



Draft of the Integrated National Energy and Climate Plan

In accordance with the REGULATION OF THE EUROPEAN PARLIAMENT AND 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 the Council Directive (EU) 2015/652, and repealing Regulation (EU) No 525/2013

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Abbreviations

AA	Federal Foreign Office
ACER	Agency for the Cooperation of Energy Regulators
ACOMES	Annual Coordinating Meeting Entities Stockholding
ADEME	Agence de l'Environnement et de la Maîtrise de l'Énergie
AGEB	Arbeitsgemeinschaft Energiebilanzen e.V. (working community on energy statistics)
AGEE-Stat	Working Group on Renewable Energy Statistics
APKS	Climate Action Programme
APEE	Incentive Programme – Energy Efficiency
ARegV	Energy Incentive Regulation Regulation
BAFA	Federal Office for Economic Affairs and Export Control
BAG	Federal Office for Goods Transport
BBPlG	Federal Requirement Plan Act
BBSR	Federal Institute for Research on Building, Urban Affairs and Spatial Development
BDS	Electricity grid - citizens' dialogue
BEMIP	Baltic Energy Market Interconnection Plan
BfEE	Federal Energy Efficiency Centre
BHKW	Mini engine-based cogeneration system
BLE	Federal Office for Agriculture and Food
BMBF	Federal Ministry of Education and Research
BMEL	Federal Ministry of Food and Agriculture
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMVI	Federal Ministry of Transport and Digital Infrastructure
BMWi	Federal Ministry for Economic Affairs and Energy
BNetzA	Federal Network Agency
BKV	Party responsible for balancing group
BSH	Federal Maritime and Hydrographic Agency
BSI	Federal Office for Information Security
CACM	Network Code Capacity Allocation and Congestion Management
CA-RES	'Concerted Action' Forum for Renewable Energies
CCU	Carbon Capture and Utilisation
CCS	Carbon Dioxide Capture and Storage
CCUS	Carbon Capture, Utilisation, and Storage
CDU	Christian Democratic Union
CEER	Council of European Energy Regulators
CEF	Connecting Europe Facility
CH ₄	Methane
CNG	Compressed natural gas
CO ₂	Carbon dioxide
CO _{2equ}	Carbon dioxide equivalents
CORE	Capacity Calculation Region for Central and Eastern Europe
CSU	Christian Social Union
ct	cent
DEHST	German Emissions Trading Authority
dena	German Energy Agency
DeuGrInZus	Greco-German Research Cooperation and Promotion of Upcoming Researchers
DFBEW	Franco-German Office for the Energy Transition
DIW	German Institute for Economic Research
DIHK	Association of German Chambers of Commerce and Industry

DK	Denmark
DPMA	German Patent and Trade Mark Office
EBK	Energy consultation for non-residential buildings owned by municipalities/not-for-profit organisations
EBM	Energy consultation among small and medium-sized enterprises
EBV	German National Petroleum Stockpiling Agency
EE	Renewable energies
EEA	European Environment Agency
EED	Energy Efficiency Directive
EEG	Renewable Energy Sources Act
EEV	Final-energy consumption
EEWärmeG	Renewable Energies Heat Act
EEX	European Energy Exchange
EKF	Energie- und Klimafonds
EltLastV	Regulation on Electricity Load Distribution
EltLastVwV	General Administrative Ruling on the Regulation on Electricity Load Distribution
EltSV	Electricity-Securing Regulation
EnEG	Energy Saving Act
EnEV	Energy Conservation Ordinance
EnergieStG	Energy Tax Act
EnLAG	Power Grid Expansion Act
EnSaG	Omnibus Energy Act
EnSiG	Act on Securing the Energy Supply, 1975
EnStatG	Energy Statistics Act
EnWG	Energy Business Act
EPBD	Energy Performance of Buildings Directive
ERA-Net	European Research Area
ErdölBevG	Petroleum Stockpiling Act
ESB	Energy-related schedule for refurbishment of Federal-Government-owned real estate
ESD	Effort Sharing Decision (EU)
ESG	Energy Efficiency Strategy for Buildings
ESR	Effort Sharing Regulation (EU)
EStG	German Income Tax Act
ETS	Emissions Trading System
EU	European Union
EUKI	European Climate Initiative
EUR	Euro
EU-SET-Plan	European Strategic Energy Technology Plan
FEP	Area development plan
FNB	Long-Distance Grid Operator
GasSV	Gas Supply Regulation
GasNZV	Gas Grid Access Regulation
GDP	Gross Domestic Product
GEEV	Cross-Border Renewable Energy Regulation
GEG	New version: Energy for Buildings Act
GemAV	Regulation on Joint Tenders for Onshore Wind and Solar Installations
GewStG	Trade Tax Act
GHD	Trade, commerce, services
GIZ	German Development Cooperation
GVFG	Municipal Transport Financing Act
GW	Gigawatt

GWB	Act against Restraints on Competition
GWS	Institute of Economic Structures Research
HeizöLLBV	Heating-Oil Supply Restrictions Regulation
HEL	Light heating oil
HVO	Hydrotreated vegetable oil
IEA	International Energy Agency
IFAM	Fraunhofer Institute for Manufacturing Technology and Advanced Materials
IFFS	Inefficient fossil fuel subsidies
IKT	Information and communications technology
IKzB	Information and Competence Centre for Construction with a Future
IPC	International Patent Classification
ISI	Fraunhofer Institute for Systems and Innovation Research
k	Thousand
KFK	Commission to Review the Financing for the Phase-out of Nuclear Energy
KfW	Kreditanstalt für den Wiederaufbau (bank)
KGV	Koordinierungsgruppe Versorgung (Supply Coordination Group)
km	Kilometre
KOM	European Commission
KraftstoffLBV	Fuel-Supply Restrictions Regulation
KSB	Climate Protection Report
KSP	Climate Action Plan
KSP2050	Climate Action Plan 2050
KStG	Corporation Tax Act
kW	Kilowatt
kWh	Kilowatt-hour
KWK	Combined Heat and Power (CHP)
KWKG	Combined Heat and Power Act (CHP Act)
Ladesäulen- verordnung	Regulation on Electric Charging-Units for Vehicles
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land-Use Change and Forestry
MAP	Market Incentive Programme for Renewable Energies in the Heating Market
MGV	Party responsible for market area
Mrd.	Billion
Mieterstromgesetz	Landlord-to-Tenant Electricity Act
MinöIaV	Regulation on Balancing of Petroleum Resources
MinöIBewV	Regulation on Management of Petroleum Resources
MinÖlDatG	Petroleum-Related Data Act
M.	Million
MKS	Mobility and Fuels Strategy
MOPGA-GRI	Make Our Planet Great Again – German Research Initiative
MSR	Market stability reserve
MsbG	Metering Point Operation Act
MW	Megawatt
MWh	Megawatt-hour
MwSt.	Value-added tax
NABEG	Grid Expansion Acceleration Act – Transmission Grid
NAPE	National Action Plan on Energy Efficiency
NECP	National Energy and Climate Plan

