toe – Climate Action Plan scenario

Indicator	2005	2010	2015	2020	2025	2030	2035	2040
Industry	1.9	2.0	2.1	2.0	1.9	1.9	1.5	1.1
Industry including processes	3.2	3.0	3.1	3.0	2.9	2.9	2.5	2.0
Transport	2.6	2.5	2.6	2.5	2.4	2.1	1.8	1.3
Private households	1.8	1.7	1.7	1.6	1.4	1.3	1.0	0.7
Commerce/trade/services, including agriculture	3.3	3.1	2.9	2.8	2.7	2.6	2.5	2.4

Sources: model calculation

Bundesministerium
für Wirtschaft
und Energie

Notification of Member States' measures and methodologies to implement Article 7 of Directive 2012/27/EU

Pursuant to Article 3 (2) (h) of the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the governance of the energy union and climate action, amending Directive 94/22/EC, Directive 98/70/EC, Directive 2009/31/EC, Regulation (EC) No 663/2009, Regulation (EC) No 715/2009, Directive 2009/73/EC, Council Directive 2009/119/EC, Directive 2010/31/EU, Directive 2012/27/EU, Directive 2013/30/EU and Council Directive (EU) 2015/652 and repealing Regulation (EU) No 525/2013

The Federal Government of the Federal Republic of Germany hereby submits to the Commission, subject to further review, a provisional communication concerning the planned implementation of Article 7 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (as amended by Directive 2018/2002/EU) (hereinafter EED). In accordance with the requirements of Annex V number 5 EED and Annex III of Regulation (EU) 2018/1999, the communication contains the following information:

- A provisional quantification of the savings target for the Federal Republic of Germany in accordance with Article 7(1)(b) EED (section 1),
- Overview of the possible use of the options provided for in Article 7(2) EED (section 2),
- The provisional identification of strategic measures in accordance with Article 7b EED including the cumulative final energy savings to be achieved by them during the period 2020-2030 and more detailed clarification of the methodology of this estimate (section 3),
- Information on the methods of calculation used (section 4),
- Measures and systems for reviewing and monitoring the savings (section 5).

The corresponding requirements in Article 7 and Annex V EED together with Annex III of Regulation (EU) 2018/1999 have been included in the estimate of the cumulative final energy savings resulting from the measures.

Amendments may be made to the planned implementation on the basis of future resolutions of the Federal Government and the German Bundestag. The Federal Government will thus give prompt notification of further instruments and measures relevant to the fulfilment of Article 7(1)(b) EED and so guarantee that the Federal Republic of Germany will achieve the savings target pursuant to Article 7 EED. These may consist inter alia of further existing strategic measures to increase energy efficiency. The announcement of additional measures may also be included. The Federal Government will also inform the EU Commission of any amendments in the scope of its reporting obligations in accordance with the Governance regulation.

1. Calculation of the level of the energy savings requirements to be achieved over the whole period from 1 January 2021 to 31 December 2030

a) Annual final energy consumption, averaged over the most recent 3-year period prior to 1 January 2019

Calculations relating to the energy savings target pursuant to Article 7(1)(b) EED are based on average final energy consumption values for the Federal Republic of Germany from 2016 to 2018, based on figures from EUROSTAT concerning final energy consumption.

- Final energy consumption in 2016: 216.87 Mtoe (9 080 PJ)
- Final energy consumption in 2017: 218.62 Mtoe (9 153 PJ)
- Final energy consumption in 2018: 215.37 Mtoe (9 017 PJ)
- Average annual final energy consumption in 2016-2018: **9 083 PJ / 216.95 Mtoe**

b) the total cumulative amount of end-use energy savings to be achieved [in ktoe] in accordance with Article 7(1)(b) of Directive 2012/27/EU

The energy savings target pursuant to Article 7(1)(b) EED is thus estimated at 3 996.5 PJ or 95.46 Mtoe.

c) Data and sources used for the calculation of final energy consumption:

The figures for final energy consumption are based on data from Eurostat[24]. In the Eurostat database, the indicator for following progress towards achieving the targets has the code ‘FEC2020-2030’ and description ‘Final energy consumption (Europe 2020-2030)’.

2. Use of the options set out in Article 7(2) of Directive 2012/27/EU:
The Federal Government does not currently intend to make use of the options set out in Article 7(2) EED.

3. Strategic measures for achieving the energy savings pursuant to Article 7(1) of Directive 2012/27/EU:
For the fulfilment of the savings target pursuant to Article 7(1) EED of 3 996.5 PJ or 95.46 Mtoe, the Federal Government opts to implement alternative strategic measures in accordance with Article 7b EED.

A combination will be selected of existing measures that have already been introduced but that will lead to the implementation of individual measures after 31 December 2020, and new measures adopted by the

[24] Data retrieved: 11/03/2020.

Federal Government as part of the Climate Action Programme 2030[25] and the Energy Efficiency Strategy 2050[26].

a) Overview of the expected cumulative final energy savings for the period from 1 January 2021 to 31 December 2030

The following table provides an overview of the existing and planned alternative measures pursuant to Article 7b EED and the expected cumulative final energy savings for the period from 1 January 2021 to 31 December 2030:

[25] 'Federal Government Climate Action Programme 2030 for the implementation of the Climate Action Plan 2050' dated 9.10.2019.
[26] 'Energy Efficiency Strategy 2050' of the Federal Ministry of Economic Affairs and Energy (BMWi) dated December 2019.

Notification No[27]	Title of measures	Subject	Expected cumulative final energy saving 2021-2030 in PJ[28]
Investment incentive			
M01	Energy efficiency in the economy – subsidy and credit	Funding of cross-sectional technology, process heating from renewable energy sources, instrumentation and control technology, sensor technology and energy management software and energy-related optimisation of equipment and processes	480 PJ
M02	Energy efficiency in the economy – funding competition	Funding of actor, sector and technology-neutral implementation of energy efficiency projects in companies	56 PJ
M03	Federal funding for efficient buildings	Funding of energy efficiency in buildings (residential, non-residential, individual measures, replacement of storage water heaters by electronic flow heaters)	305 PJ
M04	Refrigeration and air conditioning guideline	Funding for increasing the efficiency of refrigeration/air conditioning equipment	18 PJ
M05	Energy efficiency in agriculture and horticulture	Funding (new construction, systemic optimisation, individual measures, energy consultancy, efficiency 'tables')	18 PJ
M06	Selected elements of the local guideline	Funding for energy efficiency of interior ventilation systems, interior/hall lighting, exterior lighting	15 PJ
M07	Funding of serial renovation work	Acceleration of energy-related renovation with simultaneous increase in the depth and speed of the renovations	11 PJ
M08	Funding for e-mobility – e-mobility environmental bonus	Proportional funding via an environmental bonus	61 PJ
M09	Funding guideline for procuring electric buses in local public transport	Funding for the procurement of plug-in hybrid buses and battery buses	3 PJ

[27] The notification number of the measures is not identical to the notification number of the measures announced for the fulfilment of the savings obligation for the previous period 2014 to 2020.
[28] Net effect taking into account windfall, anticipatory, spill-over, structural and rebound effects. At individual measure level, with consideration of interactions between measures pursuant to the individual interaction factors listed in section 4e.

Voluntary commitments and standards			
M10	§45 of the draft for the Buildings Energy Act [Gebäudeenergiegesetz, GEG]	Incentive for non-obligatory undercutting of the legal requirements for the structural thermal insulation of new residential and non-residential buildings	33 PJ
M11	Draft for the Buildings Energy Act (GEG) – existing buildings	Requirements for an existing building	573 PJ
M12	Exemplary role of federal buildings	Minimum requirements for construction projects for the renovation and modernisation of federal buildings	6 PJ
M13	Electricity-based fuels	Funding for electricity-based fuels	16 PJ
M14	Accelerated implementation of the measures of the energy audit and energy management systems	Implementation of previously unused potentials on the basis of voluntary commitment	19 PJ
Pricing instruments			
M15	Energy and electricity tax	Steering effect via consumer taxes	573 PJ
M16	CO_2 pricing for the transport and heating sectors	CO_2 pricing for the transport and heating sectors from 2021	713 PJ
M17	Air transport tax	Increase in air transport tax	38 PJ
M18	Tax incentives for energy-related building renovations	Tax reduction for energy-related measures for buildings used for own residential purposes	127 PJ
M19	Heavy goods vehicle toll	CO_2-dependent heavy goods vehicle toll	51 PJ
M20	Make rail travel cheaper	VAT reduction for long-distance rail travel	26 PJ
Consultation and information programme			
M21	Energy consulting	Funding of energy consulting services for residential buildings and private households as well as for non-residential buildings belonging to communities and charitable organisations	27 PJ
M22	Energy consulting SMEs	Funding of energy consulting for small and medium-sized enterprises	49 PJ
M23	Electricity saving check	Consulting for low-income households regarding saving electricity and energy.	5 PJ
M24	SME initiative for energy transition and climate action (MIE)	Providing assistance via qualification and network projects for SMEs in skilled crafts and industry concerning energy efficiency and climate protection	10 PJ
M25	Energy management systems (EnMS)	Exemption from energy and electricity tax and the Cogeneration Act and Renewable Energy Sources Act levy for energy and electricity cost-intensive companies for implementation of an energy management system	120 PJ

M26	Introduction of environmental management system in the federal administration	Introduction of an environmental management system by 2025 for all supreme federal authorities and 300 other government properties	9 PJ
M27	Heating label	Consumer information concerning the efficiency status of each of their old heating appliances and funding opportunities	9 PJ
Total (net and also corrected for interactions within the package of measures announced)			3371 PJ

b) Description of the measures pursuant to the requirements in Annex III(3)(3.2) and (3.3) and Annex III(4)(c)-(d) of Regulation (EU) 2018/1999

A detailed description of these measures and the annual savings made as a result of these pursuant to the requirements in Annex III(3)(3.2) and (3.3) and Annex III(4)(c)-(d) of Regulation (EU) 2018/1999 can be found below. Further technical details can be provided on request.

Investment incentive

M 01: Energy efficiency in the economy – subsidy and credit

Brief description of the measure	**Energy efficiency in the economy – subsidy and credit**
Name of the measure	Federal funding for energy efficiency in the economy – subsidy and credit
Type of strategic measure	Funding programme
Description of strategic measure	The programme represents a reorganisation of a range of previous funding measures. The programmes Funding of high-efficiency cross-sectional technologies, the waste heat guideline, the funding of energy-efficient and climate-friendly production processes, the funding of energy management systems, and the funding of renewable process heat in the market incentive programme expired by December 2018 at the latest and were re-started with adjusted funding conditions and funding rates in January 2019 as a joint support package. The programmes were packaged in the form of four modules and their application procedure was simplified. The target of the restructuring is to offer an integrated energy efficiency support programme for the economy, remove obstacles to the application process and eliminate overlaps between various measures. In the new funding programme 'Federal funding for energy efficiency in the economy', funding is possible in four selectable and combinable modules: • Module 1: Cross-sectional technologies • Module 2: Process heat from renewable energy sources • Module 3: MSR, sensor technology and energy management software • Module 4: Energy-related optimisation of equipment and processes
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by: • Federal Office for Economic Affairs and Export Control [Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA] – variant subsidy • Reconstruction Loan Corporation [Kreditanstalt für Wiederaufbau, KfW] – variant credit
Target sectors	Industry, commerce/trade/services
Recipient	Companies of all sectors and sizes, municipal utilities and energy service providers
Permissible actions proposed as part of the relevant measure	Cross-sectional technologies, processes
Lifetime	On average 11 years

Methodological aspects	The savings effects of these measures are based on the savings calculated by bottom-up evaluations from measures already funded by the preceding programme. In addition to an extrapolation of the evaluation results, the forecast includes a growth effect of 10% due to the removal of obstacles resulting from the better organisation of the funding landscape. An adjustment of the gross values to represent those savings that are the main reason for the programme (net values) is carried out on the basis of the windfall, anticipatory and spill-over effects estimated by surveys from the preceding programme. For the estimate, a low average value of the values of the preceding programme, weighted according to programme size, is used a basis. The reason behind the choice of the low level is that the newly simplified funding structure provides more targeted funding and thus decreases the windfall effects. At the same time, this structure removes obstacles and therefore favours the occurrence of spill-over effects. Taking into account an average weighted by share of the savings of 28%, the net values correspond to 72% of the gross values. An adjustment for double counting is also made (see 5). Specific gross final energy saving (PJ/year) from the bottom-up evaluations of the preceding programme: • Waste heat 2018 10 • Cross-sectional technologies 2018 0.4 • Production processes 2017 0.5 • Energy management systems 2017 0.1 • Total (preceding programme) 11 • Total estimated for Impact assessment (renewable process heat does not lead to final energy savings) 12.8
Sources/references	Richtlinie für die Förderung der Energieeffizienz und Prozesswärme aus Erneuerbaren Energien in der Wirtschaft – Zuschuss und Kredit („Energieeffizienz in der Wirtschaft – Zuschuss und Kredit“) [Guideline for funding of energy efficiency and process heat from renewable energy sources in the economy – subsidy and credit (‘Efficiency in the economy – subsidy and credit’)], Federal Gazette, official section 29.3.2019 B2 Fichtner, Fraunhofer Institute for Solar Energy Systems, TFZ, Qoncept Energy, Leipzig Institute for Energy (various years): Evaluation des Marktanreizprogramms zur Förderung von Maßnahmen zur Nutzung erneuerbarer Energien im Wärmemarkt [Evaluation of the market incentive programme for funding measures for the use of renewable energies in the heating market]. Fraunhofer Institute for Systems and Innovation Research, Prognos AG, Institute for Energy and Environmental Research, Foundation for Environmental Energy Law: Evaluierung und Weiterentwicklung des Energieeffizienzfonds [Evaluation and further development of the Energy Efficiency Fund] (Project No 63/15).

	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross*	**net***	
Expected total	12.8	8.7	480.42

* Gross values contain no adjustments, net values are adjusted for all effects including interactions within the package of measures.

M 02: Federal funding for energy efficiency in the economy – funding competition

Brief description of the measure	**Energy efficiency in the economy – funding competition**
Name of the measure	Federal funding for energy efficiency in the economy – funding competition
Type of strategic measure	Funding programme

Description of strategic measure	In the context of the programme, the stakeholder-, sector- and technology-neutral implementation of energy efficiency projects in companies are funded in a competitive procedure. Funding is given for investment measures for the energy-related optimisation of industrial and commercial equipment and processes, which contribute to increasing energy efficiency and reducing consumption of fossil fuels in companies. This also includes measures for providing process heat from renewable energy sources. In addition, costs for setting up an energy-saving concept and supporting the implementation of the necessary investment measures using external experts are also eligible for funding. This is a further development of the programme introduced in 2016, 'Promoting electricity conservation on the basis of competitive tendering: Harness electricity efficiency potentials – STEP up!'		
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The programme is administered by VDI/VDE Innovation + Technik GmbH.		
Target sectors	Industry, commerce/trade/services		
Recipient	Companies of all sectors and sizes, municipal utilities and energy service providers		
Permissible actions proposed as part of the relevant measure	Cross-sectional technologies, processes		
Lifetime	On average 7.8 years, individual lifetime depends on the measure [electrical drives 8 years, compressed air 8 years, systemic solutions 8 years, pumps 8 years, process heat 8 years, process cooling 8 years, information and communication technology 3 years]		
Methodological aspects	As part of the evaluation of the preceding guideline, windfall, anticipatory, expansion and spill-over effects were estimated by means of a survey of funding recipients, with the result that the expansion and spill-over effects exceeded the anticipatory and windfall effects. According to this, the net savings are approx. 9% higher than the gross savings.		
Sources/references	Prognos, Institute for Energy and Environmental Research (2019): Ex post analysis of the STEP up! pilot programme (Evaluation of the preceding programme). Richtlinie für die Bundesförderung der Energieeffizienz und Prozesswärme aus Erneuerbaren Energien in der Wirtschaft – Wettbewerb (BMWi-Wettbewerb Energieeffizienz) [Guideline for funding of energy efficiency and process heat from renewable energy sources in the economy – competition (Federal Ministry of Economic Affairs and Energy competition energy efficiency] of 26.3.2019, Federal Gazette, official section 29.3.2019 B1.		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	1.03	1.07	55.72

M 03: Federal subsidy for efficient buildings [Bundesförderung für energieeffiziente Gebäude, BEG]

Brief description of the measure	**Federal funding for efficient buildings**
Name of the measure	Federal subsidy for efficient buildings
Type of strategic measure	Funding programme

Description of strategic measure	Energy efficiency in buildings is promoted by means of the following modules: • BEG residential buildings: KfW Energy efficient building and renovation [Energieeffizient Bauen und Sanieren, EBS] Residential buildings (existing programme numbers 151, 153, 430) • BEG non-residential buildings: KfW Energy efficient building and renovation Non-residential buildings (existing programme numbers 217, 218, 219, 220, 276, 277) • BEG individual measures: BAFA/KfW Market Incentive Programme [Marktanreizprogramm, MAP] for funding measures for the use of renewable energy sources in the heating market, including Energy Efficiency Incentive Programme [Anreizprogramm Energieeffizienz, APEE], KfW programme numbers 167, 271/281/272/282 and existing programme numbers 152, 430, 218, 219, 278 • If necessary, replacement of storage water heaters by electronic flow heaters (review planned as NEEAP 2.0 measure)
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by: • Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) Frankfurter Str. • Kreditanstalt für Wiederaufbau (KfW) [Reconstruction Loan Corporation]
Target sectors	Cross-sectoral
Recipient	Building owners
Permissible actions proposed as part of the relevant measure	Building shell, technical building services
Lifetime	Average 22 years, individual lifetime depends on the measure [building renovation 25 years, replaced heating systems 20 years, replaced storage water heaters 15 years]
Methodological aspects	With regard to adjustment, a windfall effect of 20% is assumed.
Sources/references	IWU, Fraunhofer Institute for Manufacturing Technology and Advanced Materials (various years): Monitoring of the KfW programmes 'Energieeffizient Sanieren' [Energy-efficient renovation] and 'Energieeffizient Bauen' [Energy-efficient building]. Fichtner, Fraunhofer Institute for Solar Energy Systems, TFZ, Qoncept Energy, Leipzig Institute for Energy (various years): Evaluation des Marktanreizprogramms zur Förderung von Maßnahmen zur Nutzung erneuerbarer Energien im Wärmemarkt [Evaluation of the market incentive programme for funding measures for the use of renewable energies in the heating market]. Prognos (2019, not yet published): Evaluation of the KfW funding programme for energy-efficient building and renovation for non-residential buildings (Energieeffizienten Bauen und Sanieren für Nichtwohngebäude, EBS NWG) in the funding period 2015 to 2017. Prognos, German Energy Agency, bbh, adelphi, Öko-Institut, Institute for Energy and Environmental Research, Navigant (2020, not yet published): Brief report on measures aimed at achieving targets 2030 to support the Cabinet Committee on climate protection.

	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	9.9	5.5	305.40

M 04: Refrigeration and air conditioning guideline

Brief description of the measure	**Refrigeration and air conditioning guideline**
Name of the measure	Funding for energy-efficient refrigeration and air-conditioning equipment with non-halogenated refrigerants in stationary and vehicle applications
Type of strategic measure	Funding programme

Description of strategic measure	The measure is essentially aimed at increasing the efficiency of the necessary equipment compared to the market average, in addition to reducing harmful F-gases. The effect of the necessary use of waste heat is particularly relevant to the final energy savings.		
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by the Federal Office for Economic Affairs and Export Control [Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA].		
Target sectors	Industry, commerce/trade/services		
Recipient	Company		
Permissible actions proposed as part of the relevant measure	Technical building services		
Lifetime	8 years		
Methodological aspects	Windfall effects were calculated in the evaluation of the National Climate Protection Initiative. To simplify, this assumes that the effects calculated there, which refer to the reduction of greenhouse gases, which are not based on efficiency effects, affect the final energy savings concerned here in the same ratio (32%).		
Sources/references	Öko-Institut, Institute for Energy and Environmental Research, Prognos, ffu, Ziesing, Klinski (2019): Evaluierung der Nationalen Klimaschutzinitiative [Evaluation of the National Climate Protection Initiative]. Status 31.12. 2017. Öko-Institut, Fraunhofer Institute for Systems and Innovation Research (2019): Umsetzung Aktionsprogramm Klimaschutz 2020 – Begleitung der Umsetzung der Maßnahmen des Aktionsprogramms [Implementing the Climate Action Plan 2020 – Supporting the implementation of the measures of the Action Plan]. 3. Quantification report of 5.2.2019, Tab. 3-94 Richtlinie zur Förderung von Kälte-und Klimaanlagen mit nicht-halogenierten Kältemitteln in stationären und Fahrzeug-Anwendungen im Rahmen der Nationalen Klimaschutzinitiative (Kälte-Klima-Richtlinie) [Guideline for funding for refrigeration and air-conditioning equipment with non-halogenated refrigerants in stationary and vehicle applications in the context of the National Climate Protection Initiative (Refrigeration and air-conditioning guideline)] of 19.12.2018, Federal Gazette, official section 31.1.2019 B2.		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	0.54	0.35	18.12

M 05: Energy efficiency in agriculture and horticulture

Brief description of the measure	**Energy efficiency in agriculture and horticulture**
Name of the measure	Federal Programme for funding for measures for increasing energy efficiency in agriculture and horticulture
Type of strategic measure	Funding programme
Description of strategic measure	Measures in the following areas are funded by means of a non-repayable subsidy: • new construction • systemic optimisation • individual measures • energy consultancy (not quantified) • efficiency ‘tables’ (not quantified)
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by the Federal Office for Agriculture and Food [Bundesanstalt für Landwirtschaft und Ernährung, BLE].
Target sectors	Commerce/trade/services

Recipient	Agriculture and horticulture businesses		
Permissible actions proposed as part of the relevant measure	Building shell, technical building services, processes		
Lifetime	Weighted average 23 years, individual lifetime depends on the measure [new construction 25 years, systemic optimisation 15 years, individual measures 15 years]		
Methodological aspects	As no quantification of the net effects is available from evaluations, generalised possible windfall effects of 20% of the saving are assumed.		
Sources/references	USV-Agrar, abc (2018): Ermittlung zusätzlicher Energieeinsparpotentiale und Effizienzreserven in der Landwirtschaft und im Gartenbau sowie Maßnahmen und Instrumente zu ihrer Erschließung [Calculating additional potential energy savings and efficiency reserves in agriculture and horticulture, and measures and instruments for their development]. Final report to target 1 of the study. Richtlinie zur Förderung von Maßnahmen zur Steigerung der Energieeffizienz in der Landwirtschaft und im Gartenbau [Guideline for funding of measures for increasing energy efficiency in agriculture and horticulture] dated 29 October 2018, Federal Gazette, official section 20.11.2018 B2.		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	0.42	0.32	17.68

M 06: Selected elements of the local guideline

Brief description of the measure	**Selected elements of the local guideline**
Name of the measure	Programme sections ‘Exterior lighting, interior lighting, ventilation and air-conditioning systems’ of the funding for climate protection projects in the local area ‘Local guideline’.
Type of strategic measure	Funding programme
Description of strategic measure	Individual funding objectives of the local guideline are financed by the Energy Efficiency Fund. Consequently, measures in the following areas will be funded: • ventilation and air-conditioning systems, • interior/hall lighting, • exterior lighting.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by the project sponsor Jülich (PtJ), Forschungszentrum Jülich GmbH, business area Local Climate Protection [Kommunaler Klimaschutz, KKS].
Target sectors	Commerce, trade and services
Recipient	Public sector
Permissible actions proposed as part of the relevant measure	Lighting, technical building services
Lifetime	Weighted average 15.4 years, individual lifetime depends on the measure [ventilation and air-conditioning systems 25 years, interior/hall lighting 15 years, exterior lighting 15 years]
Methodological aspects	In the evaluation of the programme, net effects of 43% were identified, which have been taken as a basis for the calculation. For adjustment, comparison was made to a less efficient investment/baseline and windfall and anticipatory effects were included.
Sources/references	Öko-Institut, Institute for Energy and Environmental Research, Prognos, ffu, Ziesing, Klinski (2019): Evaluierung der Nationalen Klimaschutzinitiative [Evaluation of the National Climate Protection Initiative]. Status 31.12.2017. Richtlinie zur Förderung von Klimaschutzprojekten im kommunalen Umfeld „Kommunalrichtlinie [Guideline for funding of climate protection projects in the local area ‘Local Guideline’] dated: 1.10.2018, Federal Gazette, official section 14.11.2018 B4.

	Annual new final energy savings (PJ/year) from 2021		Cumulative final energy savings (PJ) in the period 2021 to 2030 net
	gross	net	
Expected total	0.5	0.3	15.41

M 07: Funding of serial renovation work

Brief description of the measure	**Funding of serial renovation work**
Name of the measure	Funding of serial renovation work
Type of strategic measure	Funding programme
Description of strategic measure	Funding is to be given for serial renovation, i.e. energy-related renovation with prefabricated elements The measure aims for the acceleration of energy-related renovation with a simultaneous increase in the depth and speed of the renovations. At the same time, the start-up funding considered here facilitates the implementation of initial prototype series and the development of new renovation solutions which may make renovation faster and cheaper in future. Consequently there may be substantial knock-on effects, i.e. renovation overall will become more economical and will be able to be implemented without additional funding. To accelerate this development, serially renovated efficiency houses and serially implemented particularly efficient individual measures should receive an incentive in addition to the current funding.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	A programme of the Federal Ministry of Economic Affairs and Energy (BMWi). The administrating public authority has not yet been decided.
Target sectors	Buildings
Recipient	Construction industry/building owners
Permissible actions proposed as part of the relevant measure	Building shell, technical building services
Lifetime	25 years
Methodological aspects	It is assumed that 25% of these renovations would in any case have been funded by the Federal subsidy for efficient buildings and 75%, i.e. 600 000 m² will receive additional assistance.
Sources/references	Prognos, German Energy Agency, bbh, adelphi, Öko-Institut, Institute for Energy and Environmental Research, Navigant (2020, not yet published): Brief report on measures aimed at achieving targets 2030 to support the Cabinet Committee on climate protection.

	Annual new final energy savings (PJ/year) from 2021		Cumulative final energy savings (PJ) in the period 2021 to 2030 net
	gross	net	
Expected total	0.29	0.21	11.36

M 08: Funding for e-mobility – e-mobility environmental bonus

Brief description of the measure	**Funding for e-mobility – e-mobility environmental bonus**
Name of the measure	Funding for the sale of electric vehicles (environmental bonus)
Type of strategic measure	Funding programme

Description of strategic measure	Electric vehicles are currently subsidised with a purchase premium, known as the environmental bonus. The environmental bonus has been in force since 19.2.2020 and has been increased and extended until 31.12.2025. This implemented the joint decision of the Federal Government and car manufacturers at the 'car summit' in November 2019. For purely battery-driven electric vehicles and fuel cell vehicles with a net list price of up to EUR 40 000, the environmental bonus was raised by 50% to EUR 6 000 and for vehicles over EUR 40 000 by 25% to EUR 5 000. For plug-in hybrids (externally chargeable hybrid electric vehicles) with a net list price of up to EUR 40 000, the environmental bonus was raised by 50% to EUR 4 500 and for vehicles over EUR 40,000 by 25% to EUR 3,750. Half the environmental bonus is paid by the car manufacturers (self-financing) and half by a federal subsidy (government share).
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by the Federal Office for Economic Affairs and Export Control [Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA].
Target sectors	Transport
Permissible actions proposed as part of the relevant measure	Mobile drives
Lifetime	12 years
Methodological aspects (additionality and materiality)	A rebound effect is possible with these measures. Electric vehicles are significantly more efficient than combustion vehicles and could therefore lead to a considerable rebound effect. However, there are as yet no empirical results on rebound for electric vehicles. For the following calculations, a long-term rebound effect of 12% is assumed. There may be windfall effects for the environmental bonus. In addition there is a significant overlap with the passenger car CO_2 standard at European level (Regulation (EU) 2019/631). As a result of the subsidy, sales of passenger cars may become cheaper in general. Therefore, a purchase premium does not necessarily represent a (relevant) additional savings contribution compared to the effect of the CO_2 standard. Both effects are taken into account by the choice of the baseline (5.3 million in stock in 2030) in the calculation. Anticipatory effects appear unlikely, as no ban on combustion passenger cars is foreseeable.
Sources/references	Münzel, C., Plötz, P., Sprei, F., & Gnann, T. (2019): How large is the effect of financial incentives on electric vehicle sales? – A global review and European analysis. Energy Economics. 104493. Plötz, P., Gnann, T., Jochem, P., Yilmaz, H., & Kaschub, T. (2019): Impact of Electric Trucks on the European Electricity System and CO_2 Emissions. Energy Policy 130, 32-40. Richtlinie zur Förderung des Absatzes von elektrisch betriebenen Fahrzeugen (Umweltbonus) [Guideline for funding for the sale of electric vehicles (environmental bonus)] dated 28 May 2019, Federal Gazette, official section 5.6.2019 B1.