NEP	Grid Development Plan
NESO	National Emergency Strategy Organization
NGO	Non-Governmental Organisation
NIP2	National Innovation Programme on Nitrogen and Fuel-Cell Technology
NKI	National Climate Protection Initiative
NL	The Netherlands
NOW	Nationale Organisation Wasserstoff GmbH
NOR	Norway
NPE	National Platform on Electromobility
NPM	National Platform 'Future of Mobility'
NSBTF	North Sea Basin Task Force
NSR	National Strategic Framework for the Build-up of Infrastructure for Alternative Fuels
NSI	North-South Electricity Interconnections in Central Eastern and South Eastern Europe
NSOG	North Sea Offshore Grid
NTRI	National Top Runner Initiative
ÖPV	Public passenger transport
ÖPNV	Local public passenger transport
PCI	Projects of Common Interest
PEV	Primary energy consumption
PJ	Petajoule
Pkm	Kilometres per person
Pkw	Car
PL	Poland
PtH	Power to Heat
PV	Photovoltaics
RED II	Renewable Energy Directive
RL	EU Directive
SAIDI	System Average Interruption Index
EU-SET Plan	European Strategic Energy Technology Plan
SGB	Code of Social Law
SINTEG	Showcasing Intelligent Energy – Digital Agenda for the Energy Transition
SME	Small and medium-sized enterprises
SOEC	Solid Oxide Electrolysis Cells
SPD	Social Democratic Party of Germany
SRSS	Structured Reform Support Service
StBA	Federal Office of Statistics
StromNEV	Electricity Grid Remuneration Regulation
Stromsteuergesetz	Electricity Tax Act
t	tonne
tkm	tonnes-kilometres
TEHG	Greenhouse-Gas Emissions Trading Act
TEN-E	Transeuropean Networks Energy
THG	Greenhouse gas
TWh	Terawatt-hours
TYNDP	Ten-Year Network Development Plan
UBA	German Environment Agency
UGS	Underground storage facility
UGSB	Underground storage facility operator
UIP	Environmental innovation programme

ÜNB	Transmission grid operator
UNFCCC	UN Framework Convention on Climate Change
VerkLG	Transport Services Act
VET Report	Report on the greenhouse-gas emissions subject to emissions-trading obligation, from stationary facilities and air transport in Germany
VgV	Regulation on Award of Public Contracts
VNB	Gas-distribution grid operator
VOB/A	Ruling on Award of Public Orders and Contracts for Building Services, Part A
VOL/A	Ruling on Award of Public Orders and Contracts for Services, Part A
VSVgV	Defence and Security Award Regulation
vzbv	Federation of German Consumer Organisations
VNB	Distribution-grid operator
WindSeeG	Offshore Wind Energy Act
WIPO	World Intellectual Property Organisation
WiSiG	Act on Securing the Operation of Industry and Trade and of Transfer of Money and Capital
ZdH	German Confederation of Skilled Crafts

Section A: National Plan

1. Overview and process for establishing the plan

1.1. Executive 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 on German policy regarding energy and the climate. The Federal Government wants to emphasise the provisional nature of this draft of the National Energy and Climate Plan. At present, numerous political processes are being implemented regarding the future structure of Germany's energy and climate policy. Among others, these include:

- The draft of a programme of measures for implementation of the Climate Action Plan 2050, as well as the long-term climate protection strategy that backs up the climate objective for 2030 with sectoral targets (Chapter 3.1.1.)
- Development of a cross-sector strategy on energy efficiency, anchoring 'Efficiency First' as the guiding principle (Chapter 3.2.)
- Producing a plan of measures to optimise the electricity grids and to expand them more rapidly (Chapter 3.4.2.)

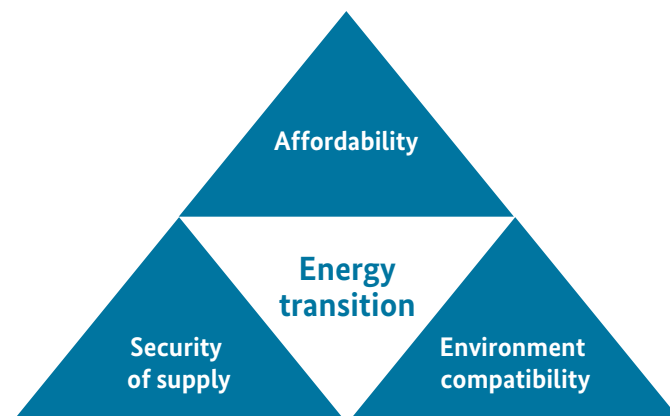
In addition, the Federal Government has introduced new commissions with the following tasks:

- The drawing up of an Action Programme, for reaching the German climate targets in the energy sector, for ending coal-fired electricity step-by-step, and for accompanying the structural change, by the Commission on 'Growth, Structural Change and Employment' (Chapter 3.1.1., 3.4.3.),
- Formulating a strategy on the 'Future of affordable and sustainable mobility' by a new commission, within the framework of the national platform on 'Mobility of the Future' (Chapter 3.1.3.).

The results of these and other political processes are to be reflected in the content of the final German Energy and Climate Plan, which is to be submitted by the end of 2019. The framework for financially viable measures taken in this context is the budget-planning and financial-planning approaches which are currently in force.

Policy on energy and climate is a matter of key significance for an industrial nation such as Germany, with its impact also touching other policy areas, especially economic, environmental and social policy. Yet the energy-policy triangle, consisting of security of supply, environment compatibility and affordability, is and remains German energy policy's point of orientation.