Expected total amount of final energy saving

	Annual new (PJ/year)										Cumulative (PJ)
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2021 to 2030
gross	1.1	1.4	1.1	1.3	1.3	1.4	1.6	1.6	1.7	1.7	71.7
net	1.0	1.1	0.9	1.0	1.1	1.3	1.3	1.4	1.4	1.4	60.8

M 09: Funding for procuring electric buses in local public transport

Brief description of the measure	**Funding for procuring electric buses in local public transport**
Name of the measure	Funding for procuring electric buses in local public transport
Type of strategic measure	Funding programme

Description of strategic measure	With this programme, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety funds the purchase of electric buses in local public transport. This includes plug-in hybrid buses as well as purely battery buses in local public transport.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The programme is administered by VDI/VDE Innovation + Technik GmbH.
Target sectors	Commerce/trade/services
Recipient	Local public transport infrastructure access
Permissible actions proposed as part of the relevant measure	Mobile drives
Lifetime	2-15 years (note: 10 years was used as the basis for the calculation)
Methodological aspects	Based on the targets of the funding guideline it is assumed that the purchase of 100 electric buses per year is funded. Only battery buses are expected, as plug-in hybrid buses are currently not commercially available. On average, electric buses have an energy consumption (including air-conditioning) of approx. 2 kWh/km. By comparison, a diesel bus consumes approx. 50 litres/100 km. In addition, an average annual mileage of approx. 50 000 km is assumed for the buses. A rebound effect for this measure is unlikely, as a saving in energy costs for the bus company will hardly lead to an increase in bus kilometres. It can be assumed that bus companies will replace conventional buses on defined routes with electric buses. In individual cases it may happen that companies also keep diesel buses in reserve, in case electric buses break down. However, this is not a rebound effect, but a different type of slight reduction in the potential for GHG reduction. As the cost-effectiveness is as yet unclear, no windfall effects are assumed.
Sources/references	BMU (2019): Bundesumweltministerium erhöht Förderung von Elektrobussen auf fast 300 Millionen Euro [Federal Ministry increases funding for electric buses to almost EUR 300 million] https://www.bmu.de/pressemitteilung/bundesumweltministerium-erhoeht-foerderung-von-elektrobussen-auf-fast-300-millionen-euro/ Plötz et al. (2019): Machbarkeitsstudie von HO-Busverkehr in Deutschland – am Beispiel Marburg und Trier [Feasibility study of HO bus transport in Germany – for example Marburg and Trier]. Scientific consultancy of the Federal Ministry of Transport and Digital Infrastructure on mobility and fuel strategy. Fraunhofer Institute for Systems and Innovation Research, 2019. Richtlinien zur Förderung der Anschaffung von Elektrobussen im öffentlichen Personennahverkehr [Guideline for funding for procuring electric buses in local public transport] dated 5.3.2018, Federal Gazette, official section 15.3.2018 B4.

	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	0.05	0.05	2.61

Voluntary commitments and standards

M 10: §45 of the draft for the Buildings Energy Act [Gebäudeenergiegesetz, GEG]

Brief description of the measure	**§45 of the draft for the Buildings Energy Act [Gebäudeenergiegesetz, GEG]**
Name of the measure	Measures for saving energy
Type of strategic measure	Regulatory law
Description of strategic measure	§45 of the draft Buildings Energy Act permits the proportionate coverage of the energy demand for heating and cooling in new buildings that must be met by renewable energies, pursuant to §10(2)(3) of the draft Buildings Energy Act, to be fulfilled also by undercutting the requirements for structural thermal insulation of a new building (residential or non-residential) by at least 15%.

Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Implementation of the obligation to use renewable energies is incumbent upon the Federal States.
Target sectors	Cross-sectoral
Recipient	Building owners (new buildings)
Permissible actions proposed as part of the relevant measure	Building shells
Lifetime	20 years
Methodological aspects	To estimate what effect the reduction of the specific transmission heat loss for residential buildings or the maximum levels for the average heat transmission coefficients of heat-transferring exterior surfaces for non-residential buildings by 15% have on final energy consumption, data from the Energy Conservation Regulation Registry were evaluated. Energy performance certificates that had been issued for 'new buildings' were considered (n=16 700). The following procedure was followed: The building's final energy requirement for heat was supplemented with ambient heat and solar energy if necessary. The final energy requirement was then differentiated into transmission losses, ventilation losses and solar and internal gains, on the basis of the statements of the energy performance certificate and by setting assumptions. From this the reduction of the final energy requirement can be deduced based on the 15% transmission loss requirement. The breakdown of savings regarding electricity and fuels is empirically difficult to prove at present. It can be assumed that the regulation pursuant to §45 of the draft Buildings Energy Act will be used more frequently if gas boilers are used. Therefore, the levels are set at 95% fuels and 5% electricity.
Sources/references	BMU (2012): Erfahrungsbericht zum Erneuerbare-Energien-Wärmegesetz (EEWärmeG-Erfahrungsbericht) gemäß §18 EEWärmeG [Progress report on the Renewable Energies Heat Act pursuant to §18 of the Renewable Energies Heat Act]. Gesetz zur Vereinheitlichung des Energieeinsparrechts für Gebäude (GEG) [Law on the harmonisation of the energy conservation legislation for buildings].

	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	0.62	0.59	32.52

M 11: Draft for the Buildings Energy Act (GEG) – existing buildings

Brief description of the measure	**Draft for the Buildings Energy Act (GEG) – existing buildings**
Name of the measure	Requirements for an existing building
Type of strategic measure	Regulatory law
Description of strategic measure	In the case of significant changes to external building elements of existing buildings, minimum requirements must be observed for the altered external element (heat transmission coefficient). The requirements of §48 of the draft Buildings Energy Act are deemed fulfilled if the altered residential or non-residential building as a whole observes certain minimum requirements for annual primary energy requirements compared to a reference building and for the specific transmission heat loss for a residential building or the average heat transmission coefficients of the heat-transferring exterior surfaces for a non-residential building (§50 of the draft Buildings Energy Act). In addition, the obligatory retrofit insulation of certain top-floor ceilings in non-listed buildings (§47 of the draft Buildings Energy Act) and the prohibition of certain heating boilers that are older than 30 years (§72 of the draft Buildings Energy Act) were considered.

Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Implementation of the obligations is incumbent upon the Federal States		
Target sectors	Cross-sectoral		
Recipient	Building owners (stock)		
Permissible actions proposed as part of the relevant measure	Building shell, technical building services		
Lifetime	15 years		
Methodological aspects	The following renovation cases were considered: • Retrofit insulation of the top-floor ceiling in non-listed buildings (§47 of the draft Buildings Energy Act), • Exterior insulation in non-listed buildings, if more than 10% of the exterior wall is to be insulated (§48 of the draft Buildings Energy Act), • Replacement of windows in non-listed buildings, if more than 10% of the glazed area is to be replaced (§48 of the draft Buildings Energy Act), • Replacement of certain heating systems older than 30 years (§72 of the draft Buildings Energy Act). The buildings database 2016 of the Institute for Housing and Environment (IWU) was used to determine the renovation activity. Statements concerning renovation activity can be estimated on the basis of a dataset of approx. 17 000 buildings. It is possible to consider only buildings that are not listed, and to differentiate between one- and two-family homes on the one hand and multi-family houses on the other. For the years 2021 to 2030, the same renovation rate is assumed as that observed in the years 2010 to 2016. With regard to non-residential buildings, no dataset is available or known; for this reason it is assumed that renovation activity is similar to multi-family houses. To define the depth of renovation, the corresponding measure for various reference buildings (one/two family house or multi-family house differentiated by building age classes) was calculated using the Prognos building simulation model and a weighted average was set. With regard to non-residential buildings, it was again assumed that the depth of renovation was similar to multi-family houses. A non-compliance rate of 25% was assumed. With regard to the compulsory retrofitting of old heating systems, the calculations of a previous study were updated: Assuming 10 000 heating systems per year which reach the age of 30 years and are not fitted with condensing technology or low-temperature technology, and assuming that 200 000 one- and two-family houses are sold annually and the boilers to be replaced are proportional to the building stock, this gives a figure of approx. 2 800 boilers per year that must be replaced. Alternative savings pursuant to §50 were not calculated. It is assumed that a renovation pursuant to §48 is equivalent to §50.		
Sources/references	Gebäudedatenbank 2016 des IWU Institutes [Buildings database 2016 of the Institute for Housing and Environment] (http://wohngebaeudedaten2016.iwu.de/). Prognos (2014): Endenergieeinsparung gem. Art. 7 EED im Kontext der Novellierung EnEV 2014 -Verpflichtung zum Heizkesseltausch [Final energy saving pursuant to Art. 7 EED in the context of the amendment Energy Conservation Regulation 2014 – Obligation to replace heating boilers]. In the framework of the keynote study on energy efficiency, Federal Office for Energy Efficiency 03/15. Gesetz zur Vereinheitlichung des Energieeinsparrechts für Gebäude (GEG) [Law on the harmonisation of the energy conservation legislation for buildings].		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	

Expected total	14.6	10.5	572.52

M 12: Exemplary role of federal buildings

Brief description of the measure	**Exemplary role of federal buildings**
Name of the measure	Exemplary role of federal buildings
Type of strategic measure	Voluntary commitment
Description of strategic measure	In the Climate Action Programme 2030[29], specifications for renovations and new builds were made in this measure. All large construction projects for the renovation and modernisation of federal buildings must be based on a standard of at least efficiency house 55. The reference date for the start of the regulation and an annual renovation rate will be set later. Consequently it is assumed that the federal renovation rate will increase. From 2022, at least the energy standard of efficiency house 40 will apply to federal new builds.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The Federal Ministry of the Interior and the Federal Ministry of Defence, as the highest authorities for civil and military federal real estate; the Federal Ministry of Finance in the function for budgetary recognition and as a legal and professional supervisory body; the Federal Ministry of Economic Affairs and Energy as the energy department, the Institute for Federal Real Estate as the agency responsible for the measure; federal and regional building authorities as part of the 'agency loan' for building work; federal administrations who make use of federal property as the main users
Target sectors	Buildings
Recipient	Federal administrations using federal property
Permissible actions proposed as part of the relevant measure	Building shell, technical building services
Lifetime	30 years
Methodological aspects	The measure has three effects which result in a saving: • Increase in the renovation rate: The annual target renovation rate for federal buildings has yet to be set. In the baseline, the average renovation rate of non-residential buildings is around 0.7%. As a result of the measure, an increase in the renovation rate to the 2% aimed at in the Federal Government's Energy Concept[30] is assumed. 2022 is set as the reference date for the introduction of the measure. In the baseline, approx. 148 000 m² of federal buildings are renovated. An increase in the renovation rate to 2% would lead to the renovation of an additional 274 000 m² per year. • Increase in the depth of renovation: By settling on the EH 55 standard as the minimum standard for renovations, the average depth of renovation is raised. The depth of renovation, i.e. the energy requirement after renovation, for non-residential buildings is currently 90 kWh/m² per year. As a result of the measure, the depth of renovation is increased to Efficiency House 55 standard (assumption: 55 kWh/m² per year). 2022 is set as the reference date for the introduction of the measure. By setting the EH 55 standard for renovations, a further 35 kWh/m² per year will be saved in addition to the potential savings stated in the Energy Renovation Roadmap for Federal Real Estate. • Savings in new buildings: New federal buildings will comply with the EH 40 standard from 2022. A general new-build rate for non-residential buildings of 0.35% is assumed. In the baseline, EH 70 standard is set for new buildings. With regard to the surface area of federal buildings shown above, a new building surface area is established of 78 000 m²/year.
Sources/references	Prognos, German Energy Agency, bbh, adelphi, Öko-Institut, Institute for Energy and Environmental Research, Navigant (2020): Kurzgutachten zu Maßnahmen zur Zielerreichung 2030 zur Begleitung des Klimakabinetts [Brief report on

[29] Federal Government Climate Protection Programme 2030 for the implementation of the Climate Action Plan 2050.
[30] Federal Ministry of Economic Affairs and Energy/Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2010): Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung [Energy concept for an environmentally sound, reliable and affordable energy supply].

	measures aimed at achieving targets 2030 to support the Cabinet Committee on climate protection]. dena (2016): Gebäudereport [Building Report]		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	0.12	0.11	6.48

M 13: Electricity-based fuels

Brief description of the measure	**Electricity-based fuels**
Name of the measure	Electricity-based fuels
Type of strategic measure	Funding
Description of strategic measure	The Federal Government will fund the development and large-volume scaling of electrolysis and refinery processes for the creation of electricity-based climate-neutral gases and fuels. These can be used directly in vehicles with combustion engines, for example in industry, chemistry and in air transport, heavy goods vehicle transport and shipping. The Federal Government will also create a National Hydrogen Strategy in the short term.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Yet to be decided
Target sectors	Transport, some industry
Permissible actions proposed as part of the relevant measure	Mobile drives
Lifetime	1 year
Methodological aspects	Timmerberg/Kaltschmitt (2019) assume that in 2030 a potential maximum of 8 PJ of electricity-based fuels will be available from Germany. This value is very ambitious, however, as no expansion plans of this size from industry or the Federal Government are known to date. It is therefore assumed that at most half of this figure can be achieved by 2030.
Sources/references	Timmerberg/Kaltschmitt (2019)

Expected total amount of final energy saving										
Annual new (PJ/year)										**Cumulative (PJ)**
2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
0	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.6	4.0	20.1
0	0.32	0.72	1.04	1.44	1.76	2.16	2.48	2.88	3.2	16.08

M 14: Accelerated implementation of the measures of the energy audit and energy management systems

Brief description of the measure	**Accelerated implementation of the measures of the energy audit and energy management systems**
Name of the measure	Accelerated implementation of the measures of the energy audit and energy management systems
Type of strategic measure	Voluntary commitment
Description of strategic measure	As yet unused potentials identified during energy audits and energy management systems will be implemented on the basis of a voluntary commitment.

Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The Federal Ministry of Economic Affairs and Energy is the department responsible for this measure; the authority tasked with implementation of the measure has not been named at this time.
Target sectors	Industry, commerce/trade/services
Recipient	Companies that are not micro-enterprises or small and medium-sized enterprises in the sense of recommendation 2003/361/EC of the Commission of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (OJ L 124, 20.5.2003, p. 36).
Permissible actions proposed as part of the relevant measure	Cross-sectional technologies, processes, technical building services
Lifetime	8 years
Methodological aspects	The evaluation of the audit requirement of the Energy Services Law (EDL-G) (adelphi 2018) was used for the impact assessment of the measure. As part of this evaluation, a random sample of companies obliged to conduct an energy audit pursuant to the Energy Services Law was surveyed. Questions covered the potentials established in the context of the audit and energy management systems as well as the measures implemented. The savings achieved by the audit and by the energy management systems were included in the EDL-G and the peak balancing. The instrument investigated here addresses the as yet unimplemented measures that were identified during the audit or energy management systems. The potential savings revealed were then distributed evenly over 4 years in terms of implementation and scaled to the total of all companies. Achieving 25% of the potential thus calculated appears realistic under the framework conditions of a voluntary agreement.
Sources/references	adelphi (2018): Evaluierung der Auditpflicht nach dem Energiedienstleistungs-Gesetz für das Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) [Evaluation of the audit requirement of the Energy Services Law for the Federal Office for Economic Affairs and Export Control (BAFA)] https://www.adelphi.de/de/projekt/evaluierung-der-auditpflicht-nach-dem-energiedienstleistungs-gesetz

	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	1.2	0.5	19.08

Pricing instruments

M 15: Energy and electricity tax

Brief description of the measure	**Energy and electricity tax**
Name of the measure	Energy and electricity tax
Type of strategic measure	Fiscal
Description of the measure	The energy tax and electricity tax laws regulate the taxation of various energy sources (e.g. fuel oil, petrol, diesel, natural gas, LPG, CNG) and electricity. Because of their price impulse setting effect, these taxes influence the behaviour of end consumers towards increased use of energy efficient technologies and careful use of energy.
Duration of the fiscal measure	The electricity tax was introduced in 1999 and a start was made on restructuring the taxation of energy. The last amendment of the Energy Tax Act took place in June 2018.
Implementing public authority	Federal Ministry of Finance
Target sectors and tax payer segment	Cross-sectoral
Lifetime	1 year

Methodological aspects, stating the price elasticities used and how they were established.	Using the energy statistics of the Federal Ministry of Economic Affairs and Energy and the Federal Government report on subsidies, an estimate of the most important consumption segments was made and a conclusion concerning development up to 2030 was drawn using the values from the energy reference forecast. As the next step, the price increases connected with the taxes were examined. To do this, energy prices in the consumption segments were calculated with taxes and assuming EU minimum tax rates. For industrial use, VAT was not taken into account. The gradual increase in energy tax on CNG and LPG was taken into account. With regard to the development of energy prices, a real price increase and inflation of 1.4% was assumed; it is assumed that the tax rates remain nominally constant. Only short-term effects are considered.
Sources/references	Energy Tax Act, Federal Law Gazette I p. 856, 908 Electricity Tax Act, Federal Law Gazette I p. 856, 908

Expected total amount of final energy saving

	Annual new (PJ/year)										Cumulative (PJ)
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	71.38	68.45	65.72	63.28	61.04	58.86	56.86	54.68	52.64	50.73	603.64
net	67.81	65.03	62.43	60.12	57.99	55.92	54.02	51.95	50.01	48.19	573.46

M 16: CO_2 pricing for the transport and heating sectors

Brief description of the measure	**CO_2 pricing for the transport and heating sectors**
Name of the measure	CO_2 pricing for the transport and heating sectors
Type of strategic measure	Fiscal
Description of the measure	In the Climate Action Programme 2030[31] the Federal Government has expressed the wish to introduce CO_2 pricing for the transport and heating sectors (non-ETS sectors) from 2021. The Bundestag already decided to introduce such CO_2 pricing with the National Emissions Trading System (nEHS), based on the Fuel Emissions Trading Act (BEHG), in November 2019. An amendment to the act was required due to the findings of the conciliation committee concerning the tax laws and regulations for the implementation of the Climate Action Programme 2030. The first law amending the BEHG was passed by the Cabinet on 20 May 2020. The nEHS includes emissions from the combustion of fossil fuels, in particular fuel oil, liquid gas, natural gas, coal, petrol, diesel. Until 2025 a fixed price system will be introduced, which will be replaced by a price corridor in 2026. This creates a reliable price trajectory that enables the general public and industry to adjust to the progression.
Duration of the fiscal measure	2021-2030
Implementing public authority	Federal Ministry for Environment, Nature Conservation and Nuclear Safety
Target sectors and tax payer segment	Cross-sectoral energy consumers
Lifetime	1 year for short-term price elasticities and 25 years for long-term price elasticities
Methodological aspects, stating the price elasticities used and how they were established.	To calculate the energy savings of CO_2 pricing, an approach is used that addresses short-term and long-term elasticities. By including the effects of long-term elasticities, additional estimates of the investment decisions that have been initiated are taken into account. A CO_2 levy on natural gas, fuel oil, liquid gas and coal is being considered in the buildings and transport sector. A tax on district heat is applied at the place of generation by the power station operator and is therefore not accepted by final customers. The calculation of the savings takes into account the findings of the conciliation committee regarding the CO_2 prices used. Relative price increases due to the CO_2 levy by consumption sector and energy source:

[31] Federal Government Climate Protection Programme 2030 for the implementation of the Climate Action Plan 2050.

	Consumption segment	Energy source	2021	2025	2030
	IND	Fuel oil	13%	21%	75%
	IND	Natural gas	20%	34%	132%
	CTS, space heating	Fuel oil	10%	17%	59%
	CTS, space heating	Natural gas	11%	20%	78%
	CTS, process heat	Fuel oil	10%	17%	59%
	CTS, process heat	Natural gas	11%	20%	78%
	Private households, space heating, rented	Fuel oil	8%	13%	47%
	Private households, space heating, rented	Natural gas	9%	16%	62%
	Private households, hot water, rented	Fuel oil	8%	13%	47%
Sources/references	Federal Ministry of Economic Affairs and Energy (2019): Energieeffizienzstrategie [Energy Efficiency Strategy] 2050. Prognos, Fraunhofer Institute for Systems and Innovation Research, ecofys et al. (2018): 'Mittel-und langfristige Weiterentwicklung des Instrumentenmixes der Energieeffizienzpolitik zur Umsetzung der Energiekonzeptziele – NAPE 2.0' [Medium and long-term development of the instrument mix of the energy efficiency policy for the implementation of energy concept targets – NEEAP 2.0]				

Expected total amount of final energy saving

Short-term elasticities	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	23.45	27.57	26.96	39.74	38.88	50.96	49.88	151.86	148.62	145.47	703.39
net	21.85	26.6	25.65	38	37.05	48.45	47.5	144.4	141.55	137.75	668.22
Long-term elasticities	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	5.2	6.8	6.7	6.9	7.5	11.7	12.7	12.9	13.2	13.6	448.3
net	0.52	0.68	0.67	0.69	0.75	1.17	1.27	1.29	1.32	1.36	44.83
Total savings	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	27.65	34.37	33.66	46.64	46.38	62.66	62.58	164.76	161.82	159.07	1 151.69
net	22.37	27.28	26.32	38.69	37.80	49.62	48.77	145.69	142.87	139.11	713.05

M 17: Air transport tax

Brief description of the measure	Air transport tax
Name of the measure	Air transport tax
Type of strategic measure	Fiscal
Description of the measure	Increase the statutory tax rates for flights to destinations up to 2 500 km away[32] by EUR 5.53 to EUR 13.03, for medium distances over 2 500 km to 6 000 km by EUR 9.58 to EUR 33.01 and for long-haul flights over 6 000 km by EUR 17.25 to EUR 59.43.
Duration of the fiscal measure	From 1 April 2020 until further notice
Implementing public authority	Federal Ministry of Finance
Target sectors and tax payer segment	Transport Air transport companies which operate commercial passenger flights. The tax can be passed on by airline companies to air passengers.
Lifetime	1 year
Methodological aspects, stating the price elasticities used and how they were established.	A decrease in air transport due to the price increase is linked to an increase in transport with other modes of transport, such as an increase use of railways and passenger vehicles, particularly for travel within Germany. It is thus assumed that only three quarters of gross savings will become net savings.

[32] The distance from the largest commercial airport of the destination country to Frankfurt am Main airport is decisive.

Sources/references	Law amending the Aviation Tax Act of 12 December 2019 (Federal Law Gazette I p. 2492) Federal Statistical Office (Pub.): Finanzen und Steuern – Luftverkehrsteuer 2018 [Finances and Taxes – Aviation Tax 2018] (= Technical volume 14 series 9.6): published on 12 April 2019. Puwein, W. (2009): Preise und Preiselastizitäten im Verkehr [Prices and price elasticities in transport]. Wifo-Monatsberichte [Austrian Institute of Economic Research monthly report] 10/2009.

Expected total amount of final energy saving											
	Annual new (PJ/year)										**Cumulative (PJ)**
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	4	4	4	4	4	4	4	4	4	4	40.0
net	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	38.0

M 18: Tax incentives for energy-related building renovations

Brief description of the measure	**Tax incentives for energy-related building renovations**
Name of the measure	Tax incentives for energy-related building renovations
Type of strategic measure	Fiscal
Description of the measure	The funding is given in the form of a deduction in tax liability over a period of 3 years. 20% of investment costs are tax deductible, where 7% of eligible investment costs can be deducted in each of the first 2 years and 6% in the third year. The maximum amount of funding is EUR 40 000. Renovation measures started after 1.1.2020 are eligible. Eligible measures include: • Thermal insulation of walls, • Thermal insulation of roofs, • Thermal insulation of storey ceilings, • Replacement of windows or exterior doors, • Replacement or installation of a ventilation system, • Replacement of the heating system, • Installation of digital systems for energy-related optimisation of operation and consumption, • Optimisation of existing heating systems, provided these are more than 2 years old. The condition for funding is that the respective energy-related measure has been carried out by a specialist company. The minimum materials requirements are set by the Energy Renovation Measures Regulation (ESanMV)[33].
Duration of the fiscal measure	2020–2030
Implementing public authority	Federal Ministry of Finance
Target sectors and tax payer segment	Buildings, building owners
Lifetime	Average 23 years, individual lifetime depends on the measure [general renovation 25 years, replaced heating systems 20 years]
Methodological aspects, stating the price elasticities used and how they were established.	An adjustment of 20% was made for windfall effects.
Sources/references	Gesetz zur Umsetzung des Klimaschutzprogramms 2030 im Steuerrecht vom 21 Dezember 2019 [Law implementing the Climate Action Programme 2030 in the Tax Law of 21 December 2019]. Verordnung zur Bestimmung von Mindestanforderungen für energetische Maßnahmen bei zu eigenen Wohnzwecken genutzten Gebäuden nach §35c des Einkommensteuergesetzes [Regulation determining the minimum requirements for energy-related measures for buildings used for personal occupation pursuant to §35c of the Income Tax Act].

[33] Regulation determining the minimum requirements for energy-related measures for buildings used for personal occupation pursuant to §35c of the Income Tax Act

	Prognos, German Energy Agency, bbh, adelphi, Öko-Institut, Institute for Energy and Environmental Research, Navigant (2020, not yet published): Kurzgutachten zu Maßnahmen zur Zielerreichung 2030 zur Begleitung des Klimakabinetts [Brief report on measures aimed at achieving targets 2030 to support the Cabinet Committee on climate protection].		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	3.0	2.3	127.11

M 19: Heavy goods vehicle toll

Brief description of the measure	**Heavy goods vehicle toll**
Name of the measure	Introduction of low-carbon heavy goods vehicles to the roads
Type of strategic measure	Pricing instrument
Description of the measure	The heavy goods vehicle toll is a usage-based levy for the use of major roads by goods vehicles, which is based on the type of vehicle and the permissible overall weight. In the next few years a CO_2-dependent heavy goods vehicle toll will be introduced.
Duration of the fiscal measure	A condition for the implementation of the measure is an adjustment of the Eurovignette Directive. The Federal Government aims to achieve the corresponding revision of the Directive by the end of 2020, embodiment in German law will then take place by the end of 2021.
Implementing public authority	Federal Ministry of Transport and Digital Infrastructure (BMVI)
Target sectors and tax payer segment	Transport
Lifetime	1 year
Methodological aspects, stating the price elasticities used and how they were established.	For estimating the energy savings, a price of approx. EUR 80/tCO_2 was assumed, which is shifted onto the toll as a pollutant.
Sources/references	Bericht über Verkehrsverlagerungen auf das nachgeordnete Straßennetz infolge der Einführung der Lkw-Maut [Report on the transfer of traffic to the subsidiary road network as a result of the introduction of the heavy goods vehicle toll]. Bundestag document no. 18/689 of 27 February 2014. Straßburg et al. (2018): Energieeffizienzgespreizte Lkw-Maut [Energy efficiency-based heavy goods vehicle toll]. Federal Environment Agency (2020): Fahrleistungen, Verkehrsaufwand und 'Modal Split' [Mileage, transport volume and 'Modal Split'].

Expected total amount of final energy saving

	Annual new (PJ/year)										**Cumulative (PJ)**
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	4	4	4	10.8	8.5	6.3	4	4	4	4	53.6
net	3.8	3.8	3.8	10.26	8.075	5.985	3.8	3.8	3.8	3.8	50.92

M 20: Make rail travel cheaper

Brief description of the measure	**Make rail travel cheaper**
Name of the measure	Increasing rail passenger transport (component: make rail travel cheaper)
Type of strategic measure	Fiscal
Description of the measure	VAT reduction for long-distance rail travel from 19% to 7%.
Duration of the fiscal measure	2020-2030 (and beyond 2030).
Implementing public authority	Federal Ministry of Finance

Target sectors and tax payer segment	Transport Users of long-distance rail travel		
Lifetime	1 year		
Methodological aspects, stating the price elasticities used and how they were established.	The reduced VAT for rail travel leads to a price reduction of 10%. A medium price elasticity of -0.5 was used in rail passenger transport (mixed private and business travel).		
Sources/references	Gesetz zur Umsetzung des Klimaschutzprogramms 2030 im Steuerrecht vom 21. Dezember 2019 [Law implementing the Climate Action Programme 2030 in the Tax Law of 21 December 2019], Federal Law Gazette year 2019 part I No 52, published in Bonn on 30 December 2019, pages 2886ff. BMWI (2018): Energieeffizienz in Zahlen [Energy efficiency in numbers].		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	2.7	2.6	25.65

Consultation and information programme

M 21: Energy consulting

Brief description of the measure	**Energy consulting**
Name of the measure	Funding of energy consultancy for residential buildings, funding of energy consultancy for non-residential buildings belonging to communities and charitable organisations, measures for energy consultancy for private households via consumer advice centres
Type of strategic measure	Funding programme
Description of strategic measure	Energy efficiency in buildings is promoted as follows: Energy consultancy for residential buildings (on-site consulting, individual renovation roadmap) (EBW) Measures for energy consultancy for private households via consumer advice centres (Verbraucherzentrale Bundesverband e. V. (VZBV)), including components addressing energy poverty (see section c). Energy consultancy for non-residential buildings owned by communities and charitable organisations (EBK)
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Federal Office for Economic Affairs and Export Control (BAFA) – EBW, EBK Verbraucherzentrale Bundesverband e. V. – VZBV
Target sectors	Cross-sectoral
Recipient	Private households, communities and charitable organisations
Permissible actions proposed as part of the relevant measure	Building shell, technical building services, lighting, equipment (white goods, household appliances), appliances (brown goods, consumer electronics), appliances (grey goods, IT and communication), mobile drives
Lifetime	On average 6.9 years, individual lifetime depends on the measure
Methodological aspects (additionality and materiality)	The impact assessment of the consultancy offered is made on the basis of programme parameters calculated in the evaluations. Also taken from the evaluations are the parameters for adjustment, in particular for windfall effects, which are set at 37%.
Sources/references	Institute for Energy and Environmental Research (2014): Evaluation der Energiesparberatung vor Ort [Evaluation of energy saving consultancy on site]. German Energy Agency, Institute for Energy and Environmental Research (2018): Pilotprojekt zur Einführung des individuellen Sanierungsfahrplans [Pilot project for the introduction of the individual renovation roadmap]. PwC (2017): Evaluation der Energieeinsparberatung und der Energie-Checks der Verbraucherzentralen [Evaluation of the energy saving consultancy and energy check of consumer advice centres]. PwC (2018): Evaluierung des Förderprogramm ‘Energieberatung für Nichtwohngebäude von Kommunen und gemeinnützigen Organisationen’ [Evaluation of the funding programme ‘Energy consultancy for non-

	residential buildings belonging to communities and charitable organisations'].		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	2.0	0.6	27.31

M 22: Energy consultancy for SMEs

Brief description of the measure	**Energy consultancy for SMEs**		
Name of the measure	Funding of energy consultancy for SMEs		
Type of strategic measure	Funding programme		
Description of strategic measure	Energy efficiency in buildings is promoted as follows: Energy consultancy for SMEs (energy consultancy for small and medium-sized enterprises) (EBM) Economical use of energy in enterprises can make a significant contribution to energy security in Germany and to global climate protection. This is the aim of the federal subsidy for energy consultancy for SMEs (EBM). The Federal Government supports small and medium-sized enterprises (SMEs) with subsidies for qualified energy consultations. They are an important instrument for remedying lack of information, identifying potential savings and pointing out measures for improving energy efficiency in the enterprise. Starting points for energy consultancy are the areas of buildings and equipment, and also user behaviour; the measure suggestions should be oriented towards economic efficiency. If the use of renewable energies appears reasonable, special mention should be made of this and if necessary a corresponding design should be drawn up; this also applies to the use of waste heat. A contracting-orientation consultation may be an optional component of the energy audit.		
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) Frankfurter Str.		
Target sectors	Cross-sectoral		
Recipient	Small and medium-sized enterprises		
Permissible actions proposed as part of the relevant measure	Building shell, technical building services, lighting, appliances, mobile drives		
Lifetime	On average 10 years, individual lifetime depends on the measure		
Methodological aspects (additionality and materiality)	The impact assessment of the consultancy offered is made on the basis of programme parameters calculated in the evaluations. Also taken from the evaluations are the parameters for adjustment, in particular for windfall effects, which are set at 55%.		
Sources/references	PwC (2018): Evaluierung der Förderprogramme 'Energieberatung im Mittelstand' [Evaluation of the funding programme 'Energy consultancy for SMEs']		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	2.3	1.38	48.69

M 23: Electricity saving check

Brief description of the measure	**Electricity saving check**
Name of the measure	Electricity saving check
Type of strategic measure	Consultancy and funding programme

Description of strategic measure	The measure specifically includes consultancy for low-income households regarding electricity and energy saving. As part of the consultancy, households receive free energy-saving items (e.g. LED lights and switchable multiple socket strips) with which they can directly reduce their electricity requirement and contribute to climate protection. This measure addresses energy poverty pursuant to Article 7(11) (see section c).		
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The funding programme is administered by the project sponsor Jülich (PtJ).		
Target sectors	Private households		
Permissible actions proposed as part of the relevant measure	Building shell, technical building services, lighting, equipment (white goods, household appliances), appliances (brown goods, consumer electronics), appliances (grey goods, IT and communication), mobile drives		
Lifetime	On average 5.8 years, individual lifetime depends on the measure [investment measures in cooling appliances and lighting 12 years, measures in the area of IT and communication technology (IKT) 3 years, behaviour-based measures 2 years].		
Methodological aspects (additionality and materiality)	Due to the predominantly advisory nature [of the measure] and the special target group of low-income households, windfall effects are expected to be very low. For the calculation of the additional savings from replacement of cooling appliances, the minimum standard of the EU Eco-design Directive is set as the baseline.		
Sources/references	Seifried, D. & Albert-Seifried, S. (2015). 'Stromspar-Check' for low-income households (Proceedings of the eceee summer study 2015). Öko-Institut, Institute for Energy and Environmental Research, Prognos, ffu, Ziesing, Klinski (2019): Evaluierung der Nationalen Klimaschutzinitiative [Evaluation of the National Climate Protection Initiative]. Status 31.12. 2017. Öko-Institut, Fraunhofer Institute for Systems and Innovation Research (2019): Umsetzung Aktionsprogramm Klimaschutz 2020 – Begleitung der Umsetzung der Maßnahmen des Aktionsprogramms [Implementing the Climate Action Plan 2020 – Supporting the implementation of the measures of the Action Plan]. 3. Quantification report of 5.2.2019, Tab. 3-114 Federal Government (2019): Projektionsbericht 2019 für Deutschland gemäß Verordnung (EU) Nr. 525/2013 [Projection report 2019 for Germany pursuant to Regulation (EU) No 525/2013]. Table 34.		
	Annual new final energy savings (PJ/year) from 2021		**Cumulative final energy savings (PJ) in the period 2021 to 2030 net**
	gross	**net**	
Expected total	0.11	0.10	4.95

M 24: SME initiative for the energy transition and climate action (MIE)

Brief description of the measure	**SME initiative for the energy transition and climate action (MIE)**
Name of the measure	SME initiative for the energy transition and climate action (MIE)
Type of strategic measure	Information: Individualised knowledge

Description of strategic measure	The MIE provides concrete assistance via qualification and network projects for SMEs in skilled crafts and industry concerning energy efficiency and climate protection. The SME initiative will work towards the following objectives: • Strengthening the local dialogue between politics and SMEs in industry, trade and skilled crafts. • Removing obstacles which in practice [hamper] the implementation of economical energy efficiency measures, through the optimisation and needs-based expansion of the available range of information and consultancy, and • More effective support for small and medium-sized enterprises by means of new concepts of knowledge transfer, qualification and exchange of experience, in order to tap their own energy efficiency potential. Activities implemented by the MIE include: • Testing of new trade-specific consulting concepts, • Setting up a service centre for companies, • Giving and implementing qualification projects for apprentices ('Energy Scouts') in 300 companies, • The development of 'toolboxes', manuals, checklists, an energy manual for preparing and implementing energy efficiency measures, and finally a company development road map for SMEs and combine them into an 'efficiency toolbox'. • The design of a national uniform standard for explanatory consultation for the trade as a whole and • Comprehensive public relations work; provision of information and consultancy via publications and webinars.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	DIHK Service GmbH; Federal Office for Economic Affairs and Export Control (BAFA)
Target sectors	Industry, commerce/trade/services
Recipient	Small and medium-sized enterprises
Permissible actions proposed as part of the relevant measure	Building shell, technical building services, lighting, equipment (white goods, household appliances), appliances (brown goods, consumer electronics), appliances (grey goods, IT and communication), mobile drives
Lifetime	On average 11 years, individual lifetime depends on the measure [energy-related building renovation (windows, building shell) 24-25 years, energy-related building renovation (heating system and interior ventilation systems) 15 years, technical building measures 8 years, behaviour-based measures 2 years].
Methodological aspects	The impact assessment of the measure was based on its bottom-up assessment which took place as part of the evaluation of the Energy Efficiency Fund. The indicator for funding efficiency identified in this, for which the energy saving achieved is referenced to the budgetary resources used, was used to estimate the overall effect of the measure. Overlaps with other measures were taken into account as part of the evaluation. Windfall effects and anticipatory effects play no significant role due to the exclusively advisory nature of the programme.
Sources/references	Fraunhofer Institute for Systems and Innovation Research, Prognos AG, Institute for Energy and Environmental Research, Foundation for Environmental Energy Law (2019): Evaluierung und Weiterentwicklung des Energieeffizienzfonds [Evaluation and further development of the Energy Efficiency Fund] (Project No 63/15). Öko-Institut, Fraunhofer Institute for Systems and Innovation Research (2019): Umsetzung Aktionsprogramm Klimaschutz 2020 – Begleitung der Umsetzung der Maßnahmen des Aktionsprogramms [Implementing the Climate Action Plan 2020 – Supporting the implementation of the measures of the Action Plan]. 3. Quantification report of 5.2.2019, Tab. 3-25 SME initiative for energy transition. An agreement between the Federal Ministry of Economic Affairs and Energy, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Association of German Chambers of Industry and Commerce and the German Confederation of Skilled Crafts, dated 1.10.2012.

	Annual new final energy savings (PJ/year) from 2021		Cumulative final energy savings (PJ) in the period 2021 to 2030 net
	gross	net	
Expected total	0.18	0.18	9.90

M 25: Energy management systems (EnMS)

Brief description of the measure	**Energy management systems (EnMS)**
Name of the measure	Peak balancing in the context of the Energy Tax Act (EnergieStG) and the Electricity Tax Act (StromStG); Special Equalisation Scheme (BesAR) of the Renewable Energy Sources Act (EEG)
Type of strategic measure	Economic: Prerequisite for exemption from the payment of taxes and levies
Description of strategic measure	Energy and electricity-intensive companies will be granted exemption from the energy and electricity tax and the Cogeneration Act and Renewable Energy Sources Act levy, provided that they prove that they have implemented an energy management system in their company.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Federal Office for Economic Affairs and Export Control (Special Equalisation Scheme of the Renewable Energy Sources Act and Cogeneration Act) Main customs offices (Energy and electricity tax)
Target sectors	Industry, commerce/trade/services
Recipient	Energy-intensive companies
Permissible actions proposed as part of the relevant measure	Building shell, technical building services, lighting, equipment (white goods, household appliances), appliances (brown goods, consumer electronics), appliances (grey goods, IT and communication), mobile drives
Lifetime	On average 11 years, individual lifetime depends on the measure [lifetime results from the mix of measures used, which were calculated as part of the adelphi evaluation (2018)].
Methodological aspects	The evaluation of the audit requirement of the Energy Services Law (EDL-G) (adelphi 2018) was used for the impact assessment of the measure. As part of this evaluation, a random sample of companies obliged to conduct an energy audit pursuant to the Energy Services Law was surveyed. For the impact assessment of peak balancing and BesAR, only those savings are relevant which are produced by companies in peak balancing by the introduction of energy management systems and would not have been achieved in any case by the energy audit pursuant to the EDL-G. The adelphi study assumes that 50% of the companies with an energy audit had already introduced this due to the provisions of the peak balancing or BesAR. An adjustment of the gross effects is proving extremely difficult with the current data situation. As no evaluation of the measure exists, no statements can be made concerning the various effects. If it is assumed that impact-reducing effects occur equally in the group of companies which have implemented only an energy audit, the additional impact of the energy management systems on this baseline is already the adjusted impact of the measure. Therefore, a specific adjustment is waived here.
Sources/references	adelphi 2018: Evaluierung der Auditpflicht nach dem Energiedienstleistungs-Gesetz für das Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) [Evaluation of the audit requirement of the Energy Services Law for the Federal Office for Economic Affairs and Export Control (BAFA)]. Energy tax and electricity tax act Renewable Energy Sources Act (EEG) Cogeneration Act (KWKG).

	Annual new final energy savings (PJ/year) from 2021		Cumulative final energy savings (PJ) in the period 2021 to 2030 net
	gross	net	
Expected total	3.9	2.3	120.41

M 26: Introduction of and environmental management system in the Federal Government

Brief description of the measure	**Introduction of and environmental management system in the Federal**

	Government
Name of the measure	Introduction of and environmental management system in the Federal Government
Type of strategic measure	Voluntary commitment
Description of strategic measure	By 2025, all supreme federal authorities and other federal authorities at 300 locations will introduce an environmental management system in accordance with EMAS (Eco Management and Audit Scheme) or an extended property-related environmental management and audit system (LUMAS^{Plus}). The supreme federal authorities have a special exemplary role in public and toward their business area. A voluntary environmental management system pursuant to EMAS or LUMAS^{Plus} of the Institute for Federal Real Estate ensures reliable data and continuous environmental improvement and at the same time contributes significantly to climate protection. This is ensured by a systematic approach, e.g. installing/updating an environmental programme with objectives and measures and verifying the achievement of objectives, as well as taking corrective measures.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	Responsibility for implementation lies with the heads of the relevant authorities; the authority and responsibility for introducing an environmental management system lies with the department/divisional authority, the Institute for Federal Real Estate can provide support within the scope of its resources.
Target sectors	Public authorities
Recipient	Federal administration
Permissible actions proposed as part of the relevant measure	Mobility (business trips, commutes), vehicle fleet, materials consumption, purchasing, Green IT, telecommunications equipment, event management, canteen operation, building shell, technical building services, lighting
Lifetime	8 years
Methodological aspects	Calculations build on the Prognos brief expert report (2019) carried out for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The activity variable is the number of people employed by the Federal Government who work in an organisation where an energy management system is in force. It is assumed that by 2030, the whole of the Federal Government will be included in environmental management systems.
Sources/references	Prognos (2019): Introduction of environmental management systems pursuant to EMAS/LUMASPlus in the Federal Government by 2025.

Expected total amount of final energy saving

	Annual new (PJ/year)										Cumulative (PJ)
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	0.17	0.17	0.17	0.16	0.16	0.25	0.25	0.24	0.24	0.23	9.84
net	0.16	0.16	0.16	0.15	0.15	0.24	0.24	0.23	0.23	0.22	9.34

M 27: Heating label

Brief description of the measure	**Heating label**
Name of the measure	National efficiency label for old heating installations
Type of strategic measure	Information: Mass campaign

Description of strategic measure	Since the beginning of 2016, consumers have been informed of the efficiency status of their old heating installations by the national efficiency label. At the start of 2016, labelling of the installations was performed on a voluntary basis by chimney sweeps, heating engineers or energy consultants under existing contractual relationships. Since the beginning of 2017, district chimney sweeps have been obliged to label installations that have not yet been marked as part of the regular combustion system inspection. Owners of heating systems must accept this labelling. With the labelling they receive an individual confirmation of the efficiency class of the heating installation, an information brochure containing additional information about the federal consultancy service and funding scheme in the area of heating systems, and also verbal information about the energy efficiency of the heating installation. This label and the information provided should encourage the owners of heating systems to carry out an energy consultation or replace the old installation.
Implementing public authorities, participating parties or their authorised representatives and their responsibilities in the implementation of strategic measures	The Federal Office for Economic Affairs and Export Control (BAFA) pays the authorised district chimney sweep an allowance and is entitled to verify the award of labels on a random basis.
Target sectors	Private households
Recipient	Building owners (stock)
Permissible actions proposed as part of the relevant measure	Technical building services
Lifetime	3 years
Methodological aspects	On the basis of the IZT/Öko-Institut evaluation (2018), it is assumed that a final energy consumption of 20 MWh existed previously for each boiler replacement and a specific saving of 25% was achieved. The sales figures rose by approx. 7 000 boilers per year in the period 2008 to 2015, while in the period 2016 to 2018, an increase of almost 20 000 boilers per year was observed. It is assumed that 13 000 additional boilers are replaced annually as a result of the national efficiency label.
Sources/references	IZT & Öko-Institut (2018): Endbericht der begleitenden Evaluation – Evaluation der Maßnahme ‘Nationales Effizienzlabel für Heizungsaltanlagen’ [Final report of the accompanying evaluation – Evaluation of the measure ‘National efficiency label for old heating installations’] (draft version, January 2018).

Expected total amount of final energy saving

	Annual new (PJ/year)										Cumulative (PJ)
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2021 to 2030**
gross	1.56	1.61	1.61	0.9	0.39	0.12	0.08	0.08	0.08	0.08	19.31
net	0.70	0.72	0.72	0.41	0.18	0.05	0.04	0.04	0.04	0.04	8.69

c) Specific measures and share of the savings which must be achieved in households affected by energy poverty pursuant to Article 7(11)

The measure M23 Electricity saving check and measure M21 Energy consultancy (part VZBV) address energy poverty. The electricity saving check is aimed exclusively at the target group of low-income households and thus makes a significant contribution to combating energy poverty. Low-income households are specifically advised about saving electricity and energy and free energy-saving items are made available. As part of the measures for energy consultancy for private households by consumer advice centres, which is a component of measure M21 Energy consultancy, all offers of consumer advice centres are free for low-income households. Verbraucherzentrale Bundesverband e. V. (VZBV) offers various types of energy consultancy, particularly in the area of private households and residential buildings. In addition to on-line consultancy and telephone consultancy, other formats for personal advice are available. These include ‘Energy Checks’, which address different topics concerning (private) homes in different ways. These are the basic check, building check, heating and solar heat check, detailed check and the suitability check for the use of solar thermal or photovoltaic energy. In addition, VZBV also offers in-house consultancy, in which more than 500 architects and engineers across Germany can be engaged by the consumer advice centre as energy consultants.

Information about the amount of the saving achieved by these measures can be found in the profiles of the relevant measures.

4. Calculation method for measures announced pursuant to Article 7b of Directive 2012/27/EU (as amended by Directive 2018/2002/EU) (with the exception of fiscal measures)

a) Measurement methods used pursuant to Annex V number 1 of Directive 2012/27/EU (as amended by Directive 2018/2002/EU)

Depending on the measure, different measurement methods have been used according to the data available. For most funding measures, the savings shown are based on extrapolations from savings recorded and measured using evaluations in accordance with Annex V(1)(a) of the Energy Efficiency Directive.

b) Method for specifying energy savings (primary or final energy savings)

The savings from the above-mentioned measures are shown as final energy.

c) Lifetime of measures, extent to which the saving effect reduces over time, and procedure for taking account of the lifetime of the savings

The information concerning the lifetime of the respective measures can be found in the profiles of the measures shown in section 3. Insofar as these could be assigned to one of the measures in Annex VIII of the Annex of recommendations of the Commission on the implementation of the energy-saving obligations under the Energy Efficiency Directive[34], the lifetimes shown there were used. In this case, no source reference is given. If no suitable lifetime was found, this was defined and justified in the profile.
The topic of degradation, i.e. the reduction in the saving over time, for instance due to wear and tear of new products/components, does not appear to play a major role according to the current state of the discussion. For investment measures, no wear and tear has been empirically proven, at least at the beginning of the lifetime. An expert workshop hosted by the European Commission was held on 15.3.2019 in Brussels on the topic of the lifetimes and degradation of savings. In the workshop documentation and in the minutes, it is recorded that there is currently no reliable scientific basis for developing a method to enable the degradation of savings to be explicitly taken into account. Against this background, the calculation of a rate of decrease has been waived at this time, as it would not be statistically robust.

d) Brief description of the calculation method, stating how the additionality and materiality of the savings are ensured and what methods and reference values are used for the assumed and estimated savings

The calculation of energy savings is essentially based on the recommendations of the EU Commission of 2 July 2010 (title: Empfehlungen zu Mess-und Prüfmethoden im Rahmen der Richtlinie 2006/32/EG über Endenergieeffizienz und Energiedienstleistungen [Recommendations concerning measurement and test methods in the context of Directive 2006/32/EC on energy end-use efficiency and energy services]). The bottom-up calculation methods suggested therein primarily concern measures in the areas of buildings and equipment and appliances and lighting. They have been adopted by the EU Commission as non-binding proposals or recommendations in order to give member states freedom to adjust the calculation methods appropriately to the national information and data, which varies widely between member states. The recommendations of the EU Commission concerning the calculation of energy savings by means of bottom-up calculation methods do not include all areas in which measures to increase energy efficiency have been implemented. The recommendations of the EU Commission thus expressly provide that member states develop or use additional national bottom-up calculation methods for those instruments for which no recommendations from the EU Commission on the calculation of resulting energy savings exist. This concerns in particular instruments and measures in the area of 'Transport and Mobility' and 'cross-sectional measures'. The Federal Government has made use of this opportunity. In addition, reference was made to existing evaluations of funding measures and programmes where these existed in a suitable way. Bottom-up calculation methods are also carried out for these programme evaluations. However, they are generally linked to additional empirical components such as standardised surveys or expert interviews and are therefore able to deliver more accurate estimates of the energy-saving effects achieved, for greater effort and an associated higher cost.
The methods have already been used in the 2nd National Energy Efficiency Action Plan of the Federal Republic of Germany (NEEAP 2011) to calculate measure-induced energy savings and were also described in detail there in a supporting methodological document. These methods were subsequently used for the announcement of the further NEEAPs and notification of implementation of Article 7 EED for the period 2014-

[34] Anhang der Empfehlung der Kommission zur Umsetzung der Energieeinsparverpflichtungen nach der Energieeffizienzrichtlinie [Annex of recommendations of the Commission on the implementation of the energy-saving obligations under the Energy Efficiency Directive], Brussels, 25.9.2019, C(2019) 6621 final, Annex.

2020, and further developed taking account of the provisions of the annex of recommendations of the Commission on the implementation of the energy-saving obligations under the Energy Efficiency Directive.

The calculation method used for a measure (calculation formula based on the recommendations of the EU Commission, national calculation formula or reference to existing external evaluation) is specified in the profile of the measure. The net effects take into account windfall, anticipatory, spill-over, structural and rebound effects. In addition, interactions between the measures were taken into account pursuant to the individual interaction factors listed in section 4e. A description of how the additionality of the relevant measures is ensured can be found in the profiles of the measures described in section 3 above, under Methodological Aspects.

For the energy efficiency funding programmes, the principles of budgetary law, in particular §23 of the Federal Budget Code, mean that measures are not fundable if they could economically be implemented even without funding or if implementation of the measure is prescribed by law. This means that the funding for the implementation of an (energy efficiency) measure must be material and that possible windfall effects must also be minimised.

e) Information on how to avoid possible overlapping of measures and individual campaigns so that energy savings are not double-counted

The Federal Government has used interaction factors (or 'instrument factors') in calculating the energy saving effects. These interaction factors are a correcting variable for avoiding the double counting of energy savings. They ensure that any double counting that occurs (particularly if a single energy saving measure is addressed by a larger package of instruments and programmes) is corrected and the calculated energy saving is only included once in the overall saving. The energy saving in a certain area is allocated proportionally to the measures addressing this area.

The use of interaction factors (then known as 'instrument factors') was used in the 2nd National Energy Efficiency Action Plan of the Federal Republic of Germany (NEEAP 2011) to calculate measure-induced energy savings, and was also described in detail there in a supporting methodological document. Subsequently this approach was also used and further developed for the announcement of the further NEEAPs and notification of implementation of Article 7 EED for the period 2014-2020.

For the measures notified above, the mutual overlap is estimated for each pair of measures. The overlaps between pairs of measures in the programmes considered here are fairly small, partly because the measures are already designed in such a way that they cannot be cumulated (e.g. generally only one investment funding programme can be used), partly because possible overlaps have already been taken into account in the calculation methods (for example, in the energy tax only the behavioural aspect is estimated, while the investment impulse – potentially overlapping with investment funding – is ignored). Thus only a few overlaps remain which need to be taken into account. For CO_2 pricing, on the other hand, an alternative method is chosen which also takes into account the investment impulses in the form of long-term elasticities, which are allocated to a corresponding instrument factor to avoid overlaps.

The following table shows the individual interaction factor used for each measure, which illustrates the reduction in effect caused by double-addressing of savings.

Notification number	Measure	Interaction factor
Investment incentive		
M01	Federal funding for energy efficiency in the economy – subsidy and credit	0.95
M02	Federal funding for energy efficiency in the economy – funding competition	0.95
M03	Federal funding for efficient buildings	0.7
M04	Refrigeration and air conditioning guideline	0.95
M05	Energy efficiency in agriculture	0.95
M06	Local guideline (programme section 'exterior lighting, interior lighting, ventilation and air-conditioning systems')	0.95
M07	Funding of serial renovation work	0.95
M08	Funding for e-mobility – e-mobility environmental bonus	0.95
M09	Funding for procuring electric buses in local public transport	0.95
Standard-setting measures		
M10	Measures for saving energy (§45 GEG)	0.95
M11	Requirements for an existing building (GEG)	0.95

M12	Exemplary role of federal buildings	0.95
M13	Electricity-based fuels	0.8
M14	Accelerated implementation of the measures of the energy audit and EMS	0.45
Pricing instruments		
M15	Energy and electricity tax	0.95
M16	CO_2 levy (short-term/long-term)	0.95 / 0.1
M17	Air transport tax	0.95
M18	Tax incentives for energy-related building renovations	0.95
M19	Heavy goods vehicle toll	0.95
M20	Make rail travel cheaper	0.95
Consultation and information programme		
M21	Energy consulting	0.45
M22	Energy consulting SMEs	0.6
M23	Electricity saving check	1.0
M24	SME initiative for the energy transition and climate action (MIE)	Not applicable[35]
M25	Energy management systems	0.6
M26	Introduction of and environmental management system in the Federal Government	0.95
M27	Heating label	0.45

f) Possible climate variations and possible approach used

As Germany has a relatively homogenous climate, the impact of varying climate conditions on the notified measures has not been considered, nor is such consideration proposed.