Figure A1: Triangle of goals pursued in the energy transition



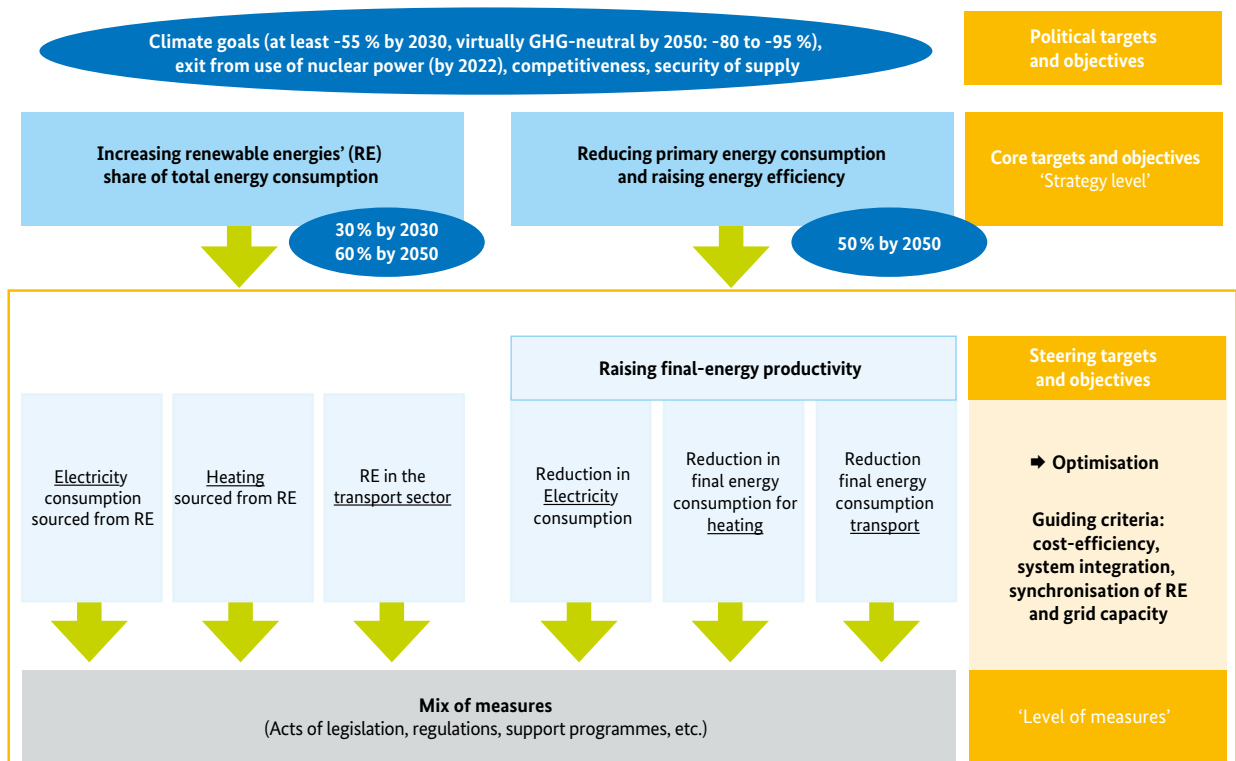
Germany wishes to shape its energy supply in a way that is environmentally friendly, by using energy more efficiently and, increasingly, by using renewable energies. Here, appropriate solutions must be found to resolve conflicts of objectives with other concerns relevant to protection of the environment, nature and living species. Security of supply must be safeguarded at a high level. Cost-effectiveness is an important precondition for energy to remain affordable to all consumers. It thus makes an important contribution to fairness within society. The aim is that the conversion of energy supply also plays its role in ensuring that Germany remains a competitive business location. Structuring the energy supply in a way that is compatible with environmental needs is the prerequisite for safeguarding the basis for human life.

The energy transition is a modernisation and investment programme. It offers major economic opportunities to innovative companies, not only on the German market and throughout Europe, but worldwide. By now many countries are expanding their provision of energy on the basis of renewable energies, increasingly banking on energy-efficiency technologies. Simultaneously the energy transition is leading to a fundamental structural shift in individual sectors of business and regions. This shift needs to be accompanied and reinforced by political actions, channelling it into a fundamental transformation of how people live and conduct business.

1.1.ii. Strategy relating to the five dimensions of the Energy Union

The general political guidelines shown in the triangle of energy-transition targets and objectives are specified in the Federal Government’s Energy Concept for an environment-compatible, safe and affordable energy supply, which was adopted in 2010, as well as additional Bundestag resolutions and European targets. These formulate numerous targets and objectives that **serve as the compass for Germany’s energy transition**. In order to structure these individual energy-transition targets and objectives and to set priorities, the Federal Government established an architecture of targets and objectives. This architecture has **three levels**, setting political targets and objectives, as well as core and steering targets and objectives:

Figure A2: Architecture of targets and objectives in Germany’s Energy Concept



The **political targets and objectives** serve as the framework for restructuring the supply of energy. These include

- the national climate-action targets,
- the withdrawal from use of nuclear energy for the nation's electricity production by the end of the year 2022,
- the safeguarding of competitiveness and of supply security.

The **core targets and objectives** are the reduction of primary-energy consumption and respectively the boosting of energy efficiency and the deployment of renewable energies. These targets and objectives describe the central strategies directed at advancing the energy transition.

Both core targets and objectives are put into specific terms by steering targets and **objectives** for electricity, heating and transport. The steering targets and objectives and the associated measures are aligned with each other in a way that allows that the overarching, higher-level targets and objectives can be reached as reliably and as cost-effectively as possible

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

The tables present the central objectives, strategies and measures that form the Federal Government's National Energy and Climate Plan, spanning the period up to 2030. This includes key national objectives (Table A1) and the most important strategies and measures; which are either existing, implemented, adopted by parliament, or respectively planned, in accordance with the EU Regulation on the Governance of the Energy Union and Climate Action, Article 2 (1)-(4), known in short as the Governance Regulation (Table A2).

Table A1: Key objectives pursued throughout the dimensions of the Energy Union

Dimension	Key objectives
1. Decarbonisation	
1.1. GHG emissions and removals	<ul style="list-style-type: none"> • National climate target: at least -55 % by 2030, compared to 1990 • ETS: EU-wide target: -43 % by 2030, compared to 2005 • ESR: -38 % by 2030 compared to 2005 • LULUCF: no net debit rule
1.2. Renewable energy	<ul style="list-style-type: none"> • Renewable energies' share of gross final-energy consumption of 30 % in 2030, as German contribution to the EU 2030 target
2. Energy efficiency	<ul style="list-style-type: none"> • Based on the Energy Concept's energy-efficiency target of -20 % by 2020 and -50 % by 2050 (in both instances: primary energy consumption, compared to 2008), a German contribution to the EU energy-efficiency target will be formulated in the context of the new Federal Government energy-efficiency strategy which is currently under development. • More efficient supply of heating in buildings • Reducing primary-energy demand in buildings
3. Energy security	<ul style="list-style-type: none"> • Covering the demand for energy in Germany at all times • Achieving resilience to supply crises • Further reducing the probability that supply crises will emerge • Having preventive-action measures at the ready in case of deteriorating supply
4. Internal energy market	<ul style="list-style-type: none"> • Implementing the level of electricity interconnectivity provided for by the Governance Regulation, Article 4(d) • Expanding and modernising grids in accordance with demand • Consider energy infrastructure resources in a holistic way • Coupling the electricity, heating and transport sectors – sector coupling • Step-by-step reduction and phasing-out of the use of coal-fired electricity, including a termination date (the Commission on 'Growth, Structural Change and Employment' is drawing up proposals for this) • Maintaining the functional capability of the Electricity Market 2.0 • Safeguarding the energy system's flexibility • Further coupling the electricity markets
5. Research, innovation, competitiveness	<ul style="list-style-type: none"> • Driving forward innovation that has scope to shape the future for the restructuring of energy supply. • Attaining and expanding competitive industrial and commercial employment in Germany, including among SMEs, and creating the foundation for sustainable prosperity and quality of life