5. Monitoring and verification

a) Brief description of the monitoring and verification system and the verification method

To ensure that the objectives aspired to are actually achieved, financial measures for the achievement of energy savings are regularly evaluated and monitored by independent external appraisers, institutes and committees. In accordance with the provisions of the Federal Budget Code (§7(2) BHO) they are subject to an efficiency review which examines the achievement of the objective, the effectiveness and cost-effectiveness of the measures. A systematic and transparent assessment is carried out, which is based on the quality standards of the German Evaluation Society (DeGEval). For each measure or each concrete evaluation of the individual measures, energy savings are either directly calculated by the appraiser or the evaluation results are included in the basis of the energy savings calculations of the responsible department (e.g. taking into account the number of actual funding cases and the actually implemented measures with energy-saving effects). To fulfil their statutory tasks, the Federal Office for Energy Efficiency has set up a monitoring and verification system. Using a structured monitoring template, information about the savings achieved by the alternative measures pursuant to Article 7b EED (for financial measures, these are the results of the evaluations carried out by independent institutions) is collected by the parties responsible for the measures. In a subsequent plausibility check, the completeness and consistency (within a reporting year, in comparison to standard values for similar measures and over time) of the data is verified.

b) The public authority implementing the monitoring and verification system and its most important responsibilities in connection with the energy efficiency commitment system or alternative measures

On the statutory basis of the Energy Services Act[36], the Federal Office for Energy Efficiency (BfEE), set up within the Federal Office for Economic Affairs and Export Control (BAFA), performs the tasks of monitoring the saving effect of energy efficiency mechanisms and other strategic government measures which are intended to produce energy savings for end customers, and preparing these savings for reporting as part of the national and European energy efficiency and energy-saving objectives. This also includes the monitoring and verification of the saving effect of the alternative measures pursuant to Article 7b EED.

c) Independence of monitoring and verification from the obligated, participating or commissioned parties

[35] Interactions with other measures were already taken into account methodically in the quantification of the saving

[36] Gesetz zur Änderung des Gesetzes über Energiedienstleistungen und andere Energieeffizienzmaßnahmen [Law amending the Act on energy services and other energy efficiency measures] (EDL-G).

Financial measures for achieving energy savings are regularly evaluated and supported by independent external appraisers, institutes and committees.

d) Statistically significant proportion of measures for improving energy efficiency and proportion used to determine and select a representative sample, and criteria applied

The definition of a statistically significant sample size depends largely on the number of cases considered and other framework conditions of the measure. Therefore, a universal definition, for example stating percentages and numbers of cases, is not possible, but must be considered in the light of the relevant framework conditions of the measure.

The Federal Ministry of Economic Affairs and Energy has developed a methodological guide[37] which must be taken into account by external appraisers for the evaluation of efficiency measures and which offers a uniform methodology for the ex-post and accompanying evaluation of measures of energy efficiency policy. This also helps to guarantee the quality of the evaluation results. The guide describes how, depending on the number of cases considered, the observed savings of a statistically significant proportion of measures to improve energy efficiency are evaluated based on a representative sample.

e) Reporting obligations of the obligated parties (energy savings of each obligated party or each subcategory of obligated parties and total energy savings achieved as part of the system)

In the absence of an energy efficiency commitment system, no parties in Germany are 'obligated' in the sense of Article 7a EED. However, the department responsible for the measures reports on the effects achieved by the measures as part of the regular monitoring of the savings of efficiency measures.

f) Publication of the energy savings achieved annually as part of the energy efficiency commitment system and by alternative measures

Continuous supervision and comprehensive monitoring of the implementation of all planned measures and of the reductions achieved by them will take place in the extrapolation of the already established regularly published reports of the Federal Government, 'Monitoring the Energy Transition' and 'Climate Protection Report'.

g) Information on the legislation of member states concerning the penalties applicable to violations

In accordance with the varying natures of the alternative measures chosen by the Federal Republic pursuant to Article 7(9) EED, the associated possible penalties for non-compliance with the relevant requirements also differ. Roughly speaking, a distinction can be made between measures in the area of regulatory law and funding measures. With funding measures, payment of the funding takes place only after completion of the review of all documentation to be presented in the use verification process. In accordance with the General Auxiliary Conditions under VV No 5.1 to §44 of the Federal Budget Code, the applicant is obliged to keep all documentation relevant to the subsidy for at least 5 years and present it in the event of a review. If this obligation is not complied with, the approval conditions are cancelled with retrospective effect and the funding may be reclaimed with interest. For measures for which tax or fee privileges are granted, these are withdrawn in the case of non-compliance with the requirements. Infringements of regulatory law are penalised with a fine (e.g. if the requirements of §48 GEG (M11) are not met, a fine of up to EUR 50 000 may be imposed).

h) Information on the strategic measures envisaged in the case of unsatisfactory progress

On the basis of the monitoring carried out by the Federal Office for Energy Efficiency, an annual review of the effectiveness of the above-mentioned measures is planned. In this way, the Federal Government creates objectivity concerning the achievement of its efficiency and climate objectives. For this purpose the Federal Government will make the Cabinet Committee on climate protection ('Climate Cabinet') permanent and assign to it the task of reviewing the effectiveness, efficiency and accuracy of the implemented measures on an annual basis[38]. If satisfactory progress is not achieved, the department minister responsible for the sector that does not fulfil its legally defined objectives will submit an emergency readjustment programme to the Climate Cabinet within 3 months of confirmation of the emissions data by the expert committee. On the basis of this, the Climate Cabinet can prepare decisions as to how the Climate Action Programme 2030 adopted by the Federal Government can be jointly adapted in such a way that the underlying objectives can be achieved.

[37] Methodikleitfaden für Evaluationen von Effizienzmaßnahmen des BMWi [Methodological guide for evaluations of efficiency measures of the Federal Ministry of Economic Affairs and Energy] (project No 63/15 – addition).
[38] Cf. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2019): Klimaschutzprogramm 2030 der Bundesregierung zur Umsetzung des Klimaschutzplans 2050 [Federal Government Climate Action Programme 2030 for the implementation of the Climate Action Plan 2050].

Bundesministerium
für Wirtschaft
und Energie

Summary of the responses received as part of the public consultation on the Federal Government's integrated National Energy and Climate Plan

Pursuant to Article 10 of the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the governance of the energy union and climate action, amending Directive 94/22/EC, Directive 98/70/EC, Directive 2009/31/EC, Regulation (EC) No 663/2009, Regulation (EC) No 715/2009, Directive 2009/73/EC, Council Directive 2009/119/EC, Directive 2010/31/EU, Directive 2012/27/EU, Directive 2013/30/EU and Council Directive (EU) 2015/652 and repealing Regulation (EU) No 525/2013

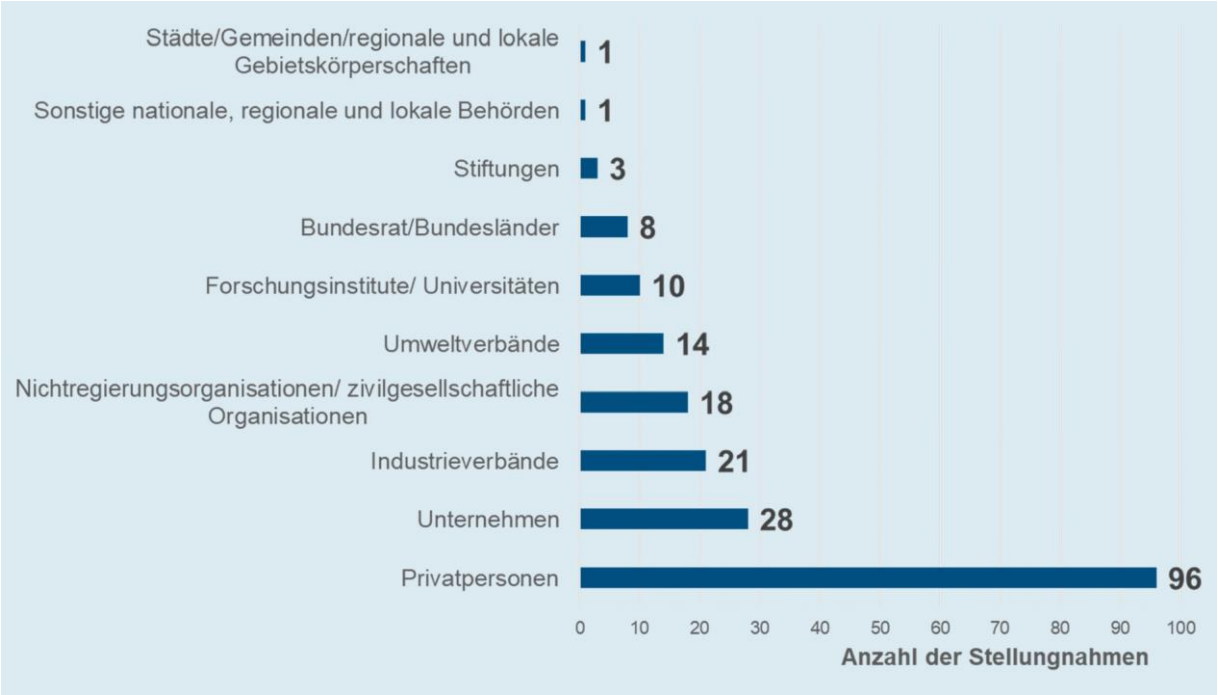
Introduction

The national consultation on the Federal Government's draft integrated National Energy and Climate Plan was conducted online between 14/06/2019 and 02/08/2019 on the basis of the draft NECP from the end of 2018 and a survey which covered the five dimensions of the energy union.

The results of the online consultation are presented in the following report in accordance with Article 10 of the EU Regulation on the governance of the energy union and climate action. The responses reproduced in it relate to the draft version of the NECP. Since then, the Federal Government has made far-reaching decisions on its energy and climate policy, taking a substantial number of the suggestions that were made into consideration. In the second half of 2019, numerous points of criticism from the responses were addressed, in particular as part of the implementation of the recommendations of the Commission on Growth, Structural Change and Employment and of the Climate Cabinet process. This is illustrated in the NECP. The summary of the responses is reproduced in the report without the addition of any comments. The extent to which the responses were taken into consideration is clear to see from the NECP.

A total of 200 responses were received as part of the online consultation process. Approximately half of the participants were private individuals (96 participants). The next sets of responses were from companies (28 participants) and industrial associations (21 participants). Then there were those from NGOs and civil society organisations (18 participants) and environmental organisations (14 participants). Research institutions/universities were represented by 10 participants. Half of the federal states also provided responses (8 participants). Foundations were represented by 3 participants whilst other national, regional and local authorities were represented by 1 participant and cities/municipalities/regional and local governments were also accounted for by 1 participant.

Overview – Frequency of responses per group of participants



Städte/Gemeinden/regionale und lokale Gebietsköroerschften	cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Stiftungen	Foundations

Bundesrat/Bundesländer	Bundesrat/federal states
Forschungsinstitute/Universitäten	Research institutions/universities
Umweltverbände	Environmental organisations
Nichtregierungsorganisationen/zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Industrieverbände	Industrial associations
Unternehmen	Companies
Privatpersonen	Private individuals
Anzahl der Stellungnahmen	**Anzahl der Stellungnahmen**

The following terminology, acronyms and abbreviations will be used in order to make the assessment of the online consultation process easier to understand:

Table 1 – Terminology used regarding the number of responses

Number of responses	**Terminology**
1	one (stakeholder/individual)
2 to 4	some (stakeholders/individuals)
5 or more	many (stakeholders/individuals)
15 or more	a very high number of (stakeholders/individuals)

Table 2 – Acronyms and abbreviations for the groups of participants

Group of participants	**Acronym/abbreviation**
Federal states	BL
Cities/municipalities/regional and local governments	Cities/municipalities
Other national, regional and local authorities	Other authorities
Industrial associations	IV
Environmental organisations	UV
Foundations	Foundations
Companies	U
Social partners/trade unions	Social partners/trade unions
Research institutions	FI
Private individuals	PP
Non-governmental organisations	NGO

Institutions involved

Alongside private individuals, the following stakeholders, institutions and organisations took part in the consultation process:

Institution	**Acronym/abbre**	**Group of**

	viation	participants (stakeholders were able to assign themselves)
ARA e. V.	ARA	NGO
B.A.U.M. e. V.	B.A.U.M.	NGO
Behörde für Wirtschaft, Verkehr und Innovation, Hamburg	BWVI	Other authorities
Buildings Performance Institute Europe	BPIE	FI
Bund für Umwelt und Naturschutz Deutschland e. V.	BUND	UV
BUND Saarbrücken e. V.	BUND-S	UV
Bundesverband der deutschen Bioethanolwirtschaft	BDBe	IV
Bundesverband der Energie- und Wasserwirtschaft e. V.	BDEW	IV
Bundesverband der Windparkbetreiber Offshore e. V.	BWO	IV
Bundesverband energieeffiziente Gebäudehülle e. V.	BuVEG	IV
Bundesverband Erneuerbare Energie e. V.	BEE	IV
Bundesverband Neue Energiewirtschaft e. V.	BNE	IV
Bundesverband Wärmepumpe e. V.	BWP	IV
Bündnis Bürgerenergie e. V.	BBEn	NGO
Bündnis gegenwind Südwestfalen e. V.	BGS	UV
Bürger-Energie Lüdenscheid eG	BEL-EG	U
Bürger-Energie-Genossenschaft Köllertal eG	BEG	U
CO2 Abgabe e. V.	CO2A	NGO
CropEnergies AG	CE	U
DAIKIN Airconditioning Germany GmbH	DAIKIN	U
Deutsche Energie-Agentur GmbH	dena	U
Deutsche Umwelthilfe	DUH	UV
Deutsche Unternehmensinitiative Energieeffizienz e. V.	DENEFF	IV
Deutscher Braunkohlen-Industrie-Verein e. V.	DEBRIV	IV
Deutscher Genossenschafts-und Raiffeisenverband e. V.	DGRV	IV
Deutscher Industrie-und Handelskammertag e. V.	DIHK	NGO
Deutscher Naturschutzring e. V.	DNR	NGO
Deutsches Biomasseforschungszentrum gGmbH	DBFZ	FI
E3G Third Generation Environmentalism Ltd	E3G	UV
EnBW Energie Baden-Württemberg AG	EnBW	U
Energie für Gebäude	EFG	U
EnergiE zum Leben, auch in W-Nord	W-NORD	NGO
Energieeffizienzverband für Wärme, Kälte und KWK e. V.	AGFW	IV
Energiegenossenschaft Untermain e.G	EGU	UV
Energy2market GmbH	E2M	U
Environmental Investigation Agency (EIA) International	EIA	UV
Exergie-Effzienz, VDI Ingenieurbüro	EXERGIE	U
Forum Ökologisch-Soziale Marktwirtschaft e. V.	N.N	UV
Fraunhofer IIS-EAS [Fraunhofer Institute for Integrated Circuits, Division Engineering of Adaptive Systems]	IIS/EAS	FI

Fraunhofer-Institut für Solare Energiesysteme ISE [Fraunhofer Institute for Solar Energy Systems]	ISE	FI
Freie Universität Berlin, Forschungszentrum für Umweltpolitik [Freie Universität Berlin, Environmental Policy Research Centre]	FFU	FI
Gaskoalition	GASKO	U
GdW Bundesverband deutscher Wohnungs-und Immobilienunternehmen e. V.	GDW	IV
Gebäudeenergieberatung Brunold	GEBB	U
GEOMAR & Universität Kiel	GEOMAR	FI
Germanwatch	GW	NGO
Green City e. V.	GC	UV
Helmholtz-Zentrum für Umweltforschung -UFZ, Department Ökonomie [Helmholtz Centre for Environmental Research, Department of Economics]	UFZÖ	FI
Helmholtz-Zentrum für Umweltforschung, Department Bioenergie [Helmholtz Centre for Environmental Research, Department of Bioenergy]	UFZB	FI
Ingenieurbüro Solar Energie Information	ISEI	U
innogy SE	INNOGY	U
Interessenverband Supraleitung e. V.	IVSUPRA	IV
Knowledge Reloaded Consulting	KRC	U
Ministerium für Energiewende, Landwirtschaft, Umwelt, Natur und Digitalisierung Schleswig-Holstein [Ministry of the Energy Transition, Agriculture, the Environment, Nature and Digitalisation for the federal state of Schleswig-Holstein]	Schleswig-Holstein	BL
Ministerium für Umwelt, Energie, Bauen und Klimaschutz Niedersachsen [Ministry of the Environment, Energy, Construction and Climate Protection for the federal state of Lower Saxony]	Lower Saxony	BL
Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg [Ministry of the Environment, Climate Protection and the Energy Sector for the federal state of Baden-Württemberg]	Baden-Württemberg	BL
Ministerium für Umwelt, Landwirtschaft und Energie des Landes Sachsen-Anhalt [Ministry of the Environment, Agriculture and Energy for the federal state of Saxony-Anhalt]	Saxony-Anhalt	BL
Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen [Ministry of Economic Affairs, Innovation, Digitalisation and Energy for the federal state of North Rhine-Westphalia]	North Rhine-Westphalia	BL
Natural Resources Defence Council	NRDC	UV
Naturschutzbund Deutschland e. V.	NABU	NGO
Netzwerk für Energie und Umwelt (NEU e. V.) – Head of the	NEU	NGO

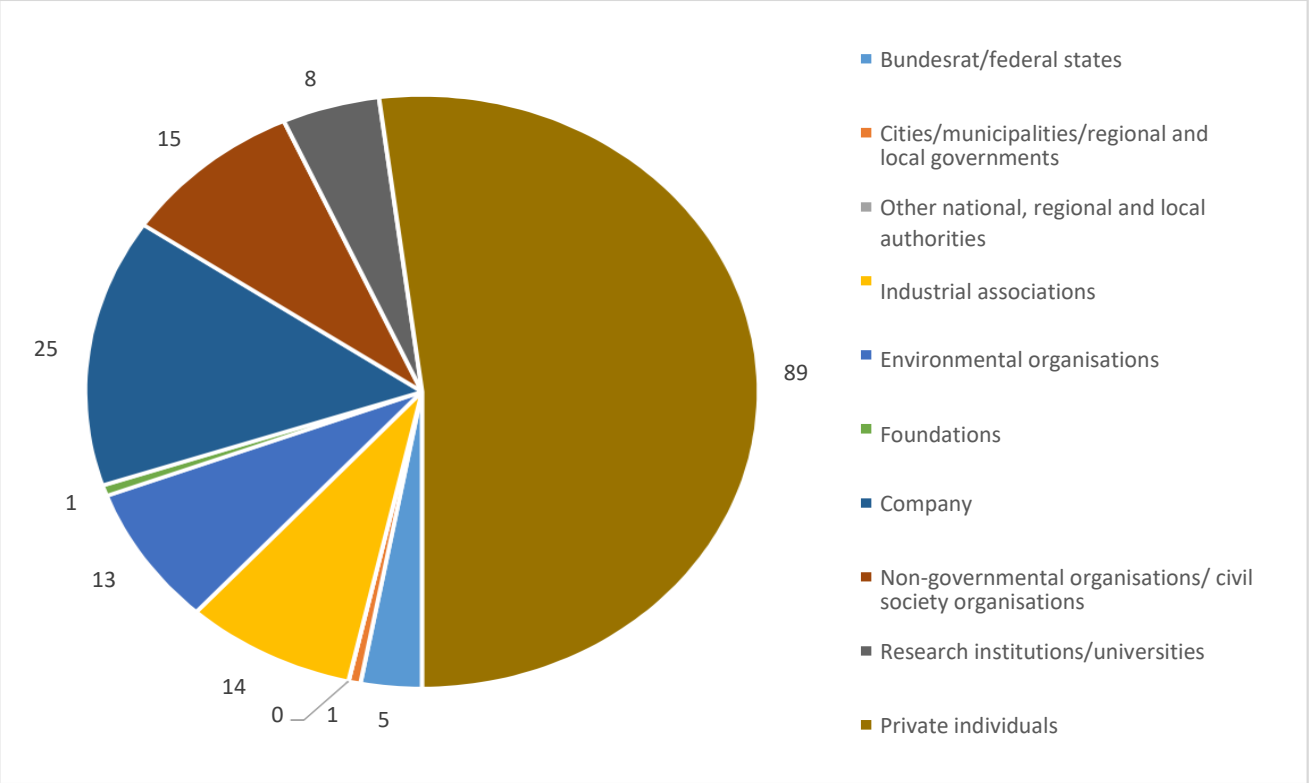
Solar team		
ONTRAS Gastransport GmbH	ONTRAS	U
Phoenix Intellectual Property BV	PIP	U
Private individuals	PP	PP
Rescue For Future et al	RFF	NGO
Saubere Luft e. V.	SLV	UV
Staatsministerium für Wirtschaft, Arbeit und Verkehr Sachsen [Ministry of Economic Affairs, Labour and Transport for the federal state of Saxony]	Saxony	BL
Stiftung Energieeffizienz [Energy Efficiency Foundation]	SE	Foundations
Stiftung OFFSHORE-WINDENERGIE (Stiftung der Deutschen Wirtschaft zur Nutzung und Erforschung der Windenergie auf See) [OFFSHORE WIND ENERGY Foundation (German Offshore Wind Energy Foundation)]	SOW	Foundations
World Future Council Foundation	WFC	Foundations
TransnetBW GmbH	TransnetBW	U
Union zur Förderung von Oel-und Proteinpflanzen	UFOP	NGO
VATTENFALL GmbH	VATTENFALL	U
Verband der Deutschen Biokraftstoffindustrie e. V.	VDB	IV
Verband der Industriellen Energie-und Kraftwirtschaft e. V.	VIK	IV
Verband Deutscher Maschinen-und Anlagenbau e. V.	VDMA	IV
Verband für Wärmelieferung e. V.	VfW	UV
Verband kommunaler Unternehmen e. V.	VKU	Cities/municipalities
Verbraucherzentrale Bundesverband e. V.	VZBV	NGO
Vereinigung der Fernleitungsnetzbetreiber Gas e. V.	FNBGas	IV
VNG AG	VNG	U
WWF Deutschland	WWF	UV
Zentralverband des Deutschen Handwerks	ZDH	U
Zentralverband Elektrotechnik- und Elektronikindustrie e. V.	ZVEI	IV

Below is a summary of the main findings from the responses received as part of the public consultation on the German NECP. The first part contains participants' general concerns regarding energy and climate policy in response to key questions 1-2 of the consultation process, which are then followed by participants' responses subdivided across the 5 dimensions of the energy union (key questions 3-25 of the consultation process).

General concerns regarding energy and climate policy

Question 1: Against this backdrop, what is your assessment of the structure and priorities of the goal-based architecture?

Figure 1 – Number and distribution of responses to question 1



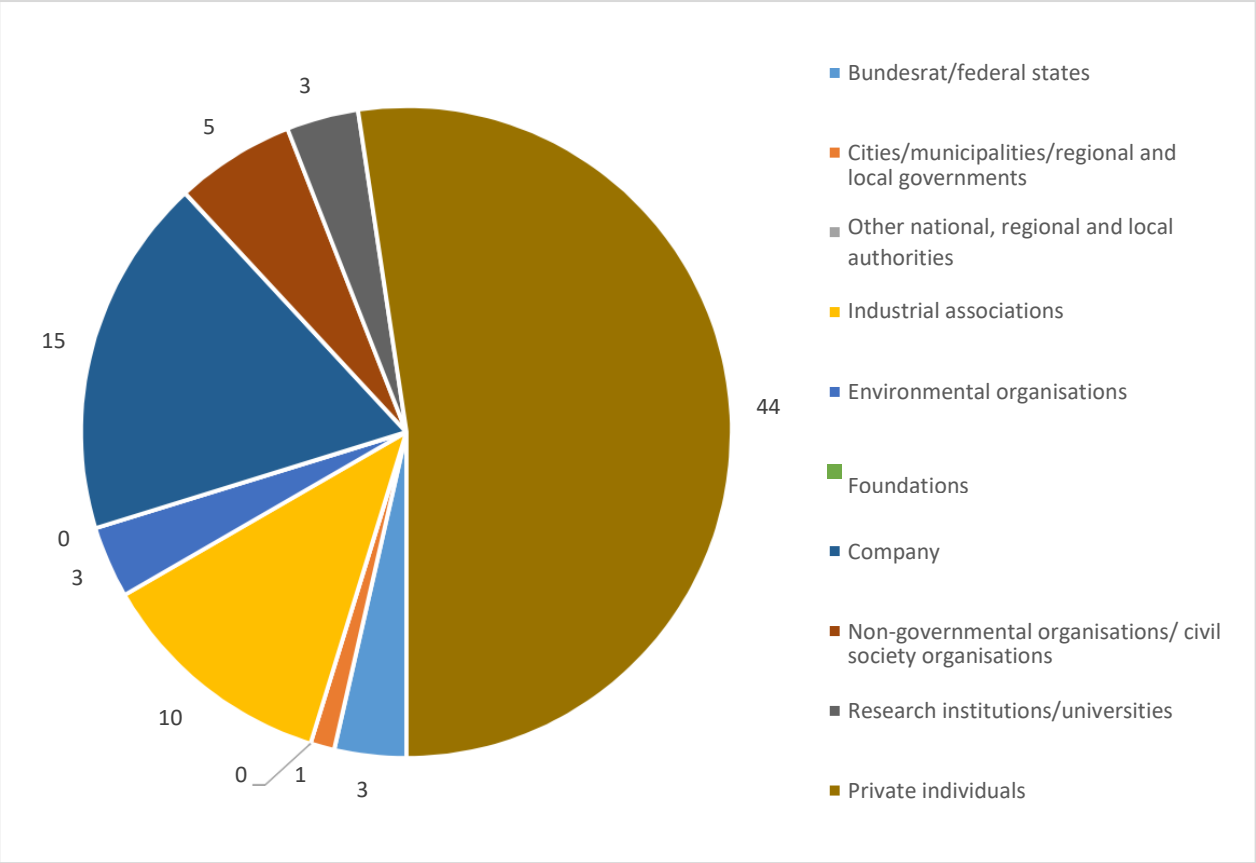
Total number of responses: 171

The draft was criticised by many stakeholders for not being ambitious enough (UV: EGU, VfW, SLV; U: N.N., BEL-EG; IV: VDMA; FI: ISE; PP: PPx10; BL: Baden-Württemberg). The general structuring was actually deemed to be coherent and appropriate (FI: ISE, IIS/IAS, IV: BDEW, AGFW, DENEFF, VDMA, DIHK, PP: PPx5, U: dena, N.N.x3), however there was extensive criticism regarding the specific goals from a very high number of stakeholders from all groups (NGO: NABU, GW, DNR, B.A.U.M, BBEn, N.N.x3; UV: DUH, GC, N.N., BUND, BUND-S, E3G, WWF, VfW; IV: BEE; PP: PPx29; Foundations: WFC; FI: DBFZ, UFZB, UFZÖ, ISE; U: dena, N.N.x2; BL: N.N., Schleswig-Holstein). The need for a wide range of different changes and additions was mentioned.