Table A2: Key strategies and measures relating to the five dimensions of the Energy Union

Dimension	Key Strategies and Measures
1. Decarbonisation	
1.1. GHG emissions and removal of GHG	<ul style="list-style-type: none"> • Complete implementation of the Climate Action Plan 2050, including a programme of measures which must, (<i>inter alia</i>) include measures to reduce the energy sector's GHG emissions (the Commission on 'Growth, Structural Change and Employment' is drawing up proposals for this)
1.2. Renewable energy	<ul style="list-style-type: none"> • Renewable Energy Sources Act (EEG) • Offshore Wind Energy Act (WindSeeG) • Better synchronisation of the deployment of renewable energies with expansion of the electricity grid • Checking the regional management of renewable energies in the electricity sector • Energy conservation legislation with regard to buildings, Renewable Energies Heat Act (EEWärmeG) and Energy for Buildings Act (GEG)* • Energy-Efficiency Strategy for Buildings (ESG)* • Heating-grid systems 4.0* • Market-incentive programme for renewable energies in the heating market* • Further development of combined heat-and-power facilities • Regional cooperation • Strengthening self-consumption of home-produced power in the electricity sector • Expansion of funding-support programmes for heating grids, heat storage units and investments that supply to two or more buildings • 'Use of biomass for energy' funding-support programme • Grant for electrically-powered vehicles, provided through an environment bonus • Strengthening Germany as a business location for battery-cell production <p><i>* Measures from the long-term renovation strategy (see 2. 'Energy efficiency') which also contribute to Dimension 1 'Decarbonisation'.</i></p>
2. Energy efficiency	<ul style="list-style-type: none"> • National Action Plan on Energy Efficiency (NAPE) • Federal Government's Efficiency Strategy with NAPE 2.0 • Funding-support strategy for energy efficiency and heating from renewable energies • Funding programme 'Energy efficiency and process heating from renewable energies in business – grant and credit' • Funding programme 'Energy efficiency and process heating from renewable energies in business – competition' • Energy-Efficiency Strategy for Buildings • Federal Government's programme of CO₂-related renovation of buildings • Market-incentive programme for renewable energies in the heating market • Incentive programme on energy efficiency • Heating-grid systems 4.0 • Energy conservation legislation with regard to efficiency and renewable energies in the buildings sector; the Energy for Buildings Act (GEG).
3. Energy security	<ul style="list-style-type: none"> • Energy Industry Act (EnWG) • Act on Securing the Energy Supply, 1975 (EnSiG) • Gas Supply Regulation (GasSV) • National Preventive Action Plan and Emergency Plan with regard to natural gas, in accordance with Regulation (EU) No 2017/1938 (formerly Regulation (EU) No 994/2010) • Solidarity mechanism among EU Member States, in accordance with Regulation (EU) No 2017/1938 • Expansion of Germany as a business location for LNG • Oil Stockpiling Act (ErdölBevG) • Petroleum-Related Data Act (MinÖlDatG)

Dimension	Key Strategies and Measures
4. Internal energy market	<p>Implementing the level of electricity interconnectivity provided for by the Governance Regulation, Article 4(d):</p> <ul style="list-style-type: none"> • Expansion of cross-border electricity interconnectors • Strengthening regional cooperation <p>Expanding and modernising grids in accordance with demand:</p> <ul style="list-style-type: none"> • More rapid expansion of the electricity grids • Optimisation of already-existing grids • Monitoring the grid-expansion projects for electricity and gas • Energy Incentive Regulation <p>Eliminating barriers to the coupling of the electricity, heating and transport sectors</p> <p>Measures for step-by-step reduction and phasing out of use of coal-fired electricity, including a termination date (the Commission on 'Growth, Structural Change and Employment' is drawing up proposals for this)</p> <p>Maintaining functional capability of the Electricity Market 2.0; ensuring energy-system flexibility:</p> <ul style="list-style-type: none"> • Expanding and modernising grids in accordance with demand • Further integrating European electricity markets and increasing their flexibility • Grid-financing that is fair and serves the system's needs • Implementing the concept of 'using instead of curtailing' • Making CHP installations flexible through pilot projects for modernised CHP resources • Redispatch as a principle: optimisation measures on the topic of redispatch • National flexibility check to ascertain the obstacles to flexibility and to determine the areas of potential for flexibility <p>Further coupling the electricity markets:</p> <ul style="list-style-type: none"> • Plan of measures to reduce bottlenecks in the grid • Creation of a Capacity Calculation Region for Central and Eastern Europe (CORE) • Optimising the trading capacities during a given individual day
5. Research, innovation, competitiveness	<ul style="list-style-type: none"> • 7th Energy Research Programme – Innovations for the energy transition • Laboratories in 'real-life' conditions; strengthening of technology transfer • Issues spanning the whole system (e.g. sector coupling, digitalisation) • Better involvement of start-ups • Strengthening international cooperation

1.2. Overview of current policy situation

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

Policy on energy and climate needs a European framework because a Member State's decisions on energy and climate policy inevitably affect other Member States. The National Energy and Climate Plans can contribute to achieving greater convergence between the individual nations' policies.

In this context, energy efficiency and the deployment of renewable energies become the supporting columns that sustain Europe's energy transition. This is in accordance with the German strategy for restructuring energy supply and supports it (see 1.1.ii.).

The operability of the European internal energy market is a precondition for the energy transition to be successful in Germany and throughout the EU. Open, flexible markets and fair competition serve as the essential prerequisites for cost-efficient and secure energy supply and also for renewable energies' integration into the market.

The electricity markets must be interconnected and the necessary price signals sent. This sets up a secure framework for the necessary investment and for increasing flexibility in energy production and consumption.

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

This table presents all strategies and measures in the Federal Government's integrated National Energy and Climate Plan, relating to the Energy Union's dimensions.