According to a very high number of stakeholders, environmental soundness should be given top priority over the other factors (PP: PPx24; UV: DUH; U: BEG, INNOGY, PIP, GEBB; NGO: N.N., RFF; Foundations: WFC; BL: N.N.). According to a very high number of stakeholders, there is an urgent need to adapt the goals in line with current commitments, such as, at the very least, net zero emissions by 2050 (NGO: NABU, GW, DNR, B.A.U.M; UV: DUH, GC, N.N.x2, BUND, E3G; IV: BEE; Foundations: WFC; PP: PP; U: dena, N.N.; BL: N.N.; Schleswig-Holstein) and the Paris climate goals (NGO: NABU, GW, DNR, N.N.x2; UV: BUND-S, DUH, GC, N.N., BUND, E3G; Foundations: WFC; PP: PPx3; IV: BEE; U: dena, N.N.; BL: N.N.). The phase-out of coal recommended by the Commission on Growth, Structural Change and Employment should also be added (NGO: N.N., NABU, GW, DNR, B.A.U.M; UV: DUH, N.N., BUND, E3G; Foundations: WFC; IV: BEE, BDEW; BL: North Rhine-Westphalia) and according to many stakeholders the phase-out of coal should be brought forward to 2030 (NGO: NABU, GW, DNR, B.A.U.M.; UV: DUH, N.N., BUND, E3G, GC; Foundations: WFC). Many other specific goals were mentioned which in most cases were more ambitious than the political commitments undertaken. Many stakeholders also recommended implementing a number of specific measures spanning all sectors.

Question 2: Other general comments

Figure 2 – Number and distribution of responses to question 2



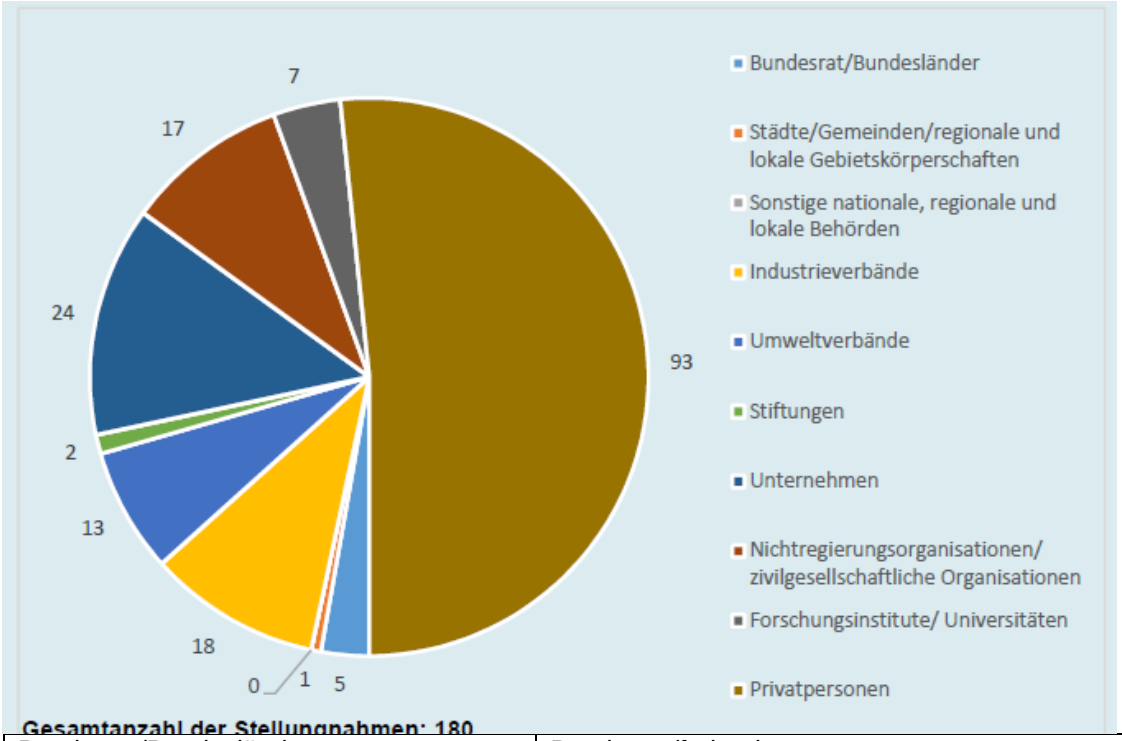
Total number of responses: 84

There was criticism that the report was not up-to-date as it were based on out-of-date goals and data (FI: DBFZ, UFZB, UFZÖ, ISE; NGO: NABU, GW, DNR, B.A.U.M, BBEn, N.N.x3; UV: DUH, GC, BUND, E3G, N.N.; IV: BEE; PP: PPx29; Foundations: WFC). Many individuals called for swift and decisive action and mentioned how urgent the situation was (UV: SLV, VfW; PP: PPx12; U: N.N.; NGO: W-NORD). The stakeholders mentioned a number of specific measures spanning all sectors. Some stakeholders mentioned the role that needs to be played by community energy, as required by the EU (IV: BBE, NGO: W-NORD, BBEn).

Dimension 1: Decarbonisation

Question 3: What is your assessment of the measures to date for achieving the 2030 greenhouse gas reduction goals mentioned in the draft German NECP?

Figure 3 – Number and distribution of responses to question 3



Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals
Gesamtanzahl der Stellungnahmen	Total number of responses

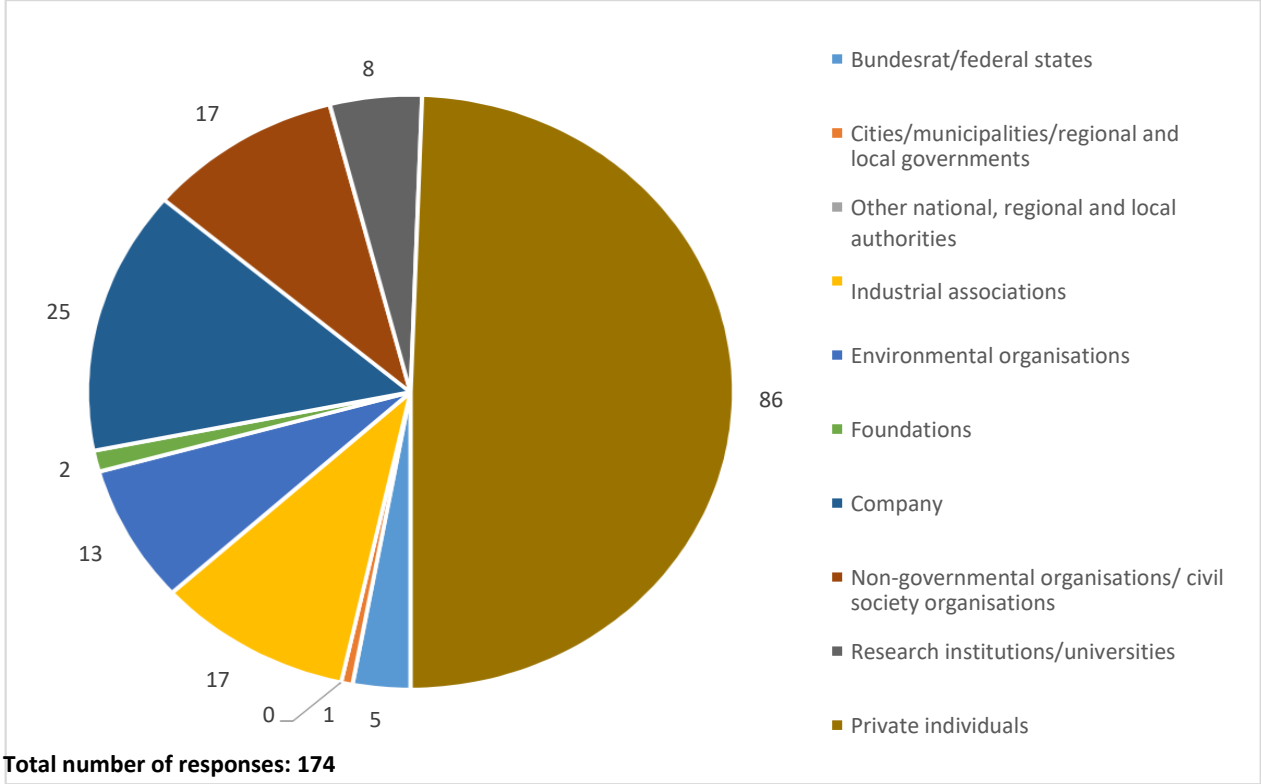
The overwhelming majority of stakeholders said that the measures to date, in particular those concerning sectors outside of the ETS, were not ambitious enough. The heating and transport sectors as well as agriculture were frequently mentioned. (BL: N.N., Saxony, Baden-Württemberg, North Rhine-Westphalia; IV: FNB Gas, DENEFF, DGRV, BEE, AGFW; UV: SLV, GW, BUND-S, SOW, E3G, BUND, N.N., DUH, GC, WWF, EGU; Foundations: WFC; NGO: NABU, GW, DNR, B.A.U.M., W-NORD, N.N.x3, RFF, BBEn; U: dena, GEBr, N.N., ISEI, INNOGY, BEL-EG, PIP, ONTRAS, N.N.x3, EnBW, BEG, E-Eff, EFG, VATTENFALL, Herrenkind, EnBW, ZDH; PP: PP; FI: GEOMAR, DBFZ, UFZÖ, UFZB, FU, ISE). Requests were also made for the measures to be adapted in line with the 2050 goal of net zero emissions. Many stakeholders said that the 2030 programme of measures and the Climate Action Plan 2050 needed to be updated and adapted in line with the goal of achieving net zero emissions by 2050 (UV: E3G, BUND, N.N., DUH, GC, WWF; Foundations: WFC; NGO: NABU, GW, DNR, B.A.U.M., N.N.; IV: BEE) and/or that the measures needed to be more ambitious (U: EFG, PP: PP).

The main areas of contention were in relation to the European Emissions Trading System (EU ETS) as well as carbon pricing. Many stakeholders mentioned swifter tightening up on emission allowances in the coming trading period (IV: BEE, BNE; UV: E3G, BUND, N.N., DUH, GC, WWF; Foundations: WFC; NGO: NABU, GW, DNR, B.A.U.M., CO2A). In general, they also felt the need for tightening up on certificates and for regulations on carbon leakage to be examined. Some explicitly stated that there should not be any further measures relating to the EU ETS. (IV: DEBRIV, N.N., VIK, NGO: DIHK). One consultation

participant explicitly called for regulations on the prevention of carbon leakage. (IV: N.N.). Many environmentally-focused stakeholders also called for the introduction of an investment-related and gradually increasing minimum price for carbon in particular in the heating and transport sectors. (IV: BEE, BWP, BNE; UV: E3G, BUND, N.N., DUH, GC, WWF; Foundations: WFC; U: dena, PIP, E2M; NGO: NABU, GW, DNR, B.A.U.M., CO2A; PP: PP). Some of them also called for the introduction of a minimum price for carbon in the electricity sector. (UV: E3G, BUND, N.N., DUH, GC, WWF; Foundations: WFC; NGO: NABU, GW, DNR, B.A.U.M., CO2A; PP: PP) On the other hand, other stakeholders saw the EU Emissions Trading System as an important (and sufficient) tool for reducing greenhouse gas emissions in the electricity sector. (IV: BDEW, N.N., U: dena).

Question 4: What other measures do you think are most important for achieving the 2030 greenhouse gas reduction goals?

Figure 4 – Number and distribution of responses to question 4



Total number of responses: 174

As expected, a very heterogeneous picture emerged in relation to the other suggested measures, some of which were detailed suggestions:
A very high number of stakeholders supported the idea of the cross-sector introduction of carbon pricing (BL: N.N., North Rhine-Westphalia, Schleswig-Holstein; FI: DBFZ, UFZB, N.N., UFZÖ; IV: BWP; NGO: N.N.; PP: PPx22; UV: VfW, BUND-S; U: dena, GEBB, BEL-EG, PIP, EnBW, BEG, N.N.x2). A very heterogeneous picture emerged in relation to the specifics on carbon pricing. Calls for carbon pricing started at EUR 25/t by 2020 / EUR 30/t by 2025 in order to secure and/or facilitate investments in renewable energies/climate-friendly generation (U: EnBW). At the opposite end of the spectrum, stakeholders called for carbon pricing of at least EUR 180/t (NGO: RFF, PP: PPx5).

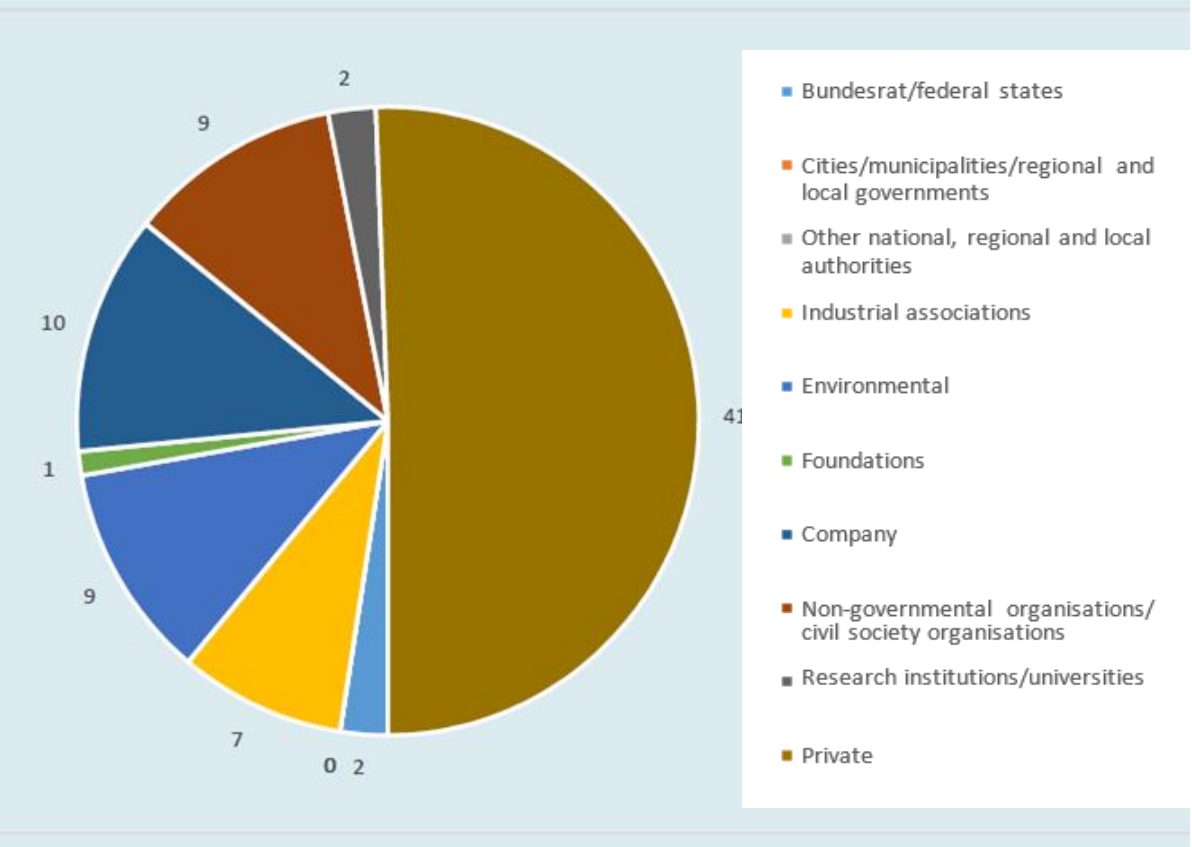
Many stakeholders also called for a federal Climate Protection Act to be passed (BL: N.N.; IV: BWP, BEE; NGO: NABU, GW, DNR, B.A.U.M., N.N.; PP: PP; Foundations: WFC; UV: E3G, BUND, GC, N.N., WWF; U: N.N.). The principle of being open to different types of technology was emphasised on multiple occasions (BL: Saxony; IV: VIK, N.N.; NGO: DIHK). The opportunities in the heating sector were highlighted by many stakeholders without any objections and many suggestions for measures were put forward, some of which were ambitious (FI: GEOMAR, DBFZ, UFZB, UFZÖ, FFU, ISE; PP: PPx2; U:

INNOGY, VATTENFALL; IV: BWP, AGFW, BDEW, ZDH). One stakeholder put forward a range of suggestions for measures specifically for the cooling sector (UV: EIA). Numerous suggestions for measures for the buildings sector were also put forward and were not all that polarising (IV: GDW, BWP, BNE; U: ZDH, GEBB, EFG, ISEI; PP: PPx5). More radical measures such as a ban on oil and gas heating (PP: PPx5) were in particular put forward by private individuals. With regard to the transport sector, firstly there was an overwhelming call for local public transport and rail transport to be expanded (NGO: N.N.; PP: PPx13; U: N.N.). Several stakeholders called for efforts and measures designed to achieve electrification of the transport sector (FI: ISE, DBFZ, UFZÖ; PP: PPx5, U: GEBB, INNOGY, N.N., EnBW; IV: BDEW; NGO: DIHK). There were also calls for the development of a hydrogen strategy (IV: FNBGas, N.N.; U: ONTRAS). Secondly, suggestions focused on making fossil fuels and/or motorised private transport less attractive and even introducing driving bans (IV: BDBe; NGO: BBen; PP: PPx21; U: EnBW). Several stakeholders also called for the introduction of a kerosene tax or restrictive measures on air transport (NGO: N.N.x2; PP: x15; UV: SLV; U: N.N.). Ramping up expansion of the use of renewable energies in the electricity sector was a key request (IV: BWO, BDEW; PP: x18; Cities/municipalities: VKU; U: INNOGY, EnBW, N.N.). Many stakeholders also stated adamantly that they were in favour of the removal of the ceiling imposed on the expansion of the use of wind and solar energy (PP: PPx11; U: EnBW). Some stakeholders also stated that they were in favour of climate action-focused reform of the charges, taxes, duties and levies on energy (BL: Schleswig-Holstein; FI: FFU; IV: AGFW, BDEW; Cities/municipalities: VKU; UV: VfW; U: dena, EnBW, E2M) as well as a reduction in the amount of red tape (NGO: BBen; U: VATTENFALL, EnBW). On that basis, some stakeholders called for electricity costs to be reduced (PP: PP; NGO: DIHK; IV: BDEW, N.N.; U: EnBW). Other suggested measures concerned the expansion of storage capacities (PP: PPx3; U: N.N.; UV: SLV) as well as the reduction of conventional must-run capacities (U: N.N.).

Many stakeholders were in favour of continued support for sectoral coupling (FI: UFZB, UFZÖ; Foundations: SOW; NGO: BBen; PP: PPx2; U: GASKO). District heating was highlighted as a good option for the integration of surplus renewable electricity in the heating sector (IV: AGFW; PP: PP). Four stakeholders also called for the continued promotion of cogeneration via the Cogeneration Act until 2030 and/or highlighted cogeneration's potential in terms of decarbonisation (IV: BDEW; U: VATTENFALL, EnBW; GASKO; Cities/municipalities: VKU). The responses received were also not at odds here. Many stakeholders also suggested considering, researching and assessing CCS and CCU for emission prevention and, where applicable, implementing them (FI: GEOMAR, IV: N.N.; NGO: DIHK; PP: PP; U: PIP, VNG, GASKO). Several stakeholders were in favour of political support for the measures in order to encourage acceptance (U: dena, EXERGIE; FI: UFZB, UFZÖ, ISE, NGO: N.N.; PP: PPx3).

Question 5: Other comments regarding the dimension

Figure 5 – Number and distribution of responses to question 5

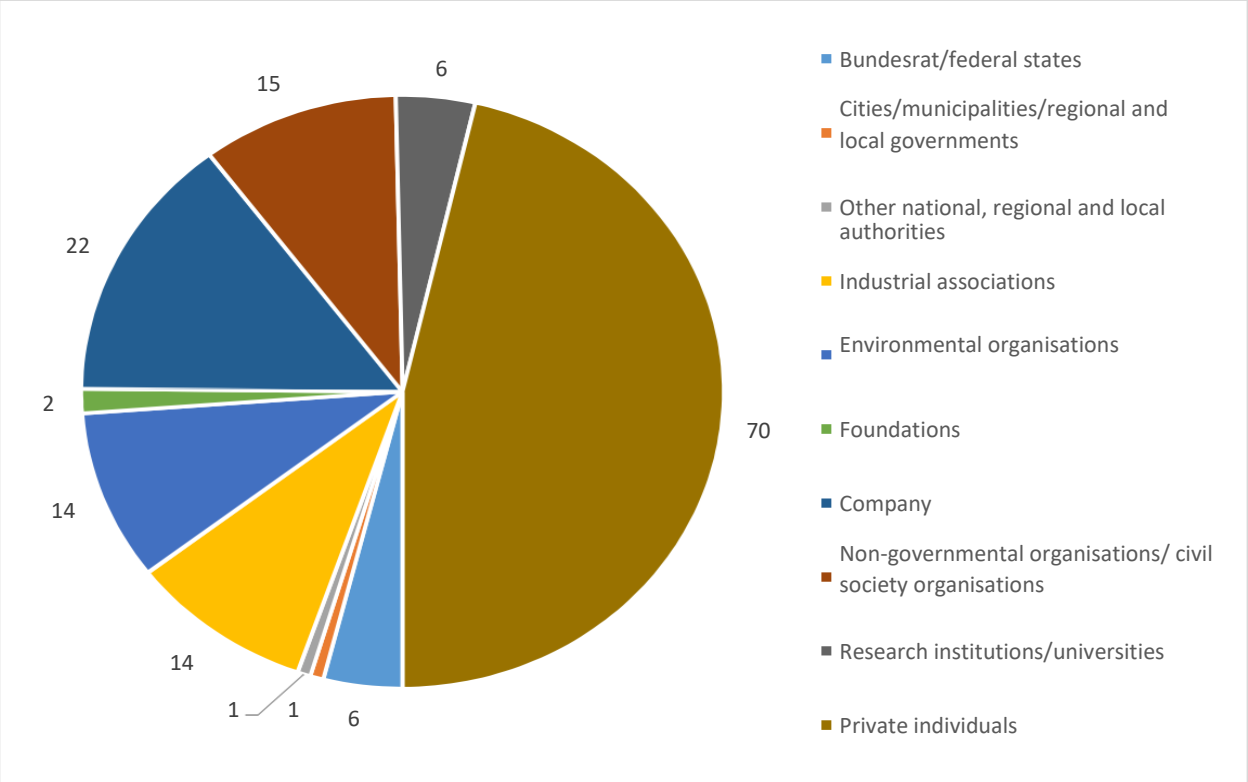


Total number of responses: 81

Other comments regarding the decarbonisation dimension primarily concerned additional suggestions for measures. These suggestions focused mainly on the topics covered in the previous questions and/or were related to measures that had already been proposed. Remarks made regarding the NECP dimension are worth highlighting. One stakeholder, for example, criticised the lack of statements on air transport and maritime transport (NGO: DIHK). Many stakeholders also felt that the NECP was not ambitious enough (PP: PPx13; UV: EIA; U: BEL-EG; U: N.N.). Two other stakeholders said that since Germany was a rich developed country, its contribution to the reduction should be disproportionately high (NGO: GW; UV: EIA). Only one stakeholder criticised the fact that security of supply was prioritised above all else (U: KRC). A number of additional suggestions for agriculture-related measures were put forward with identical wording by four stakeholders (NGO: NABU; Foundations: WFC; UV: E3G, BUND). Two stakeholders commented that the global 2°C goal could be achieved only if action were taken preferably at global level and criticised the renationalisation of the European climate policy (IV: N.N., PP: PP). Another stakeholder suggested adopting successful measures from other countries (e.g. carbon pricing in Sweden) (PP: PP). For the sake of clarity and transparency, one stakeholder suggested providing a clear illustration of potential transformation trajectories of the entire energy system in the NECP (FI: ISE).

Question 6: Against this backdrop, what is your assessment of the measures set out in the draft NECP for achieving Germany's contribution to the goal?

Figure 6 – Number and distribution of responses to question 6

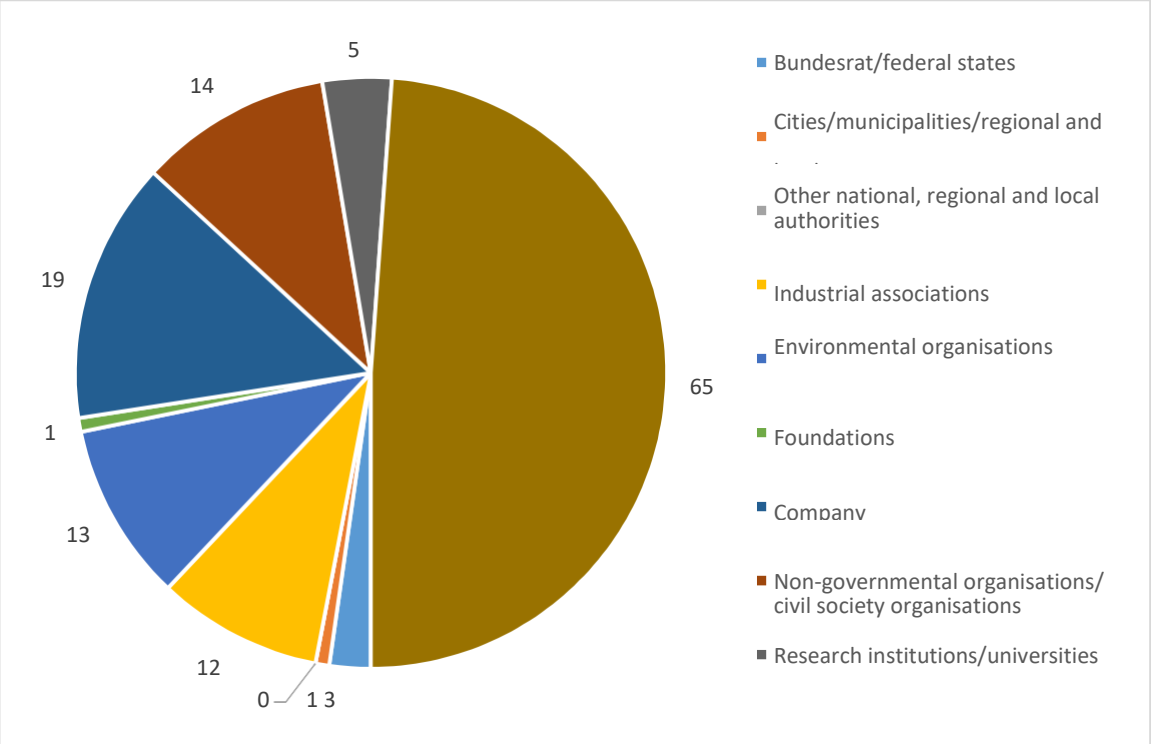


Total number of responses: 151

A very high number of stakeholders said that the measures taken were not sufficient. This was the opinion of most environmental organisations (UV: E3G, BUND, GW, N.N., GC, WWF, EGU, BUND-S), many NGOs (NGO: VZBV, BBEn, NABU, GW, DNR, B.A.U.M., N.N.x3, CO2A, W-NORD), companies (U: INNOGY, BEL-EG, N.N.x3) and private individuals (PP: PPx20) as well as some research institutions (FI: UFZB, ISE), one industrial association (IV: BEE), and some foundations (Foundations: WFC, SOW). One federal state also shared this opinion (BL: Baden-Württemberg). One consultation participant felt that the measures were, on the whole, adequate (IV: N.N.). A very high number of stakeholders felt that the speed of the expansion of the use of renewable energies was not ambitious enough. This was the opinion of many environmental organisations (UV: BUND, N.N., DUH, GC, WWF), NGOs (NGO: NABU, GW, DNR, B.A.U.M., DIHK, N.N., BBEn), and private individuals (PP: x22), as well as one federal state (BL: Baden-Württemberg), some industrial associations (IV: DGRV, BEE, BDEW, GW), some companies (U: INNOGY, EnBW, N.N.), one research institution (FI: ISE), one foundation (Foundations: WFC) and one authority (Authorities: BWVI).

Question 7: What is your assessment of the measures set out in the draft NECP for achieving the indicative milestone of increasing the combined share of renewable heat and waste heat by 1.3 percentage points a year?

Figure 7 – Number and distribution of responses to question 7

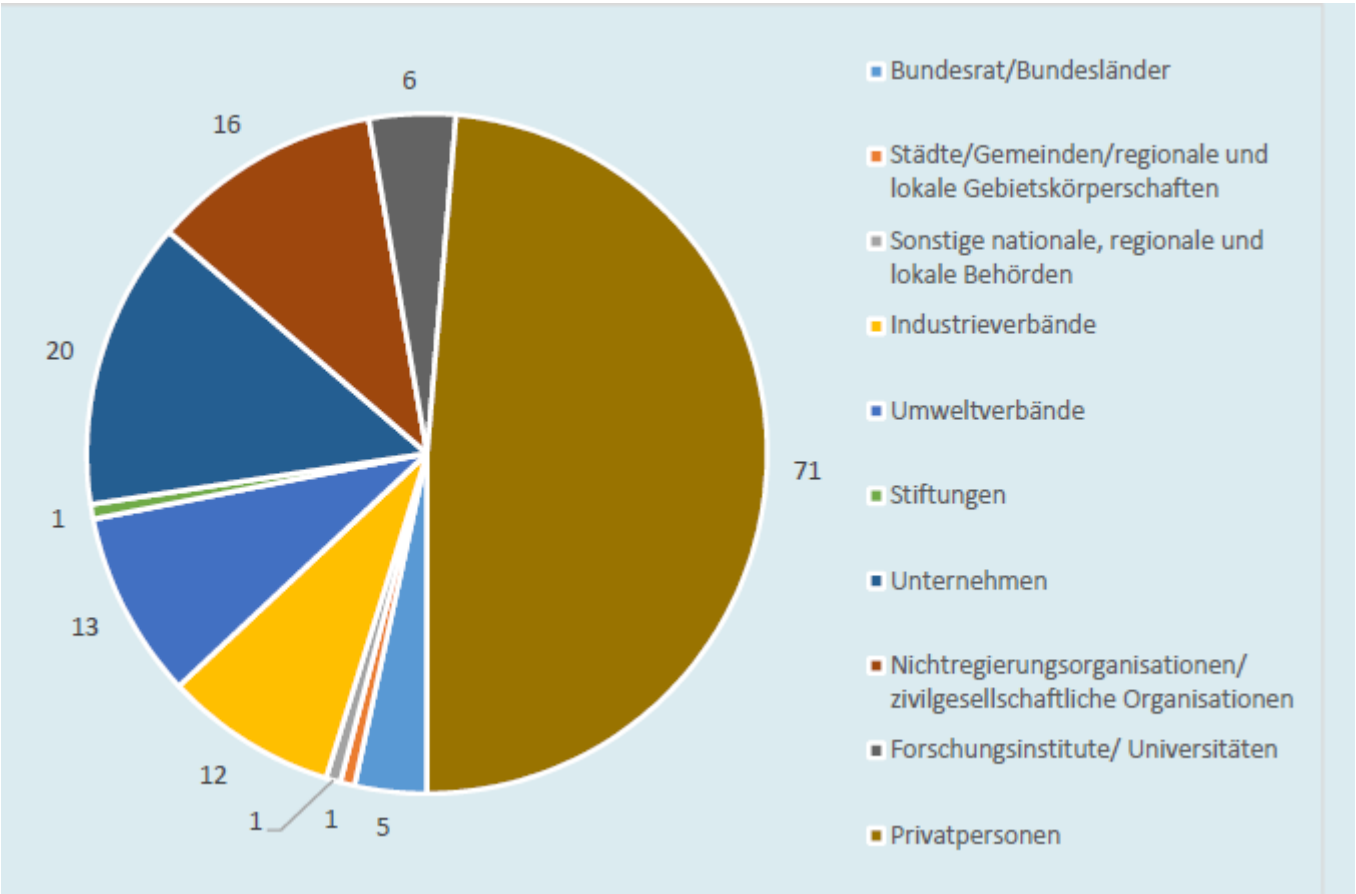


Total number of responses: 133

A very high number of private individuals and some other stakeholders felt that the goals were not sufficient (U: Exergie, GEBB, N.N.; UV: SLV; FI: UFZ-B; PP: PPx43). An increase of significantly more than 10 percentage points a year was occasionally called for in order to achieve the Paris climate goals (U: N.N.). The basis on which these goals had been developed was also said to be unclear (PP: PP). The approach of examining the sectors separately was said not to be constructive (PP: PP). A range of environmental organisations called for technology-specific trajectories in the heating and cooling sector to be worked out in detail so that they could be assessed in terms of compliance with the National Air Pollution Control Programme (NAPCP) and feasibility (UV: BUND, DUH, NRDC, GC, WWF). Other stakeholders felt that although the goals were ambitious, they were necessary for achieving Germany's energy and climate goals (U: dena). The goals were welcomed by some consultation participants (BL: North Rhine-Westphalia; PP: x3). The heating sector was said to be key to achieving the energy and climate goals and to offer by far the most potential for reducing the use of fossil fuels and reducing greenhouse gas emissions (BL: North Rhine-Westphalia). Such an ambitious goal could be achieved only if the necessary heating supply were increasingly provided through the use of electricity as a source of energy (NGO: DIHK). The goals and measures needed to be reviewed regularly and independently (PP: PP). However, predetermined annual goals were in any case useful at system level but not at an individual company level (IV: N.N.). It was necessary to made clear that the annual increase of 1.3 percentage points includes the use of waste heat (U: VATTENFALL; IV: AGFW).

Question 8: What is your assessment of the measures set out in the draft NECP relating to the transport sector for achieving the energy and climate policy goals? What other measures are required in your opinion?

Figure 8 – Number and distribution of responses to question 8



Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals

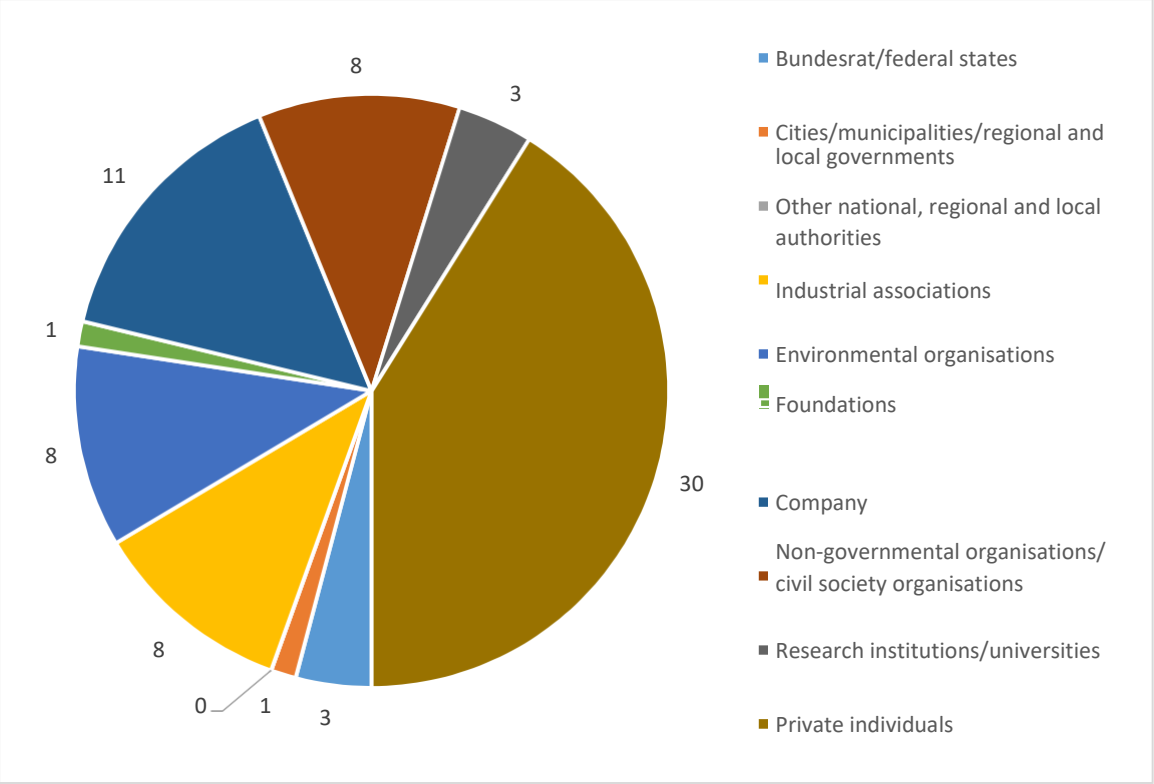
Total number of responses: 146

Many stakeholders felt that the measures for the transport sector were not sufficient. These included a very high number of private individuals, many NGOs and environmental organisations and some federal states, companies, research institutions and industrial associations (U: CE, BEL-EG; UV: E3G, N.N., GC, WWF, DUH, BUND; NGO: UFOP, ENERGIE, NABU, GW, DNR, B.A.U.M., N.N.; Foundations: WFC; IV: BDEW, DGRV, BEE, VDB; FI: bioma, UFZB, UFZÖ; BL: N.N., North Rhine-Westphalia; PP: x28). The measures set out in the NECP were not backed up with specific projects and were not in keeping with the desired concepts (IV: ZVEI). The measures presented lacked important details (IV: BNE). There appeared to be no consistent strategy (NGO: BBEn). The measures described related almost exclusively to vehicle transport and drive system-related changes being pursued in that area (Other authorities: BWVI). The draft was little more than a description of the current situation, and therefore lacked almost all the hallmarks of a plan focusing on the future (IV: BEE, VDB). Some stakeholders felt that the goals were not sufficient (U: N.N.; PP: PPx2). In recent years, energy consumption in the transport sector had even risen meaning that the targets were actually moving further and further away (U: dena). It had not been possible to reduce sector-specific emissions since 1990 (EnBW). Average CO_2 emissions of new vehicles were also

increasing again (U: dena). It was stated that, according to current forecasts, more than 1 million new SUVs would be licensed this year (U: ZDH).

Question 9: Other comments regarding the dimension?

Figure 9 – Number and distribution of responses to question 9



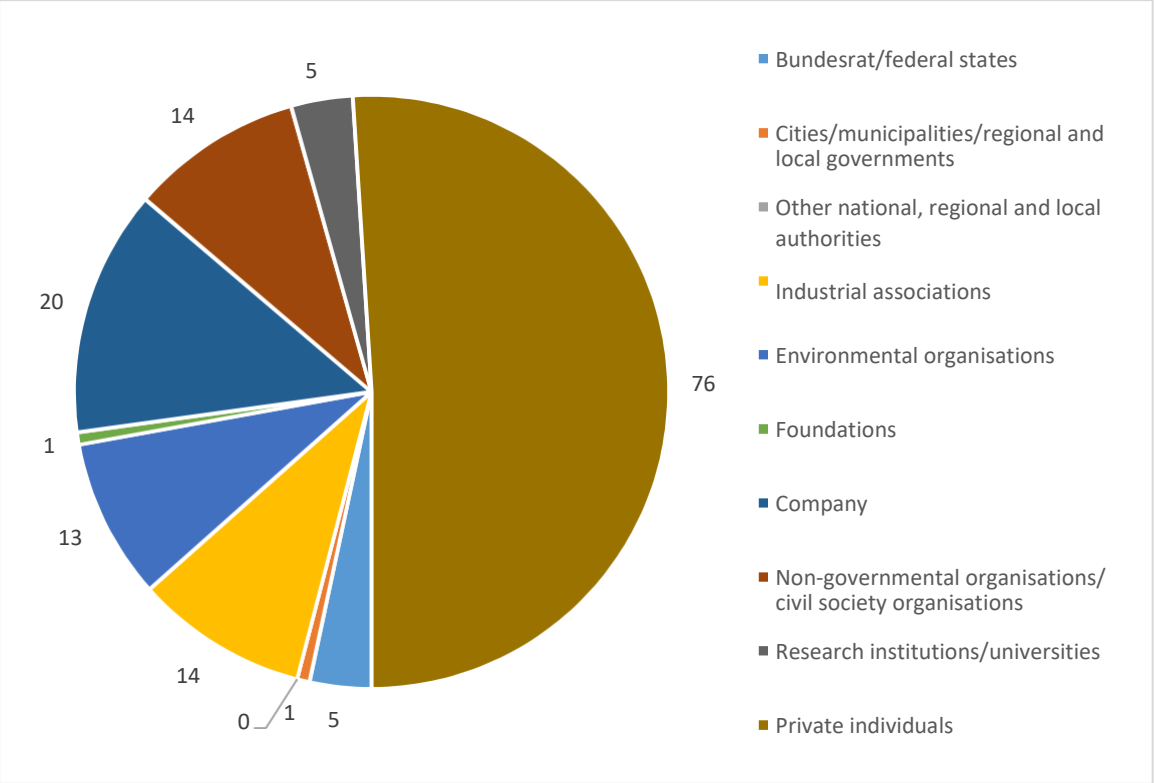
Total number of responses: 73

In their other comments regarding the decarbonisation dimension, the stakeholders taking part mentioned a broad range of sectors. With regard to the electricity sector, they mentioned areas such as the expansion of the use of renewable energies, PPAs, landlord-to-tenant models, community energy, imports for green hydrogen and Power-to-X solutions. With regard to the heating sector, they called for affordable buildings and the use of renewable gases. With regard to the transport sector, reference was once again made to sectoral coupling and existing regulatory barriers.

Dimension 2: Energy efficiency

Question 10: What is your assessment of existing measures for reducing energy consumption and increasing energy efficiency?

Figure 10 – Number and distribution of responses to question 10

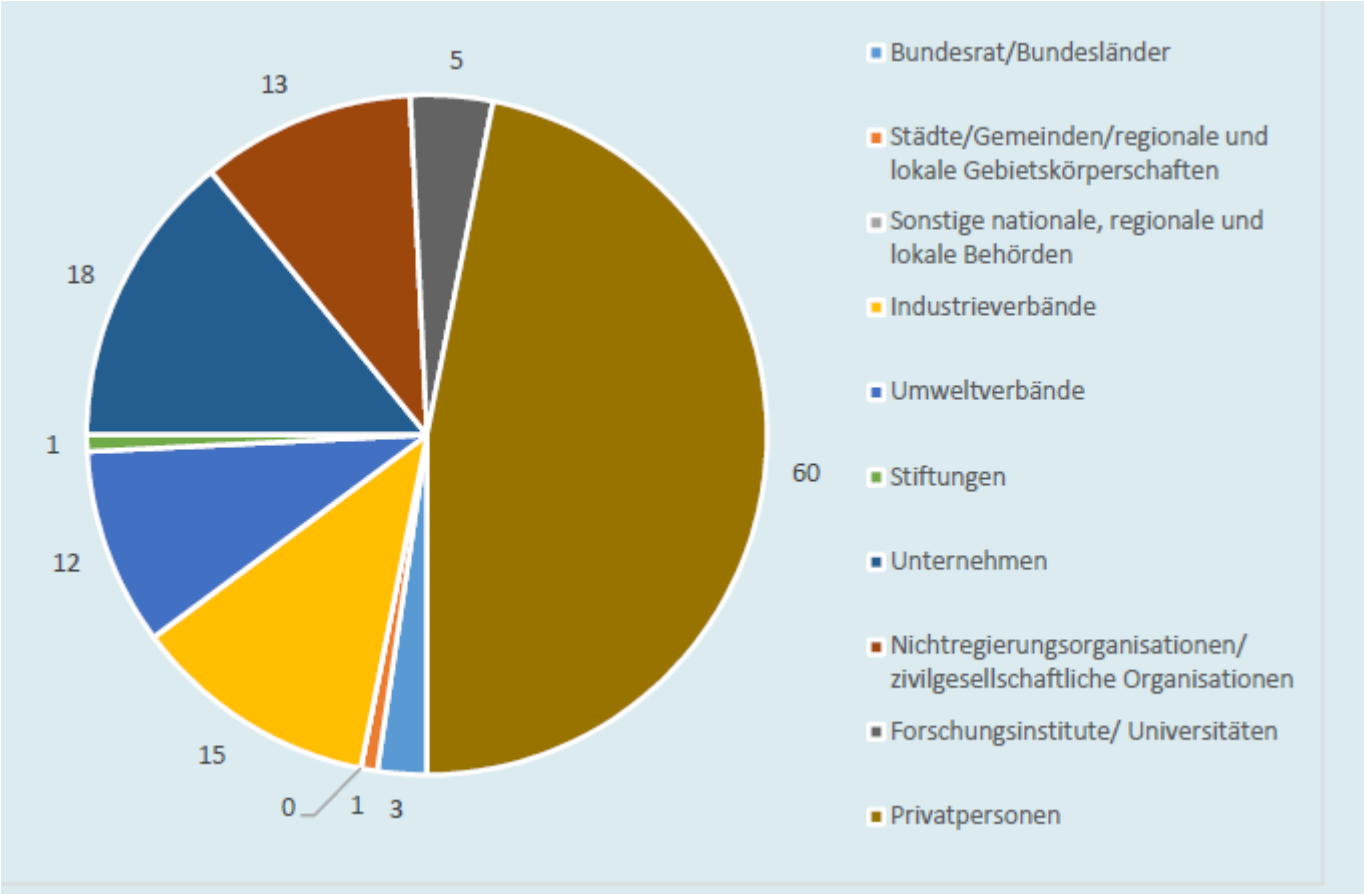


Total number of responses: 149

A very high number of stakeholders said that the measures taken were not sufficient. This was the opinion of some federal states (BL: N.N., North Rhine-Westphalia), some industrial associations (IV: ZVEI, DENEFF, AGFW, BDEW), one research institution (FI: BPIE), many environmental organisations (UV: SLV, BUND, WWF, E3G, VFW, GC, EGU, BGS, N.N.), some companies (U: BEL-EG, EnBW, DAIKIN, N.N.), many NGOs (NGO: BBEN, NABU, GW, DNR, B.A.U.M., RFF, CO2A, N.N.) and numerous private individuals (PP: PPx47). A few stakeholders welcomed the measures to date and took a positive view of them (IV: VIK, N.N. FI: IIS/EAS PP: PPx3). One stakeholder felt that the measures to date were very ambitious (U: INNOGY). It was felt that the measures for achieving the 2030 goals should be set out in more specific detail (BL: Baden-Württemberg), this would create planning security (FI: BPIE UV: DUH NGO: VZBV PP: PPx2). Many industrial associations and private individuals called for the measures that had already been announced to be implemented much more swiftly (IV: BEE, DENEFF, BDEW, VfW, DAIKIN NGO: VZBV PP: PPx7).

Question 11: What measures should the new Energy Efficiency Strategy contain in order to achieve the national energy efficiency goals and contribute to the EU's energy efficiency goal for 2030?

Figure 11 – Number and distribution of responses to question 11



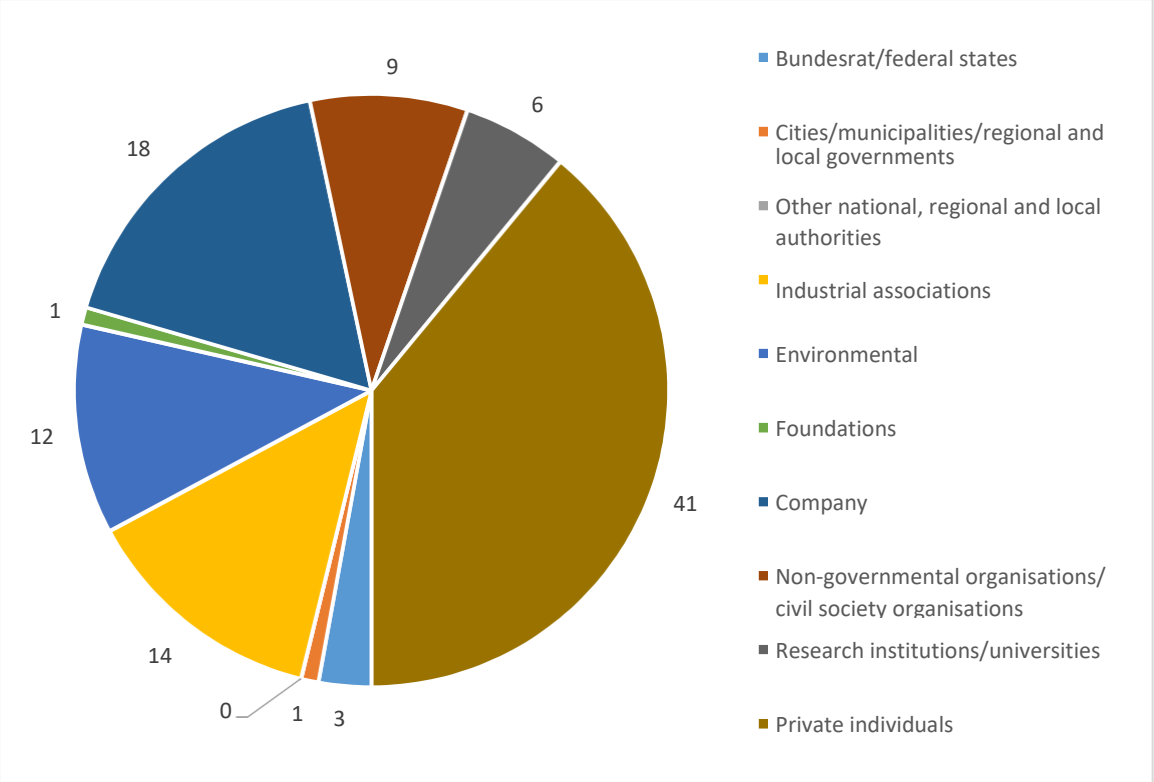
Total number of responses: 128

Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals

A very high number of stakeholders called for the consistent further development of existing regulatory measures as well as for supportive funding measures. This was the opinion of some federal states (BL: Schleswig-Holstein, Baden-Württemberg, North Rhine-Westphalia), some industrial associations (IV: BDEW, BNE), one company (U: dena), one foundation (WFC), many NGOs (NGO: NABU, GW, DNR, B.A.U.M., DIHK) and many environmental organisations (UV: E3G, GC, WWF, BUND, DUH, N.N.). Many stakeholders also called for existing and additional measures to be made as straightforward and non-bureaucratic as possible (BL: Baden-Württemberg NGO: DIHK UV: DUH IV: VDMA, BNE PP: PP).
A very high number of stakeholders called for cross-sector carbon pricing to be a focus of the new Energy Efficiency Strategy (BL: Saxony, Schleswig-Holstein; Cities/municipalities: VKU U: dena IV: BNE, VfW, BUVEG NGO: RFF, SLV PP: PPx8). Many stakeholders also called for the levies and duties on electricity to be restructured (U: dena, VATTENFALL IV: BNE, ZVEI NGO: RFF, SLV PP: PPx4).

Question 12: In your opinion, how and with what measures could the guiding principle of 'Energy Efficiency First' set out in the NECP be implemented?

Figure 12 – Number and distribution of responses to question 12

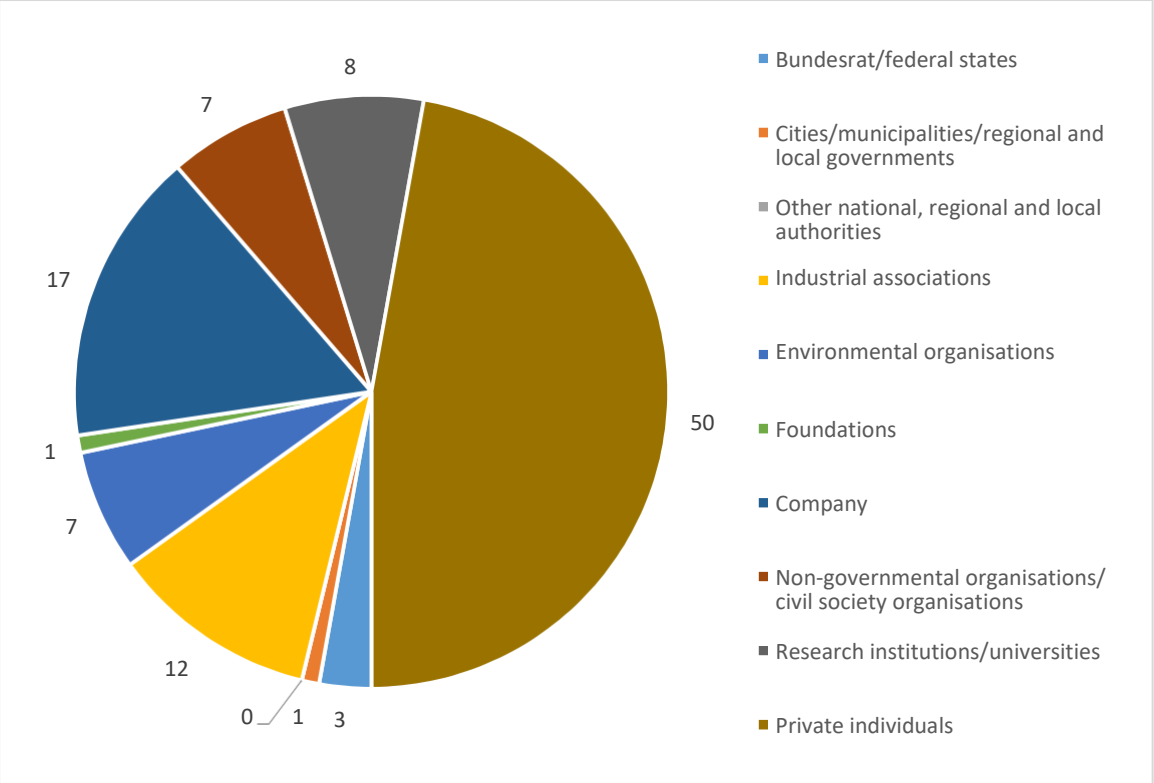


Total number of responses: 105

Some stakeholders welcomed the guiding principle of Efficiency First (BL: Saxony, Baden-Württemberg, U: dena, UV: DUH). However, they and other stakeholders also said that the principle of Efficiency First must not in any way prevent energy consumption but instead should reduce inefficient energy consumption (U: dena, ZDH, N.N.; IV: BDEW NGO: DIHK UV: DUH). Other stakeholders called for the principle of Efficiency First to be given top priority (IV: ZVEI; U: N.N. PP: PPx2). One stakeholder stated that there was no need for energy efficiency to be on a par with other important factors such as security of supply, economic efficiency and climate/environmental soundness (IV: N.N.). Many stakeholders called for an Energy Efficiency Act combining clarity, intelligibility and visibility with minimum red tape (U: dena, ZDH UV: VfW; PP: PPx5). Many stakeholders said that they would like to see efficiency measures implemented ideally on market economy terms (U: dena, IV: BDEW, ZVEI, VIK PP: PP). Other stakeholders felt that energy efficiency should play a role for the entire supply chain (from generation to consumption) (FI: BPIE IV: VKU UV: DUH). One stakeholder mentioned the concept of 'emissions efficiency' rather than energy efficiency (IV: BNE). Some stakeholders mentioned the difference between energy saving (absolute saving) and efficiency (reduction in specific energy consumption) (IV: N.N., NGO: DIHK). The same stakeholders stated that the electrification of industrial processes inevitably involved an increase in energy consumption (IV: N.N.; NGO: DIHK). Some stakeholders referred to the efficiency potential of sectoral coupling, e.g. with heating and the transport sector (IV: BEE, N.N.; U: INNOGY).

Question 13: What is your assessment of the strategies relating to energy efficiency in the buildings sector presented in the draft NECP against the backdrop of the holistic approach of the national Energy Efficiency Strategy for Buildings?