Table A3: Strategies and measures relating to the five dimensions of the Energy Union

1. Decarbonisation
1.1 GHG emissions and GHG removal
Chapter 3.1.1.i. Programme of measures for implementing the Climate Action Plan 2050 – the means of achieving the overall climate-action target for the year 2030 and also the respective sectoral targets of the climate-protection plan
Chapter 3.1.1.ii. European Climate Initiative
Chapter 3.1.1.iii. National Climate Protection Initiative (NKI) Meseberg Working Group on the Environment
1.2 Renewable energy
Chapter 3.1.2.i. Renewable Energy Sources Act Better synchronisation of the deployment of renewable energies with electricity-grid expansion Checking the regional management of renewable energies in the electricity sector Pilot project: technology-neutral tender; also, as a pilot project: a tender with specific regard to innovation Special tenders for onshore wind and for solar Offshore Wind Energy Act
Chapter 3.1.2.ii. Opening of tenders in the electricity sector Baltic Energy Market Interconnection Plan (BEMIP) – Working-Group on Renewable Energy North Sea energy cooperation in the activity area of renewable energy TARES project in Greece Concerted Action on Renewable Energies

Chapter 3.1.2.iii.

Surcharges system in the Renewable Energy Sources Act
Investments in storage technology
KfW bank's programme on renewable energies

Chapter 3.1.2.v. – Central contact points for information

Federal Network Agency
Federal Maritime and Hydrographic Agency
The company 'Nationale Organisation Wasserstoff (NOW) GmbH'
Electricity Grid: Citizens' Dialogue (BDS)

Chapter 3.1.2.v. – Strengthening the self-consumers of power generated and the landlord-to-tenant models in the electricity sector

Landlord-to-Tenant Electricity Act (Mieterstromgesetz)

Chapter 3.1.2.vi.

Heating grid systems 4.0 (Measures from the long-term renovation strategy (see 2. 'Energy efficiency'), which also decisively contributes to Dimension 1 – 'Reduction of CO₂ emission')

Chapter 3.1.2.vii.

'Use of biomass for energy' funding-support programme
'Renewable raw materials' funding programme

1.3 Further measures (in accordance with Chapter 3.1.3. on the ETS and on low-emission mobility)**Chapter 3.1.3.i.**

The EU's emissions-trading system (ETS) and national implementation through the Greenhouse-Gas Emissions-Trading Act (TEHG)
Retirement of capacity resources for electricity-generation

Chapter 3.1.3.ii.

Sector-coupling

Chapter 3.1.3.iii.

National Platform 'Future of Mobility' (NPM)
Promoting electric mobility
Amendment to the Regulation on Electric Charging Units for Vehicles
National Strategy Framework regarding infrastructure expansion for alternative fuels
Further development of the National Innovation Programme on Nitrogen and Fuel-Cell Technology (NIP 2)
Strengthening Germany as a business location for battery-cell production
Specific measures for reduction of emissions in urban road traffic
Funding of alternative drives in local public passenger transport
Further development of the Mobility and Fuels Strategy
Biofuels
Promoting natural-gas-powered mobility
Purchasing-promotion campaign regarding electric vehicles – information campaign
National cycle transport plan

Chapter 3.1.3.iv.

Peer-review process in the G20 context
Federal Government's report on subsidies
Expiry of the grants for hard coal

2. Energy efficiency

Chapter 3.2.i.

National Action Plan on Energy Efficiency (NAPE and NAPE 2.0)
Drawing-up an energy-efficiency strategy

Chapter 3.2.ii.

Energy Efficiency Strategy for Buildings
Energy consultation – residential buildings (in-situ consultation/individual renovation plan)
Energy consultation – non-residential buildings owned by municipalities/not-for-profit organisations (EBK)
Energy consultation for small to medium-sized enterprises
National efficiency label for old heating facilities
New version of Energy for Buildings Act
Tax-based financial support to renovation of buildings for energy-optimisation purposes
Federal Government's programme of CO₂-related renovation of buildings
Market Incentive Programme for funding-support to measures aimed at use of renewable energies in the heating market
Funding programmes: Energy efficiency and process heating from renewable energies in business – 'grant and credit' and 'competition' respectively
Incentive programme on energy efficiency
Promotional programme on optimisation of heating
Expansion of funding-support programmes for heating grids, heat storage units and investments that supply to two or more buildings
Construction research initiative – 'Efficient House Plus'
Promotional initiative: Energy Efficient Buildings 2050
Role-model function with regard to stock of publicly-owned buildings

Chapter 3.2.iii.

Funding-support to consultations on energy-saving contracting measures, within the 'EBK' context
Dialogue on Contracting, between the Federal Government and the Länder (states)
Model projects on contracting
Information on sample contracts and guidelines
Municipalities' networks on energy efficiency and resource efficiency

Chapter 3.2.iv. – Promoting the public sector's role-model function

Role-model function regarding stock of publicly-owned buildings

Chapter 3.2.iv. – Promoting the public sector's role-model function – energy-efficiency in award of public contracts

Energy-efficient purchasing by public institutions

Chapter 3.2.iv. – Energy audits/Energy management system

Energy audit for non-SMEs (small and medium-sized enterprises)
Promotion of Energy Management Systems
Federal Energy Efficiency Centre (BfEE)

Chapter 3.2.iv. – Consumer information/training measures

Independent consultation at the Federation of German Consumer Organisations (vzbv)
Energy consultation for residential buildings (*in-situ* consultation/individual renovation plan)
Energy consultation for non-residential buildings owned by municipalities/not-for-profit organisations
Energy consultation for SMEs
SME initiative on energy transition and environment protection
National Top Runner Initiative
Campaign – 'Germany makes it efficient!'
Information and Competence Centre for construction with a future

Chapter 3.2.vii.

Franco-German energy platform

Chapter 3.2.viii.

Funding-support strategy on energy-efficiency and renewable heating
Funding-support strategy in the realms of industry, trade, commerce, tertiary sector
Further development of the programme of 'Promotion of electricity savings in the context of competitive tenders: STEP up!'
Promotion initiative on 'solar construction/energy-efficient city'
Promotion of mini engine-based cogeneration facility
Energy Tax Act and Electricity Tax Act

3. Energy security

Chapter 3.3.i. – Gas supply

Securing the supply to household customers
 Making information available
 Grid Development Plan – Gas
 Capacities for flows of load in both directions ('Reverse Flows')
 Storage units
 Preventive Action Plan – Gas
 Regulation on Securing the Gas Supply in a Supply Crisis
 Act on Securing the Energy Supply – Natural Gas
 Possible measures in the context of decrees issued according to GasSV, Art. 1
 Solidarity
 Emergency Plan – Gas

Chapter 3.3.i. – Petroleum supply

Act on Securing the Energy Supply – Petroleum
 Oil Stockpiling Act
 Petroleum-Related Data Act
 Transport Services Act (VerkLG)
 Fuel-Supply Restrictions Regulation (KraftstoffLBV)
 Heating-Oil Supply Restrictions Regulation (HeizöllBV)
 Regulation on Balancing of Petroleum Resources (MinölAV)
 Regulation on Management of Petroleum Resources (MinölBewV)
 National Emergency Strategy Organization – NESO

Chapter 3.3.i. – Electricity supply

Operation of energy-supply grids
 Making information available
 Grid Development Plan – Electricity
 Grid reserve
 Capacity reserve
 Monitoring of security of electricity supply
 Act on Securing the Energy Supply – Electricity
 Electricity Securing Regulation (EltSV)
 Regulation on Electricity Load Distribution (EltLastV)
 General Administrative Ruling on the Regulation on Electricity Load Distribution (EltLastVwV)
 Measures to take in the event of a shortfall in production
 Conducting stress tests

Chapter 3.3.ii. – Natural gas

Solidarity among EU Member States in the context of the SOS Regulation
 Consultations: Gas Coordination Group
 Preventive Action Plan and Emergency Plan
 Risk groups
 Pentilateral Gas Forum
 Cooperation in regional groups in the context of the trans-European energy networks (TEN-E regional groups) – Gas

Chapter 3.3.ii. – Petroleum

Cooperation in regional groups in the context of the trans-European energy networks (TEN-E regional groups) – Oil
 ACOMES – Annual Coordinating Meeting Entities Stockholding

Chapter 3.3.ii. – Electricity

Cross-border evaluation of security of supply in the electricity market
 Pentilateral Energy Forum – Security of electricity supply

4. Internal energy market

Chapter 3.4.1.i.

Projects for expansion of interconnectors in the Power Grid Expansion Act (EnLAG) and the Federal Requirement Plan Act (BBPlG)

Chapter 3.4.1.ii. (see 3.4.3.vi.)

Chapter 3.4.2.i.

Electricity Grid Action Plan
Monitoring the grid-expansion projects for electricity and gas
Controlling on grid-expansion projects for electricity and gas
Optimisation of already-existing grids
More rapid expansion of the electricity grids
Remuneration incentives and Energy Incentive Regulation Regulation

Chapter 3.4.2.ii. (siehe 3.4.3.vi.)

Chapter 3.4.3.i. – Market-integration measures

Sector-coupling
Measures for step-by-step reduction and phasing-out of the use of coal-fuelled electricity (the Commission on 'Growth, Structural Change and Employment' is drawing up an action programme for this)
National action plan to reduce bottlenecks in the grid
Cross-border action plan to reduce bottlenecks in the grid

Chapter 3.4.3.i. – Measures to improve market-coupling

Creation of a Capacity Calculation Region for Central and Eastern Europe (CORE)
Coupling of electricity trading conducted in the course of a given day

Chapter 3.4.3.ii. – Measures to ensure adequacy

Ensuring an adequate energy system
Further measures for a flexible and efficient electricity supply
Safeguarding the energy system's flexibility

Chapter 3.4.3.ii. – Measures to ensure flexibility

Expanding and modernising grids in accordance with demand
Further integrating European electricity markets and increasing their flexibility
Grid-financing that is fair and serves the system's needs
Implement the 'using instead of curtailing' measure
Flexible CHP facilities
Optimisation measures on the topic of redispatch
Flexibility check

Chapter 3.4.3.iv.

Market integration/protection for energy consumers and competitiveness both at national and at European level
Basic-supply and replacement-supply concept

Chapter 3.4.3.v.

Managing and stabilising the system by means of enhanced cooperation between power-transmission grid operators and distribution grid operators, and also:
Market players
Dynamic electricity-price contracts and smart meters
Establishing a register of core market data
Metering Point Operation Act (MsbG)

Chapter 3.4.3.vi.

Pentalateral Energy Forum – internal energy market
Neighbours in electricity-use
Cooperation in regional groups in the context of the Trans-European Energy Networks (TEN-E regional groups) – internal electricity market
Franco-German showcase project on cross-border optimisation of the energy system (Smart Border Initiative)

Chapter 3.4.4.i.

Energy consultation for low-income households (electricity-saving check)

5. Research, innovation, competitiveness

Chapter 3.5.i. – Research

Federal Government's 7th Energy Research Programme

Chapter 3.5.i. – Innovation and Competitiveness

Further development of opportunities to use CO₂ in the context of CCU/CCS
 'Showcasing intelligent energy – Digital agenda for the energy transition' (SINTEG programme)

Chapter 3.5.ii. – European energy research cooperation

Strategic Energy Technology Plan (EU-SET Plan)
 European Research Area (ERA-Net) Cofund

Chapter 3.5.ii. – Regional/bilateral cooperations

North Sea energy cooperation on energy-research
 Cooperation on CCUS with countries bordering the North Sea
 Greek-German research cooperation and promotion of upcoming researchers (DeuGrInZus)
 Franco-German Fellowship Programme
 Franco-German promotion of research on electricity grids/'Smart Grids'

Chapter 3.5.iii. – Research

'Horizon 2020' – EU Framework Programme for Research and Innovation

Chapter 3.5.iii. – Innovation and Competitiveness

Strengthening Germany as a research location for energy-storage technology
 Laboratories operating under real-life conditions as supporting column in energy research
 Expanding the recycling of CO₂

1.2.iii. Key issues of cross-border relevance

Dimension 1: Decarbonisation

1.1 GHG emissions and removals

Germany is contributing to the achievement of the EU's climate-protection target for the year 2030, and also of the Paris climate agreement's targets. There is constant exchange with other Member States, in particular on national environment-protection strategies, as well as on environment-protection projects by non-governmental and regional entities (by NGOs and municipalities); the aim is to share experiences and best practice and also to recognise and discuss any ramifications for other Member States at the earliest stage possible. Another key topic in engaging with other Member States is the structuring and implementation of EU environment policy.

1.2 Renewable energy

Due to Germany's geographical location at the heart of Europe, the deployment of renewable energies in Germany has numerous ramifications for neighbouring countries. The Federal Government gives high priority to the integration of renewable-energy grids and systems (see Chapter 3.1.2.). In the years to come, the Federal Government is placing emphasis on regional cooperation with other Member States; this serves as an important driver for the market integration of renewable energies. Thus, the Federal Government is organising tenders for electricity sourced from renewable energy for installations located in other EU Member States. It is also actively participating in the North Sea Energy Cooperation Forum and is involved in the Working Group on Renewable Energies (see Chapter 1.4., 3.2., 3.4.3.), within the framework of the Baltic Energy Market Inter-Connection Plan (BEMIP). In addition, right from the start, Germany has played an active role in the 'Concerted Action' Forum for Renewable Energies (CA-RES).