Figure 13 – Number and distribution of responses to question 13

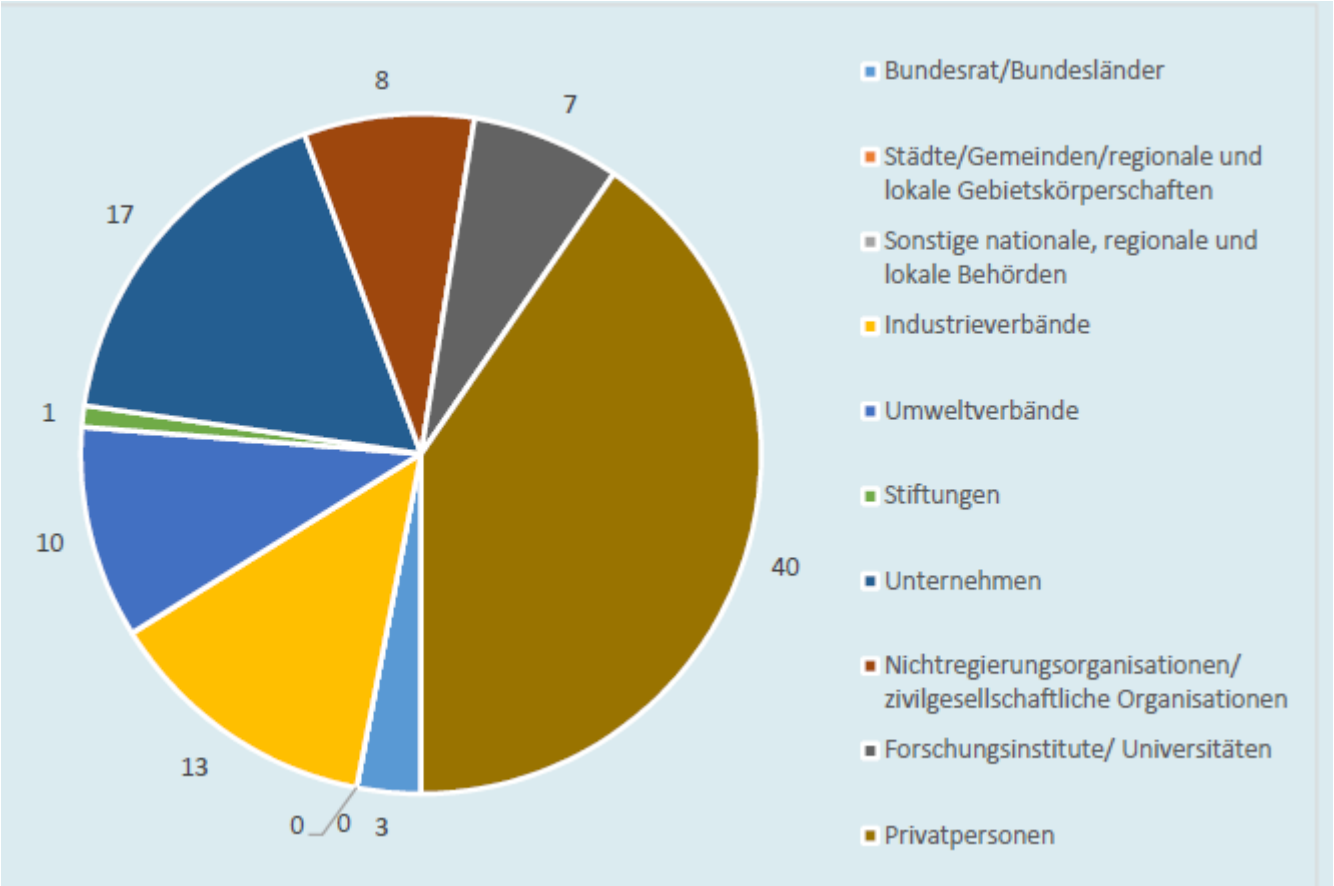


Total number of responses: 106

A very large number of stakeholders from all groups stated that the buildings-related measures mentioned in the NECP were not sufficient (BL: Baden-Württemberg, North Rhine-Westphalia; IV: DENEFF, BDEW, AGFW, BuVEG U: EnBW, DAIKIN UV: DUH, VfW, EGU; NGO: RFF; FI: BPIE PP: PPx19).
Some stakeholders argued that, contrary to what the NECP said, the instruments which had already been implemented (Energy Conservation Regulation (New Buildings Energy Act) / DIN V 4701-10 and DIN V 18599) were not effective (Foundations: SE, UV: DUH, VfW). A few stakeholders welcomed the consolidation of the Energy Conservation Act, the Energy Conservation Regulation and the Renewable Energies Heat Act into a single legal framework (NGO: DIHK U: N.N., ZDH). Some private individuals took a positive view on the measures to date (PP: PPx4).

Question 14: Should other energy topics relating to the buildings sector also be addressed in the NECP? If so, which ones?

Figure 14 – Number and distribution of responses to question 14



Total number of responses: 99

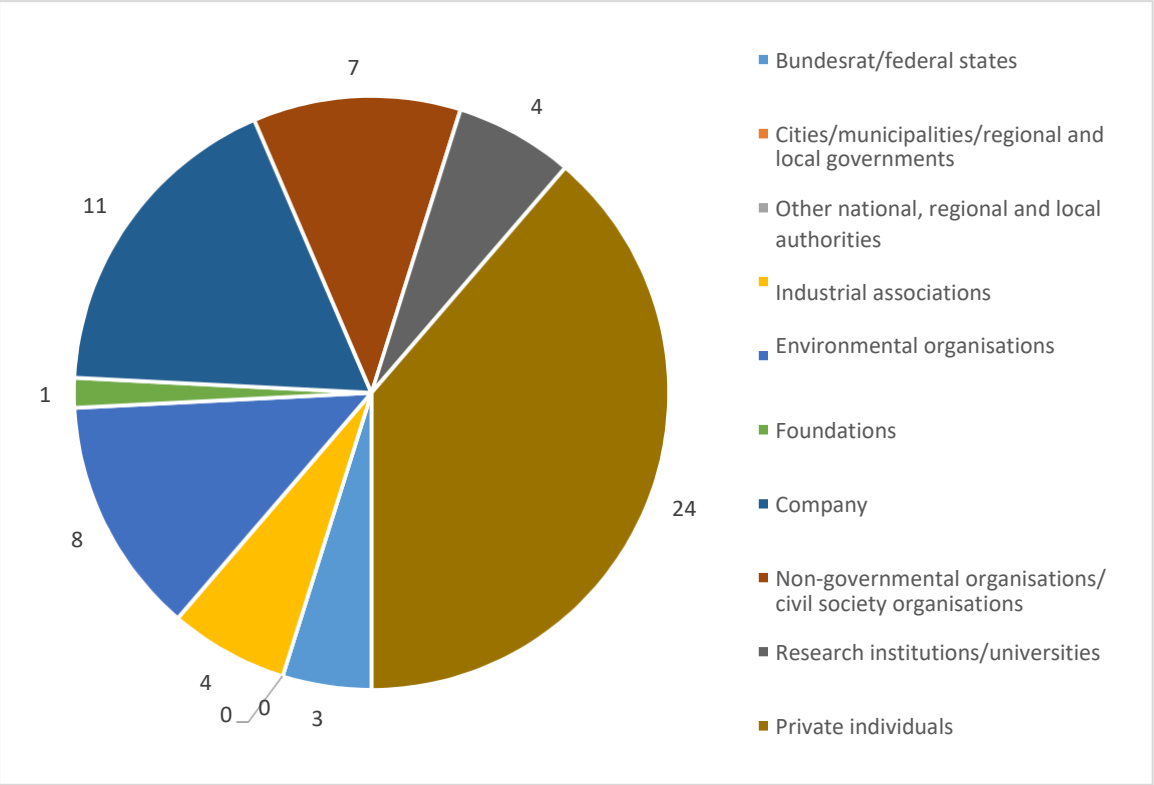
Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals

A very high number of stakeholders from all groups called for the implementation of tax incentives for the energy-related modernisation of buildings (BL: Baden-Württemberg, North Rhine-Westphalia IV: VDMA, N.N. U: dena, ZDH, VNG Foundations: WFC NGO: NABU, GW, DNR, N.N. UV: E3G, BUND, GC, WWF, N.N. PP: PP). One environmental organisation also called for the expansion of funding for renewable heating based on the Market Incentive Programme (DUH). Two research institutions also called for property-specific funding based on annual energy demand and the type of supply (FI: UFZB, UFZÖ). One stakeholder called for an increase in funding for complete renovations resulting in energy-efficient buildings and for non-residential buildings (ZDH). One stakeholder called for funding programmes in the heating market to be designed so as to be both technology-neutral and focused on the highest carbon and energy saving results per euro invested (IV: N.N.). A very high number of stakeholders from different groups called for the regulatory law for the buildings sector to be standardised, cemented and simplified (IV: VDMA U: dena, EnBW, ZDH, VNG, N.N., DAIKIN Foundations: WFC NGO: NABU, GW, DNR, UV: E3G, BUND, GC, WWF, N.N.; PP: PPx3). Many stakeholders also called for amendments to the Landlord-to-Tenant Electricity Act (Foundations: WFC NGO: NABU, GW, DNR, RFF UV: E3G, BUND, GC, WWF,

N.N.). A mixture of NGOs, a foundation and environmental organisations as well as other stakeholders called for at least the KfW-40 standard for new buildings as well as prompt implementation of the Passive Building and/or Energy-Plus Building Initiative (Foundations: WFC; U: BEL-EG NGO: NABU, GW, DNR UV: E3G, BUND, GC, WWF, N.N. PP: PP).

Question 15: Other comments regarding the dimension?

Figure 15 – Number and distribution of responses to question 15



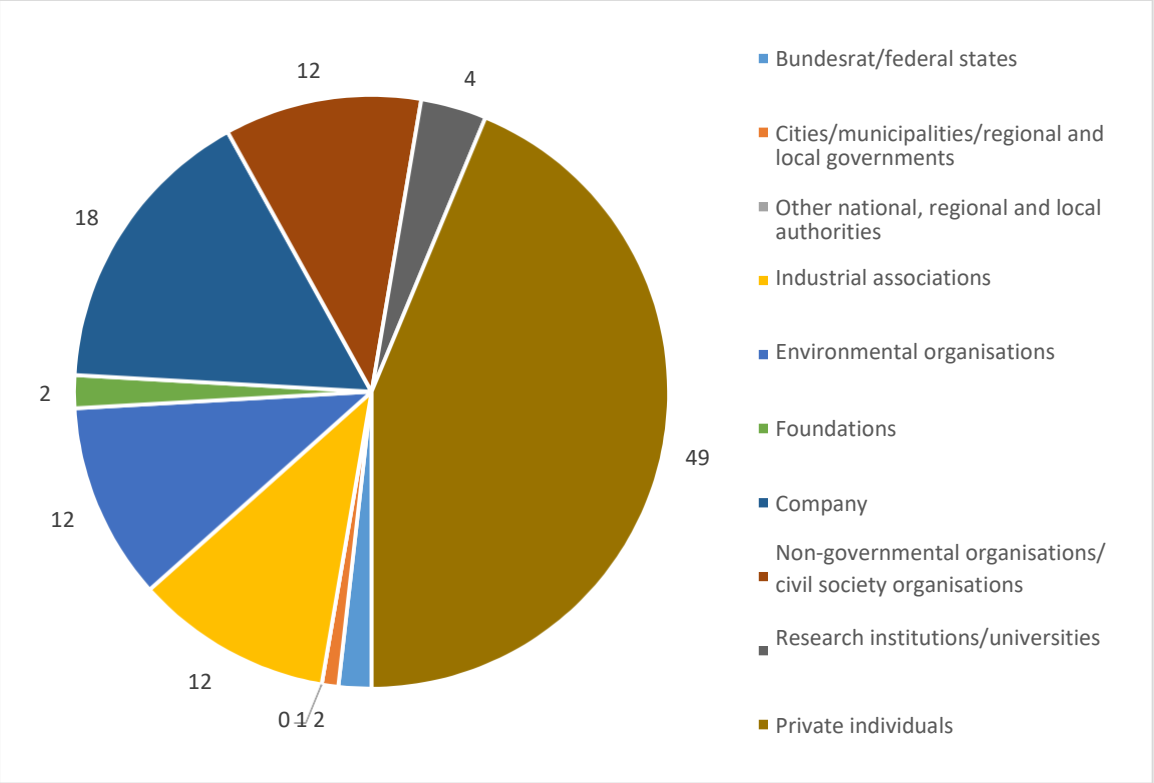
Total number of responses: 62

Some private individuals said that the energy transition needed to be implemented more swiftly (PP: PPx4). Many stakeholders called for ambitious implementation and further development of the EU Directive on ecodesign and energy labelling (Foundations: WFC NGO: NABU, GW, DNR, B.A.U.M. UV: E3G, BUND, DUH, GC, WWF, N.N.). Some stakeholders stated that a limited amount of energy could be saved in many industrial processes without any loss of quality or leakage (N.N., VIK). Many stakeholders called for public procurement to drive demand for climate-friendly building materials. The same stakeholders also called for material-specific GHG limits and a minimum recycling percentage for cement/concrete, steel, glass, aluminium and PVC. They also called for the introduction of a notional carbon price for the public sector which would have to be taken into consideration in contract award processes (Foundations: WFC; NGO: NABU, GW, DNR, B.A.U.M., DIHK UV: E3G, BUND, DUH, GC, WWF, N.N.).

Dimension 3: Energy security

Question 16: Against this backdrop, what is your assessment of the measures set out in the draft NECP?

Figure 16 – Number and distribution of responses to question 16

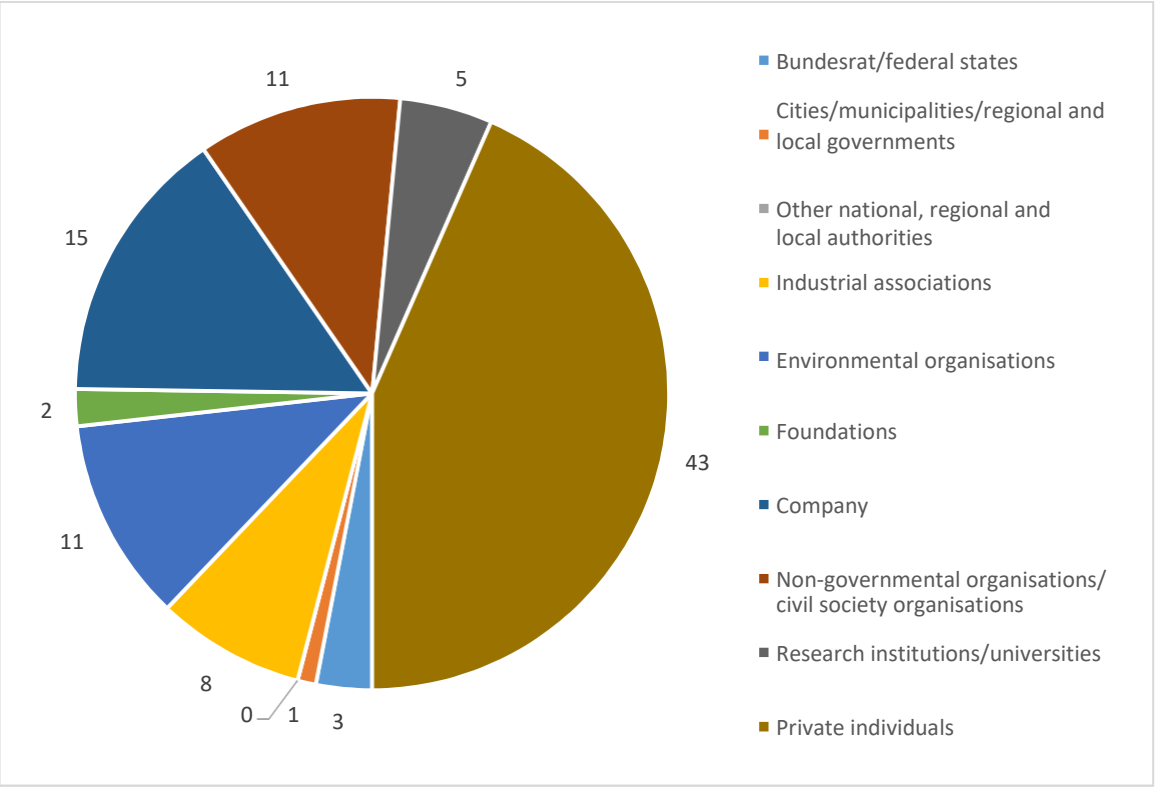


Total number of responses: 112

The assessments of the measures set out in the energy security dimension varied. Some stakeholders felt that the legal acts and regulations mentioned were, by and large, suitable for ensuring a secure supply of energy (BL: Saxony; U: N.N., TRANSNETBW; PP: x2). The measures were said to have been presented in full detail (BL: Saxony). Security of supply would presumably inevitably be based on fossil fuels in the short and medium term (FI: IIS/EAS). Others felt that the measures were not ambitious enough (NGO: RFF, W-NORD; UV: EGU; PP: x4). They essentially addressed the security of the 'old' energy system (supply with fuels) (FI: ISE). Security with regard to the new energy system of the future was not covered (FI: ISE; IIS/EAS). As such, the measures were essentially focused in the wrong direction (NGO: BBEN).

Question 17: Are other measures required in your opinion? If so, which ones?

Figure 17 – Number and distribution of responses to question 17

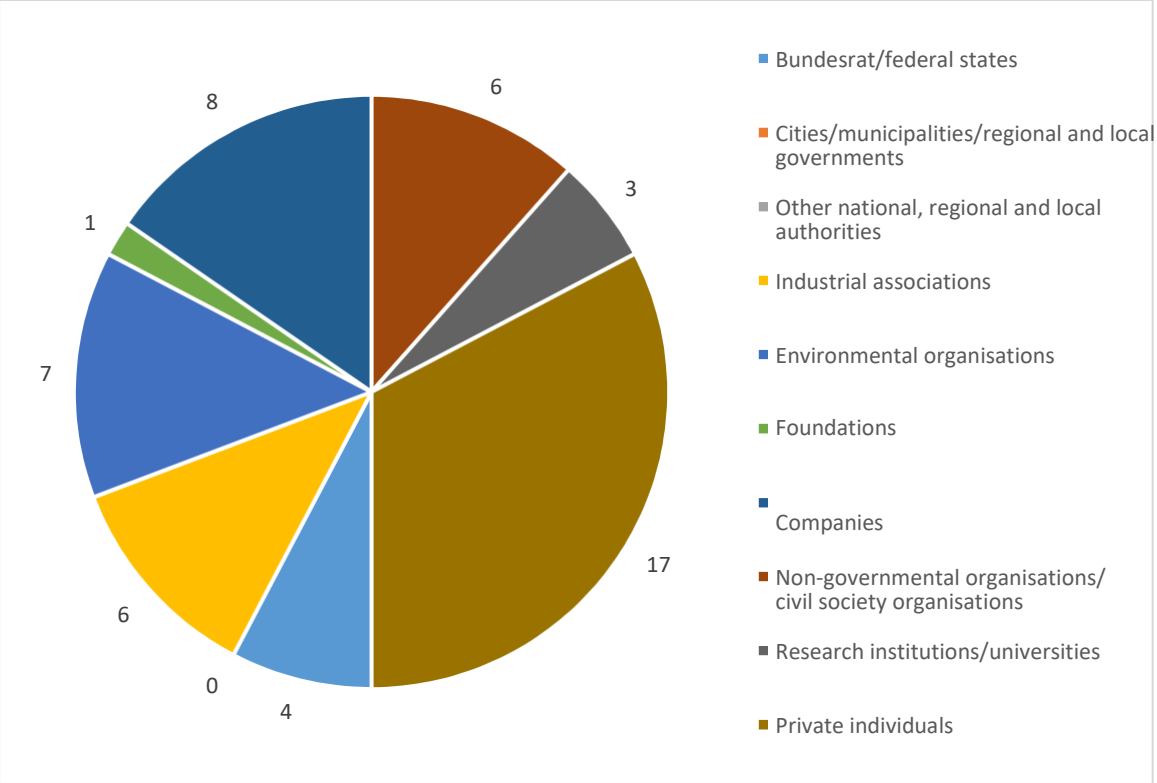


Total number of responses: 99

The consultation participants mentioned a range of potential other measures. Many areas were covered, including expansion of the transmission systems, increased system responsibility for distribution system operators, changes to the design of the electricity market and expansion of the monitoring of the security of the electricity supply. The role of different generation technologies was also covered (phase-out of coal, role of renewable energies, storage technologies and decentralised solutions). With regard to the supply of gas, goals all the way up to 2040 were discussed as well as the roles of fracking, LNG technologies and gas storage reservoirs. Many NGOs and environmental organisations were of the opinion that future-proof security of supply should be redesigned from scratch and that, as such, geopolitical considerations and matters concerning security policy should be more heavily geared towards climate protection (UV: E3G, BUND, DUH, GC; N.N. NGO: NABU, GW, B.A.U.M., DNR; Foundations: WFC). Firstly, it should take expected climate damage into consideration and secondly, it should be much more heavily based on renewable energies, energy efficiency, the electrification of the heating sector and power-to-gas technologies (UV: E3G, BUND, N.N., DUH, GC; NGO: NABU, GW, B.A.U.M., DNR; Foundations: WFC).

Question 18: Other comments regarding the dimension

Figure 18 – Number and distribution of responses to question 18



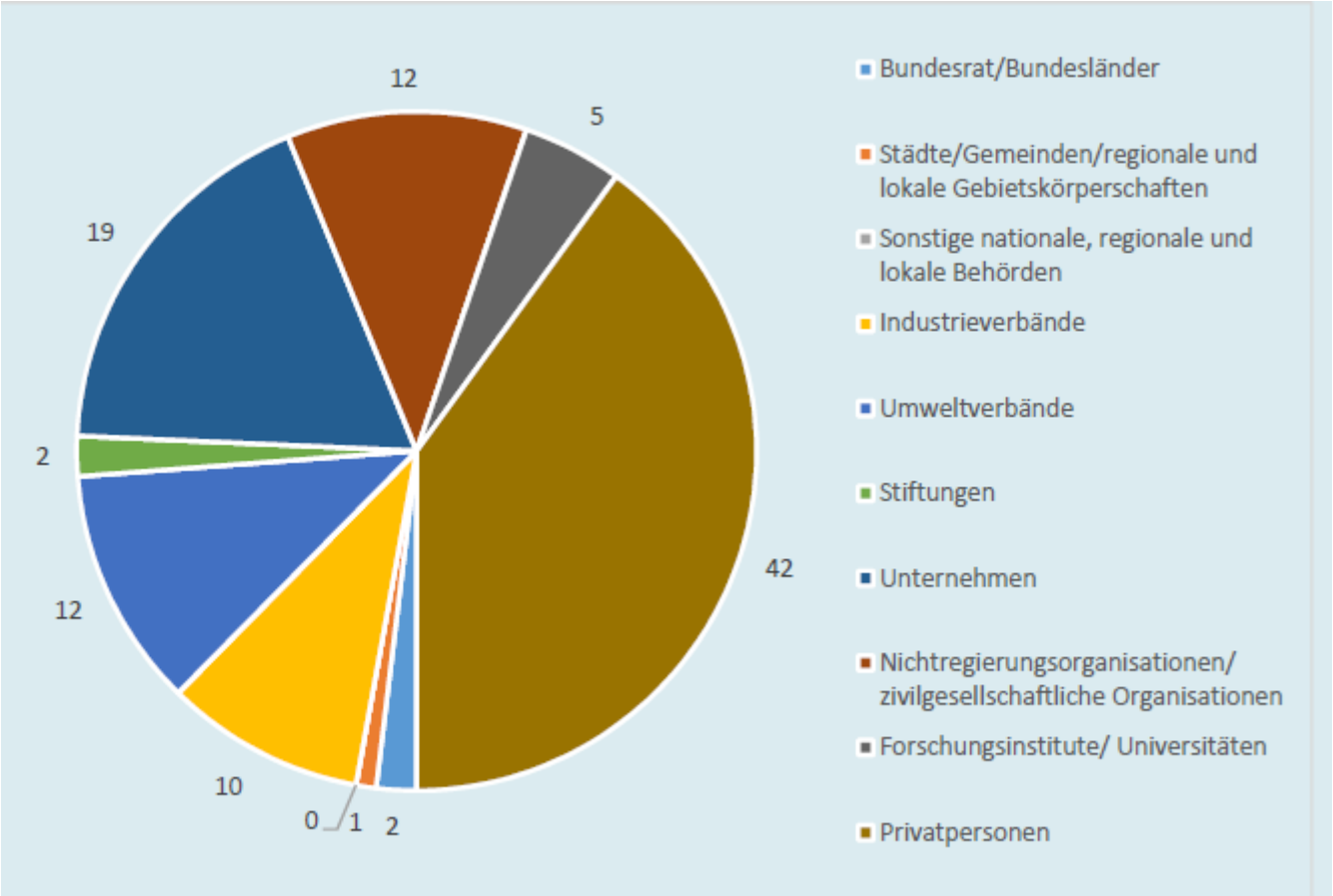
Total number of responses: 52

In their other comments regarding the energy security dimension, the consultation participants mentioned a broad range of areas. One industrial association and some NGOs and environmental organisations said that the understanding of security of supply in the NECP was outdated and was stuck in the fossil-fuel age (IV: BEE; NGO: NABU, GW, DNR, B.A.U.M.; UV: E3G, GC, BUND, N.N., DUH; Foundations: WFC). Once again, other stakeholders mentioned a range of different measures, for example energy research, grid expansion, design of the electricity market, monitoring of the security of the electricity supply, flexibility of demand and diversification of energy sources. With regard to gas supply security, many environmental organisations and NGOs called for the role of natural gas to be re-evaluated. Finally, there were suggestions as to how to improve the draft NECP's wording in places (BL: Saxony-Anhalt).

Dimension 4: Internal energy market

Question 19: What is your assessment of the measures set out in the draft NECP for achieving the goals described?

Figure 19 – Number and distribution of responses to question 19



Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals

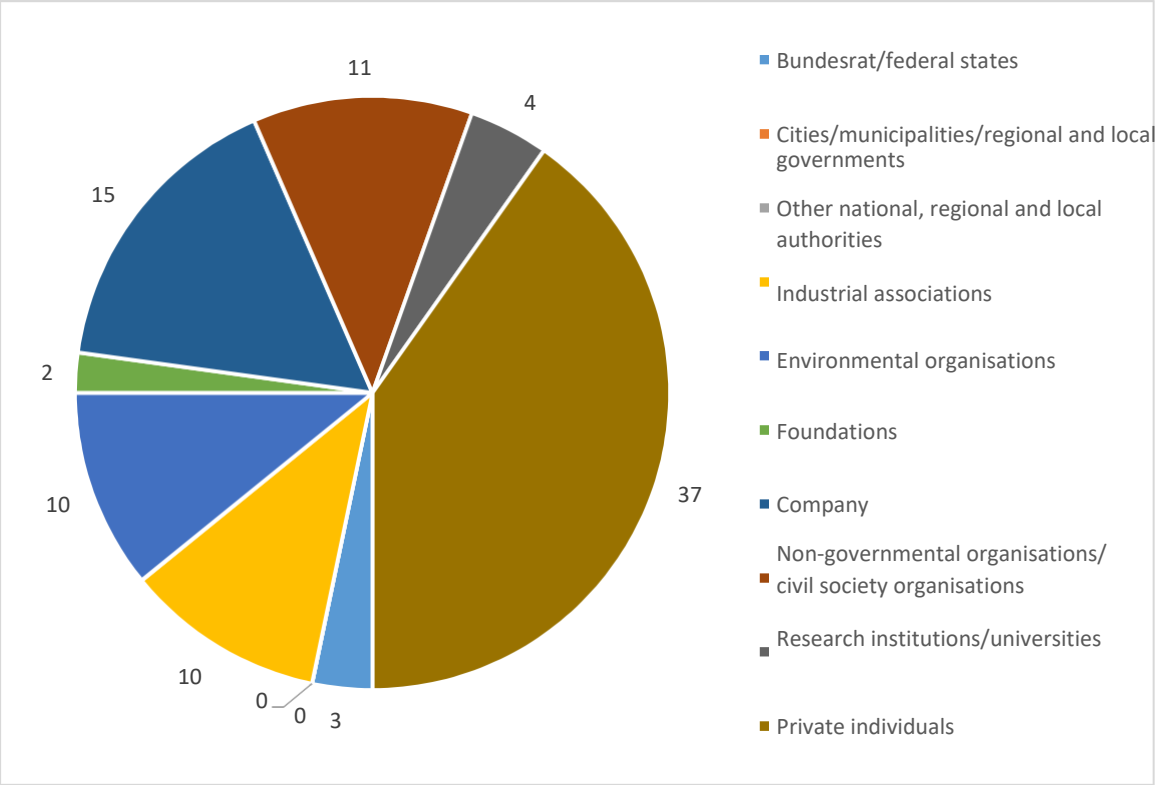
Total number of responses: 105

Many stakeholders from different groups felt that the measures were not ambitious enough (U: GEBB, E2M UV: BUND-S, EGU NGO: N.N.x2 PP: PPx8). One stakeholder said that there was no specific implementation timeframe for many of the measures (IV: BNE). Another stakeholder said that the phase-out of coal was not adequately taken into consideration in the scenario framework for the 2020-2030 Gas NDP (U: EnBW). Some stakeholders criticised the fact that only the electricity network was covered in the NECP, whereas the gas network was not (IV: FNBGas U: ONTRAS). One stakeholder objected to regulatory intervention in the gas market which could jeopardise the liquidity of the market (IV: N.N.). Some stakeholders called for the swift transposition of the Clean Energy Package into national legislation (IV: BDEW NGO: DIHK U: E2M). Some stakeholders generally backed the measures on sectoral coupling (IV: BNE UV: BGS U: dena). Many other stakeholders criticised the lack of details regarding the integration of renewable energies into the heating and mobility sectors (Foundations: WFC UV: DUH, E3G, BUND, GC, WWF, N.N. VfW, NGO: NABU, GW, DNR, B.A.U.M. PP: PPx12). Furthermore, many called for a level playing field and clear policy frameworks for sectoral coupling technologies (BL: North Rhine-Westphalia

IV: BDEW, BEE U: dena, E2M NGO: BBEn).