Dimension 2: Energy efficiency

In principle this dimension does not give rise to issues of direct cross-border significance. Nonetheless, there are cross-border cooperation projects with EU neighbouring states, as well as various initiatives aimed at exchanging inputs on efficiency-related best practice (see Chapter 3.2.).

Dimension 3: Energy security

Functioning energy markets act as the best guarantee that the energy supply remains secure throughout the EU and that there is a reduced risk that supply disruptions will have damaging consequences. If a Member State's security of energy supply is threatened, there is a risk that unilateral measures taken by that Member State endanger the smooth functioning of the internal market and have a negative impact on the energy supply in other Member States. A number of import routes is available for supplying the German gas market, via which the markets that neighbour Germany can also source gas from Germany. This reduces the risk of supply disruptions both for the German and the neighbouring gas markets respectively. Likewise, the German electricity market is deeply integrated into the European internal market for electricity. Standards for calculating the level of supply security are being developed in the EU at present. Germany's Report on Security of Supply is already applying these standards.

It is necessary to have, in advance, a cross-border coordination among those German and neighbouring European market-players involved, in order to introduce the cross-border measures that maintain security of supply in neighbouring Member States if a crisis emerges, i.e. in the event that energy supply falls well below demand. If needed, this must involve the suitably-authorized public bodies. Germany is taking part in the formulation of a regional Report on Security of Supply, in the context of the Pentalateral Energy Forum.

Dimension 4: Internal energy market

Europe's internal market serves as the backbone of the European energy transition; it has key significance in guaranteeing a secure, cost-efficient energy-supply, compatible with environmental needs, in Germany as elsewhere.

Trade in electricity among the EU Member States is becoming ever more important in this: cross-regional synergies for production and consumption can be used to make the electricity system even more flexible. Therefore, the Federal Government is actively involved in various regional cooperation fora, to pursue the deepening of integration within Europe's internal market for electricity. Particularly noteworthy here are also the Pentalateral Energy Forum and the Baltic Energy Market Interconnection Plan (BEMIP) (see Chapters 1.4., 3.2. and 3.4.3.).

Dimension 5: Research, innovation, competitiveness

Like many European countries, Germany faces major research and innovation challenges, on its path towards the energy transition that brings a larger market share to cleaner and renewable energies. In particular, topics relevant to all are the integration of increasing amounts of fluctuating supply of wind power and solar power, the digitalisation of energy supply, and also sector coupling, including use of thermal energy; technical innovations are needed to overcome these challenges. Regional cooperation helps to tackle issues jointly and effectively, to make good use of cross-border infrastructure, and to deploy financial resources efficiently. The research cooperation takes place within the international framework, particularly the European one, via the Federal Government's participation in Horizon 2020/Europe and the implementation of the objectives stated in the Strategic Energy Technology (SET) Plan. Such cooperation also emerges through joint research projects and through coordinating the points of emphasis applied in funding-support. Regional and bilateral cooperation activities are an opportunity to pool resources and use them more effectively, where there are shared issues and common interest in a given geographical area. Not least, international cooperation serves as a precondition for maintaining Germany's research landscape at a top level, worldwide and across the range of technological disciplines.

1.2.iv. Administrative structure of implementing the National Energy and Climate Policies

The energy transition and environment protection are implemented at Federal Government level, individual Land (state) level and municipal level. At Federal level, the guiding role in energy policy is played by the Federal Ministry for Economic Affairs and Energy (BMWi). The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) directs policy on climate topics.

The Federal Government and the Länder (states) are continuously coordinating their activities as they implement the energy transition. In a half-year cycle, meetings are held between the Federal Chancellor and the heads of government of the Länder; the Federal Ministers with relevant subject-area authority also take part. One of the topics discussed is the degree to which the energy transition has been put into effect. The ministers with subject-area authority at Federal and at Land level also consult each other annually, in the conferences of Federal and Land ministers of economic and environmental affairs respectively, as they clarify their priorities and coordinate the next steps to take in the energy transition. This institutional coordination is reinforced by topic-specific management-level discussions and also by an ongoing cooperation and tight-knit exchange of inputs at subject-specialist level.

The Federal Foreign Office finances a database with a comprehensive review of the organisational units with relevant authority, at federal, Land and municipal level, in the 'Who is Who of the Energy Transition in Germany' (in German): <https://www.renac.de/who-is-who/p/10/>

This document also summarises the key contact individuals with subject-area authority in politics, the economy and society.

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

This chapter will be set out in specific terms after the consultations, scheduled to be held in the course of 2019, in preparation of the final Energy and Climate Plan. The Federal Ministry for Economic Affairs and Energy provides information on its website, regarding the NECP process and the opportunities to take part in the consultations.

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

1.4. Regional cooperation in preparing the plan

The energy transition can succeed and climate protection can advance only if these topics are fitted into the European context and are strengthened by regional cooperation. Thus it is a crucial integral part of the Federal Government's policy on energy and the environment to advance regional cooperation in the form of bilateral activities or joint initiatives and fora that involve several EU Member States. This chapter is still being set out in specific terms in preparation of the Federal Government's final Energy and Climate Plan. To give an overview, some of the key existing regional cooperation initiatives with European partners are named here; these are referred to in those parts of the draft NECP that address regional cooperation:

Bilateral cooperation

The Federal Government cultivates a close cooperation on energy and environment issues with many other EU Member States, especially with its direct neighbours. This cooperation with several Member States was reinforced and given specific form by means of agreement on joint declarations of intent. For instance, the current German government's term of office has seen reinforcement of the already-existing, very good cooperation between France and Germany on energy and environment issues; this took place in the context of the 'Meseberg Declaration' of June 2018 and the declaration on energy-related cooperation in July 2018. Among other initiatives, cooperation projects with France are established in the Franco-German energy platform, in the internal energy market, and in energy research (see Chapters 3.2., 3.4.3. and 3.5.). Beyond this, there is an intensive exchange of knowledge and experience in the context of the Franco-German Office for the Energy Transition (DFBEW). In the Declaration of Intent on Energy Cooperation, signed with Belgium in October 2018, it was agreed (*inter alia*) that Germany would provide support to Belgium in handling the particular situation that the latter faced in terms of security of supply in the winter of 2018/2019.

European Climate Initiative

In 2017, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety brought the European Climate Initiative into being. Its subject areas for bilateral and multilateral projects are the development of environment strategies and their implementation on a variety of levels, the exchange of knowledge and views on instruments of environment policy, and also on measures and projects in all relevant sectors. Examples are energy, industry, transport, private households, manufacturing, commerce and the service sector, waste management, agriculture and land use (see Chapter 3.1.1.).