Question 20: Are other measures required in your opinion? If so, which ones?

Figure 20 – Number and distribution of responses to question 20

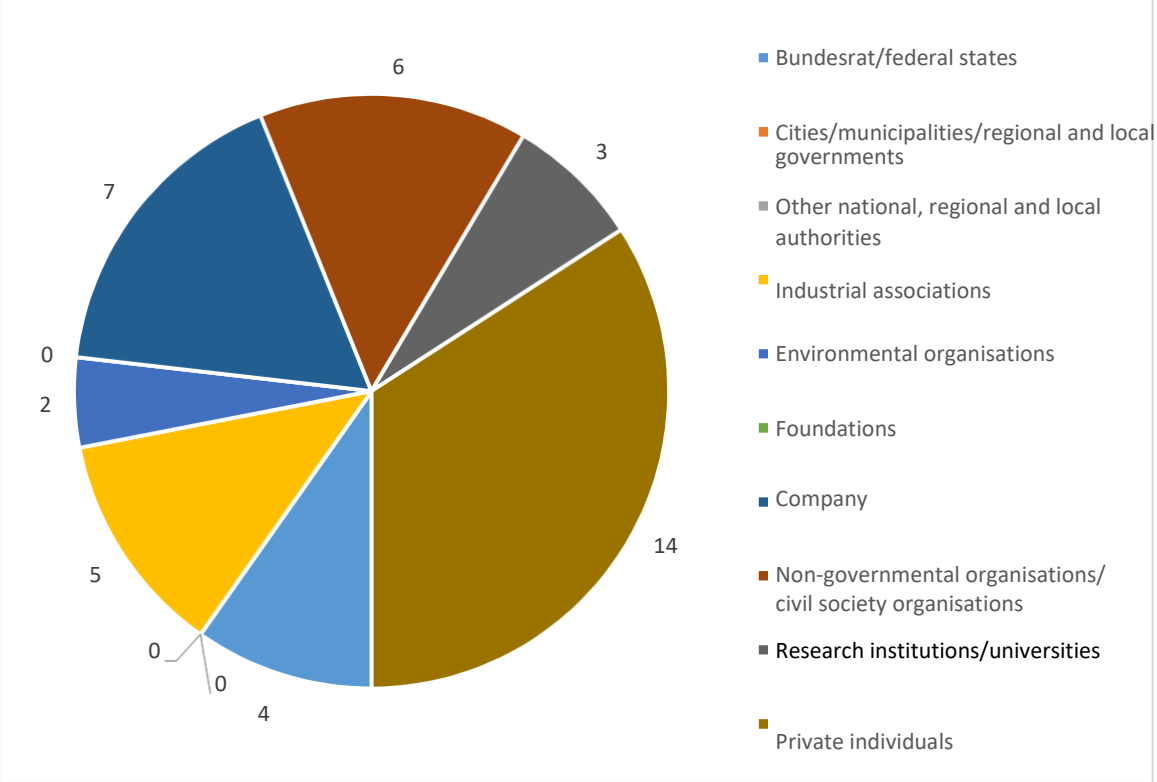


Total number of responses: 92

Many stakeholders called for the market-based procurement of flexibility as required in accordance with the essence of Article 32 of the Directive on the internal market for electricity (IV: BDEW, ZVEI UV: DUH U: dena, N.N.). Many stakeholders from all groups also welcomed the legal entitlement to dynamic electricity price contracts for end customers with a smart meter but called for swifter deployment of the infrastructure (IV: ZVEI U: dena, ISEI Foundations: WFC UV: DUH, E3G, BUND, N.N., GC, WWF NGO: NABU, GW, DNR, B.A.U.M., N.N.
PP: PP). Some stakeholders called for the legal framework to enable customers to actively request real-time applications and consequently approve real-time data transmission (IV: BDEW, ZVEI). Many stakeholders from all areas called for the tax, duty, levy and charge system to be reviewed and modernised across the entire energy sector (IV: ZVEI, AGFW, VIK, BNE UV: DUH, U: dena, VATTENFALL, ISEI, INNOGY, N.N. NGO: VZBV PP: PP). One stakeholder mentioned the suggestions of the dena Network Charges taskforce for further developing the existing charge system (IV: VIK).

Question 21: Other comments regarding the dimension

Figure 21 – Number and distribution of responses to question 21



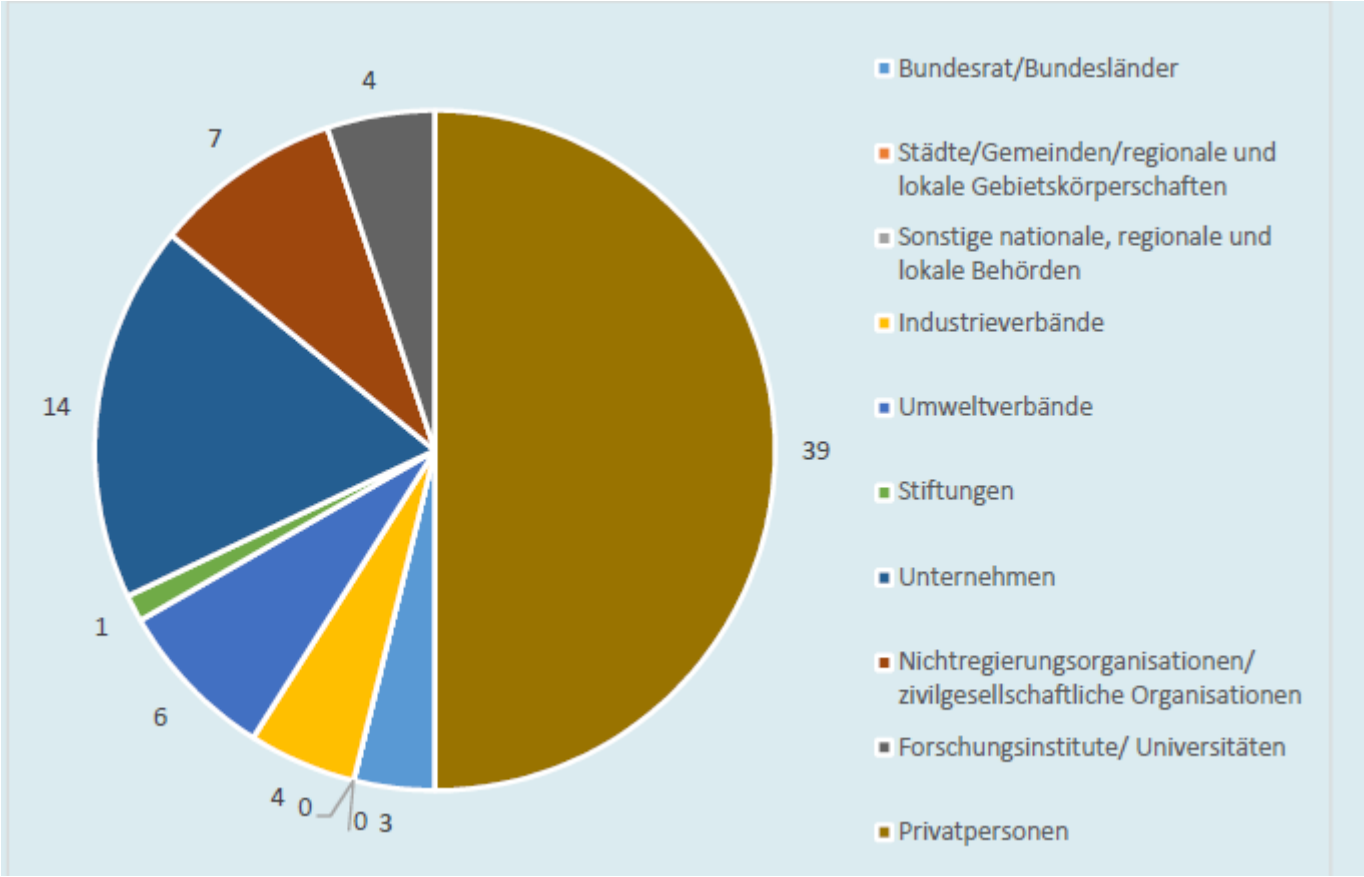
Total number of responses: 41

One company called for the phase-out of coal to be covered in the NECP (U: dena). One NGO called for consumers to be better protected from the bankruptcy of energy suppliers in the future (NGO: VZBV). One stakeholder called for §31 V of the Smart Meters Operation Act to be amended in order to guarantee that the legal maximum price limits were financially reasonable (IV: VIK). One federal state commented that more statements on the energy transmission infrastructure under 4.5.2 were needed, meaning that no response could be provided in that regard yet (BL: North Rhine-Westphalia).

Dimension 5: Research, innovation and competitiveness

Question 22: Since the consultation process on the Energy Research Programme in 2017, have there been any new developments which should be taken into consideration for the final NECP?

Figure 22 – Number and distribution of responses to question 22



Total number of responses: 78

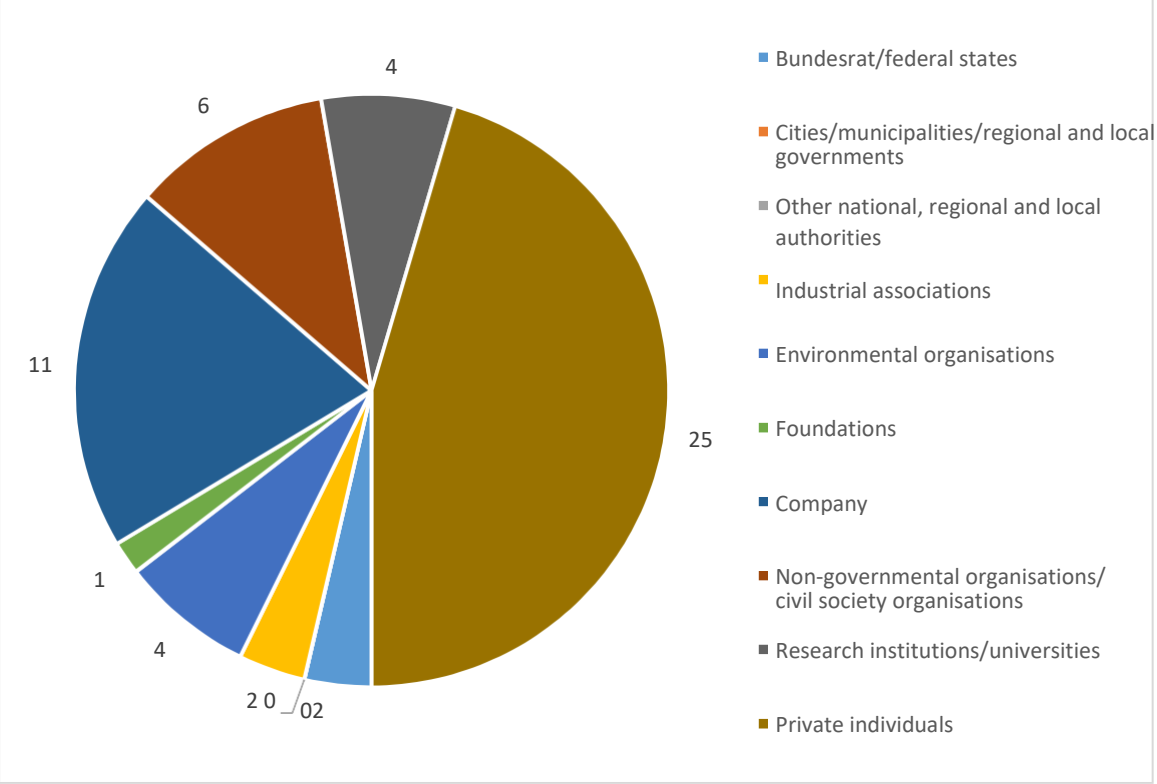
Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals

The stakeholders mentioned a range of specific research measures, some of which were the result of developments following the consultation process in 2017. Many stakeholders commented that there had not been any new developments since the Energy Research Programme in 2017 which were of such vital importance that they should be taken into consideration in the final NECP (BL: Baden-Württemberg; UV: BGS; PP: PPx2; FI: ISE; U: ZDH). More than half of the stakeholders did not answer the question. These included stakeholders from all groups (PP: PPx77, Cities/municipalities: 1, IV: 20, UV: 11, Foundations: 2, U: 19, NGO: 13, FI: 6, BL: 4, Others: 1). Some stakeholders stated that there had been new developments but did not specify what they were. According to two stakeholders, research funding should continue to be maintained and/or increased (IV: BDEW; U: dena). Many stakeholders were of the opinion that research needed to be conducted in particular in the areas of storage technology (PP: PPx5; UV: SLV; FI: FFU), social acceptance (regarding various aspects of the energy transition) (FI: FFU; PP: PP; NGO: BBEn, GW) and technologies which could close the carbon cycle (U: dena, PIP; FI: DBFZ; PP: PP). Some stakeholders commented that research should be more heavily focused on market integration and the call for a system connection (NGO: DIHK; PP: PPx2). Furthermore, extensive remarks were made about a

wide range of topics.

Question 23: Are there any current aspects of European research cooperation that have still not been sufficiently taken into consideration in the draft NECP?

Figure 23 – Number and distribution of responses to question 23

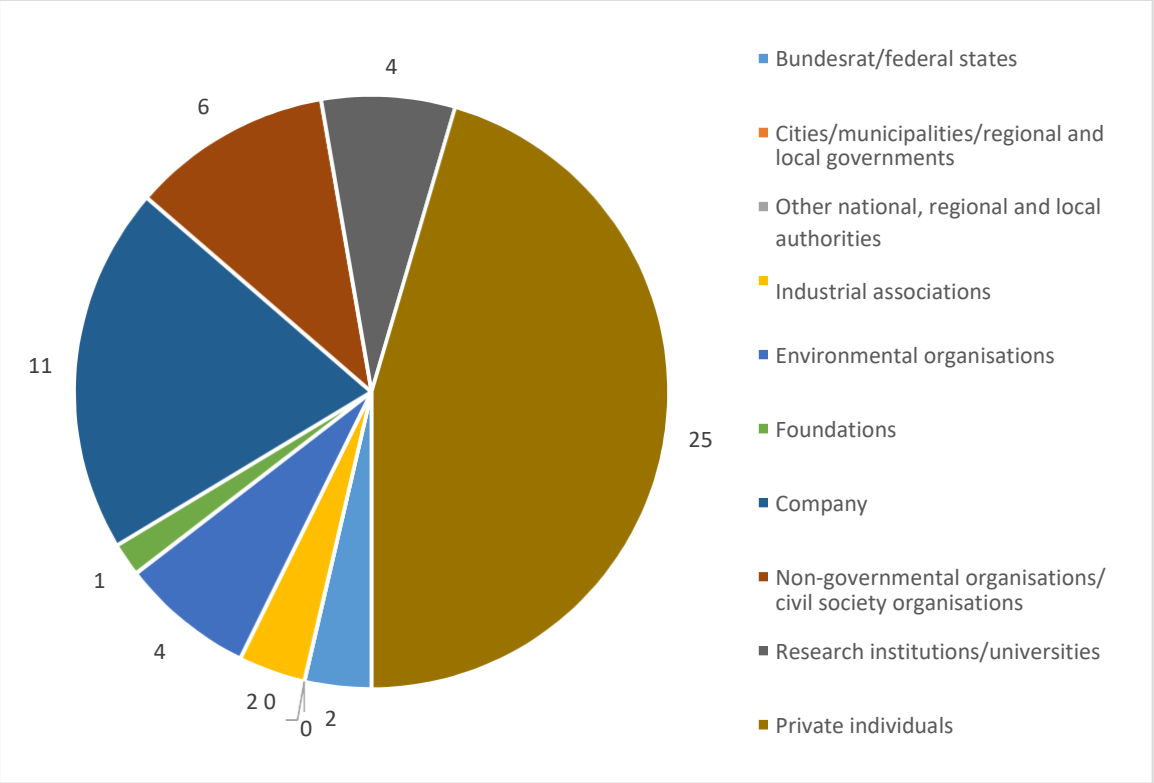


Total number of responses: 55

The stakeholders hardly mentioned any aspects that were the direct result of European research cooperation. The responses referred more to the general need for research, independently of the European context. Specific examples of research cooperation were mentioned in the areas of bilateral cooperation (U: dena), research on social acceptance (FI: FFU), and collaborative research (FI: N.N.). In this context, the aforementioned stakeholders mentioned broadening existing examples of cooperation. Many stakeholders (> 75%) did not answer the question. These included stakeholders from all groups. Furthermore, extensive remarks were made about a wide range of topics.

Question 24: Are there any aspects relating to competitiveness that are not the focus of the Seventh Energy Research Programme but should be covered in the final NECP?

Figure 24 – Number and distribution of responses to question 24

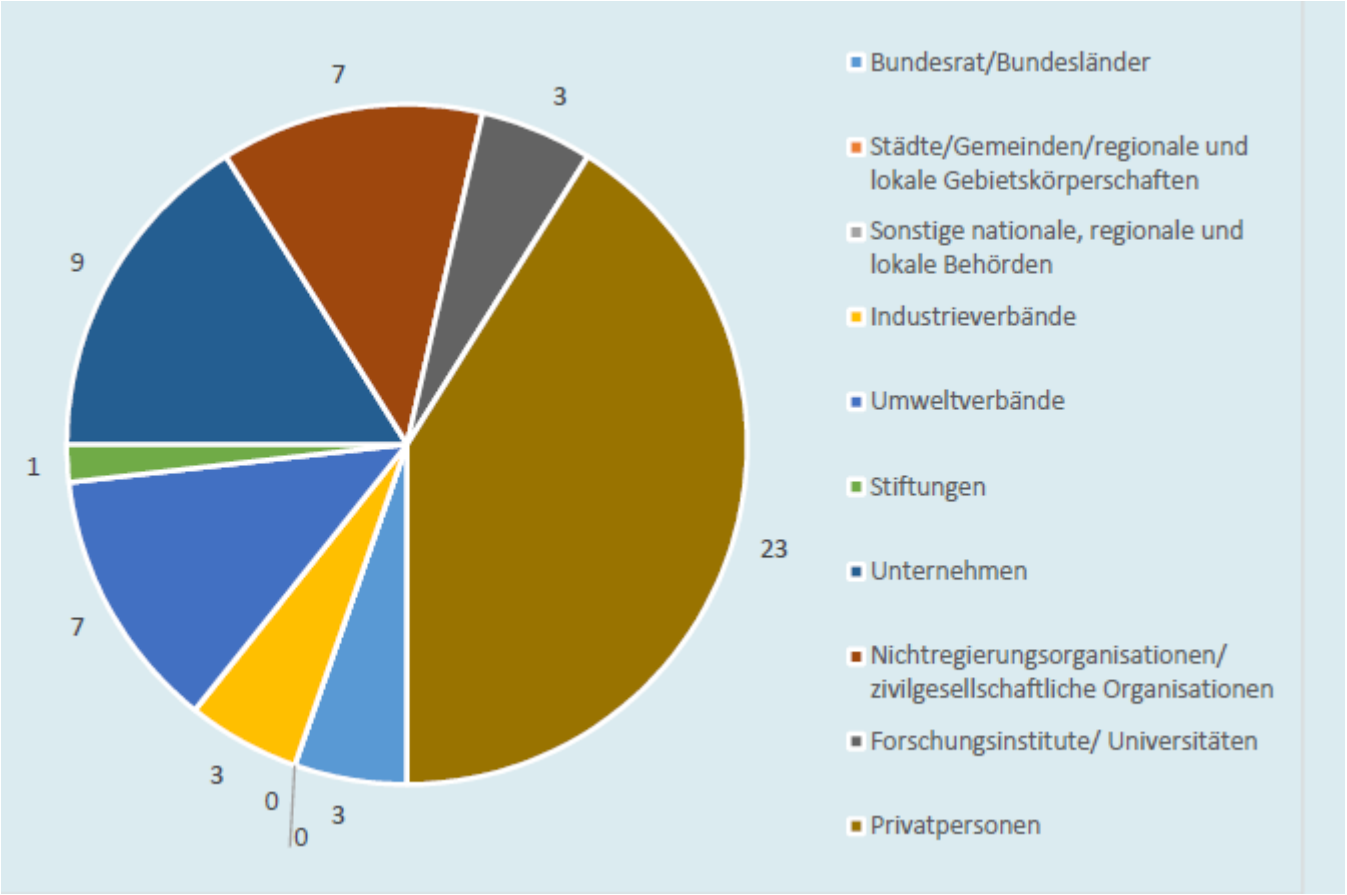


Total number of responses: 51

The stakeholders mentioned a range of specific aspects relating to competitiveness. Most stakeholders (over 80%) did not answer the question. These included stakeholders from all groups (BL: 4, FI: 6, IV: 19, NGO: 17, PP: 77, Others: 1, Cities/municipalities: 1, Foundations: 3, UV: 9, U: 21). With regard to the competitiveness of Germany (in particular in relation to industry), some stakeholders for example mentioned measures on decarbonised industrial processes (BL: Saxony, North Rhine-Westphalia; PP: PP), the role of energy costs (BL: North Rhine-Westphalia) and the role of the regulatory framework (BL: North Rhine-Westphalia, U: dena). Some stakeholders said that they saw climate and energy policy as an opportunity for industrial competitiveness, innovation and growth (IV: VDMA; NGO: B.A.U.M.; PP: PPx2) and that they were focusing on future competitiveness (UV: SLV; U: N.N.; PP: PP). Another aspect of competitiveness that was mentioned was more heavily application-oriented research and innovation for promoting the introduction of products to the market (PP: PP). Furthermore, extensive remarks were made about a wide range of topics.

Question 25: Other comments regarding the dimension?

Figure 25 – Number and distribution of responses to question 25



Total number of responses: 56

Bundesrat/Bundesländer	Bundesrat/federal states
Städte/Gemeinden/regionale und lokale Gebietskörperschaften	Cities/municipalities/regional and local governments
Sonstige nationale, regionale und lokale Behörden	Other national, regional and local authorities
Industrieverbände	Industrial associations
Umweltverbände	Environmental organisations
Stiftungen	Foundations
Unternehmen	Company
Nichtregierungsorganisationen/ zivilgesellschaftliche Organisationen	Non-governmental organisations/ civil society organisations
Forschungsinstitute/ Universitäten	Research institutions/universities
Privatpersonen	Private individuals

The stakeholders made a range of specific other comments both on the content of and on the process for drawing up the NECP as well as on the general relevance of research, innovation and competitiveness. Most stakeholders (over 80%) did not answer the question. These included stakeholders from all groups (BL: 3, FI: 8, IV: 19, NGO: 12, PP: 79, Others: 1, Cities/municipalities: 1, Foundations: 2, UV: 8, U: 22). Some stakeholders welcomed the fact that research, innovation and competitiveness were of crucial and growing importance in the NECP (BL: Saxony; NGO: N.N.). Furthermore, extensive remarks were made about a wide range of topics (BL: Saxony; NGO: GW, N.N., DNR, B.A.U.M., NABU; Foundations: WFC; UV: E3G, GC; FI: N.N.; U: dena, VNG; PP: PPx3).

Annex – Survey questions

1. Against this backdrop, what is your assessment of the structure and priorities of the goal-based architecture?

2. Other comments?

3. What is your assessment of the measures to date for achieving the 2030 greenhouse gas reduction goals mentioned in the draft German NECP?

4. What other measures do you think are most important for achieving the 2030 greenhouse gas reduction goals?

5. Other comments regarding the dimension?

6. Against this backdrop, what is your assessment of the measures set out in the draft NECP for achieving Germany's contribution to the goal?

7. What is your assessment of the measures set out in the draft NECP for achieving the indicative milestone of increasing the share of renewable heat and waste heat together by 1.3 percentage points a year?

8. What is your assessment of the measures set out in the draft NECP relating to the transport sector for achieving the energy and climate policy goals?
What other measures are required in your opinion?

9. Other comments regarding the dimension?

The reduction in energy consumption is the second pillar of the energy transition alongside the expansion of renewables. For the 19th parliamentary term, the Federal Government has undertaken to work on a cross-sector federal Energy Efficiency Strategy and further develop the National Energy Efficiency Action Plan (NEEAP 2.0).

10. What is your assessment of existing measures for reducing energy consumption and increasing energy efficiency?

11. What measures should the new Energy Efficiency Strategy contain in order to achieve the national energy efficiency goals and contribute to the EU's energy efficiency goal for 2030?

The Regulation on the governance of the energy union and climate action states that 'energy efficiency first' means taking utmost account [in energy planning, and in policy and investment decisions,] of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient.

12. In your opinion, how and with what measures could the guiding principle of 'Energy Efficiency First' set out in the NECP be implemented?

The holistic approach of the national Energy Efficiency Strategy for Buildings means that, in addition to greater energy efficiency, more heat from renewable sources of energy should be used in order to achieve a virtually climate-neutral stock of buildings by 2050. It should be noted that the 'long-term renovation strategy' to be developed pursuant to Article 2a of EU Directive 2018/844 on the energy performance of buildings is also a key element for the buildings sector and will undergo its own separate consultation process.

13. What is your assessment of the strategies for increasing energy efficiency in the buildings sector

presented in the draft NECP against the backdrop of this holistic approach of the national Energy Efficiency Strategy for Buildings?

14. Should other energy topics relating to the buildings sector also be addressed in the NECP? If so, which ones?

15. Other comments regarding the dimension?

16. Against this backdrop, what is your assessment of the measures set out in the draft NECP?

17. Are other measures required in your opinion? If so, which ones?

18. Other comments regarding the dimension?

19. Against this backdrop, what is your assessment of the measures set out in the draft NECP for achieving the goals described?

20. Are other measures required in your opinion? If so, which ones?

21. Other comments regarding the dimension?

22. Since the consultation process on the Energy Research Programme in 2017, have there been any new developments which should be taken into consideration for the final NECP?

23. Are there any current aspects of European research cooperation that have still not been sufficiently taken into consideration in the draft NECP?

24. Are there any aspects relating to competitiveness that are not the focus of the Seventh Energy Research Programme but should be covered in the final NECP?

25. Other comments regarding the dimension?