Baltic Energy Market Interconnection Plan (BEMIP)

BEMIP was set up in 2009 and includes all EU states bordering the Baltic Sea, in addition to Norway as an observer; essentially it is organised by the European Commission. The Federal Government participates in BEMIP's working groups (see Chapter 3.1.2.).

North Sea Energy Forum

In 2016 the countries bordering the North Sea, jointly with the European Commission, founded the North Sea Energy Forum, so as to further expand their cooperation on energy matters. This forum's topics of emphasis are cooperation in expanding offshore wind energy, in extending the grid infrastructure and also in marine-based area management in the North Sea. As part of this initiative, the relevant Member States, including the Federal Republic of Germany, have in addition begun to exchange information and views, as well as developing joint NECP elements, regarding the relevant parts of the NECPs for the states that border the North Sea (see Chapters 3.1.2. and 3.5.) This process is to be built upon and intensified in 2019.

Pentalateral Energy Forum

This is a Member States' cooperation, founded in 2005, between Belgium, Luxembourg, the Netherlands, France, Austria and Germany; its emphasis is on market-coupling for electricity, security of supply, precautions aimed at pre-empting crises, and achieving greater flexibility in the electricity markets. Switzerland has observer status in this forum (see Chapter 3.4.3.).

Pentalateral Gas Forum

This cooperation was set up in 2009; it deals with EU Member States' cooperation between Belgium, Luxembourg, the Netherlands, France and Germany, and mainly on gas-supply topics (see Chapter 3.3.).

Cooperation in regional groups in the context of the trans-European energy networks (TEN-E regional groups)

The Federal Government cooperates with other EU Member States in several regional groups, within the TEN-E framework. The regional groups correspond to the priority corridors for energy infrastructure, as established in the TEN-E Regulation; at regional level, they are responsible for identifying the so-called 'Projects of Common Interest' ('PCIs') from the viewpoint of energy-infrastructure development, in line with the TEN-E Regulation. According to the TEN-E Regulation, Article 4, the relevant projects aim to contribute, (*inter alia*), to market integration, sustainability, competition (diversification of sources of supply, of channels of supply, and of supplier base) and also to security of supply (see Chapters 3.3. and 3.4.3.).

2. National Objectives and Targets

2.1. Dimension decarbonisation

2.1.1. GHG emissions and removals

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

Binding, established annual national threshold values, in accordance with the Effort Sharing Regulation (ESR)

For Germany, the Effort Sharing Regulation entails a binding target of 38 per cent reduction by 2030, compared to 2005, for the sectors outside the scope of emissions trading. Based on the linear reduction path between the actual average emissions for the years 2016 to 2018, and the 2030 cut-off date, annual emission budgets are issued to Germany.

Assurances made in accordance with the LULUCF Regulation (Land Use, Land Use Change and Forestry)

For the first time, each EU Member State is given a target for the LULUCF sector. The debits from the land-use categories taken into account in the calculation, made according to the LULUCF Regulation, Article 2, are not permitted to exceed the credit balances at the end of the two five-year periods, 2021-2025 and 2026-2030 respectively (so-called 'no net debit rule').

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 2010, Germany set itself the target of reducing its greenhouse-gas emissions by at least 55 per cent by the year 2030, taking 1990's level as the base line. This equates to a permissible emission quantity of 562 m. t of CO₂ eq. Beyond this, consistent with the Energy Concept, the prospect is that Germany aims to lower its GHG emissions by the year 2040 by at least 70 per cent, and achieve a 80–95 per cent reduction by the year 2050, compared to 1990 as base-year (virtual GHG neutrality).

Table A4: Objective for GHG reduction*

	2030	2040	2050
Reduction compared to 1990 in [%]	at least 55	at least 70	virtually GHG neutral: 80–95
For information purposes only: permissible emission quantity in m. t of CO ₂	(562)	(375)	(263 to 62,5)

* Trajectory based on Energy Concept and Climate Action Plan 2050

The Federal Government has confirmed these targets with the Climate Action Plan 2050. Additionally, the National Climate Action Target 2030 is underpinned by sectoral targets. As regards the national objectives, Germany is pursuing these independently of its contribution to the EU target, but in harmony with it. So the Federal Government's understanding of this matter is that the Regulation on the Governance System for the Energy Union and for Climate Protection, Article 14, Para. 3, does not apply in this regard.

2.1.2. Renewable energy

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

Apart from the targets described in 2.1.1., aimed at GHG reduction, an increase of the share of renewable energies in the gross final energy consumption also contributes to decarbonisation. With CO₂ prices rising in the EU emissions-trading system, and due to the corresponding increase in electricity prices on the exchange, the necessary financing contribution that the Renewable Energy Sources Act surcharge requires is reduced. The EU established the target, binding for Member States, of raising renewable energies' share of gross final-energy consumption to at least 32 per cent by 2030. It is planned to review this target in 2023 with a view to further raising the target. As regards renewable energies' proportion of gross final-energy consumption, the Federal Government is striving to attain a 30 per cent contribution for 2030 (share in 2020: 18 per cent). This was already decided upon in the Energy Concept approved on 28 September 2010 (Energy Concept 2010).

It is important that this target is attained by means of a simultaneous increase in renewable energies' share in the sectors of electricity, heat-generation and cooling-generation, as well as transport; this is because the heating and cooling sectors and the transport sector jointly account for two-thirds of energy consumption. The Federal Government adopts a linear trajectory as the basis for a reliable and continuous increase of the renewable energies' share. The indicative trajectory for renewable energies' total share in gross final-energy consumption rises on a linear basis, from 18 per cent in 2020 to 30 per cent in 2030. The annual growth comprises 1.2 percentage points (see Table A5).

Within the Governance Regulation framework, in the event of a shortfall in relation to the EU trajectory, progress in expanding renewable energies is measured on the basis of reliable reference points: accordingly, renewables are to account for 18 per cent of the additional growth between 2020 and 2030 in the year 2022 (so renewable energies' share is then 20.2 per cent), 43 per cent in 2025 (i.e. renewable energies' share is to comprise 23.2 per cent), and 65 per cent in 2027 (i.e. with renewable energies' share then comprising 25.8 per cent).

Table A5: Estimated linear overall trajectory for deployment of renewable energies, as measured by 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 is based on the Energy Concept, is provisional, and can turn out to be different in the final NECP

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 sector

The sectoral trajectories play a role subordinate to the overall trajectory regarding renewable energies' overall share in gross final-energy consumption. They provide specifics on the overall trajectory and enable progress to be monitored. However, the trajectories stated below are provisional indicative trajectories that can turn out to be different in the final NECP.

Electricity

According to the Renewable Energy Sources Act, the electricity sector is making provision for a continuous rise in renewable energies' share in gross electricity consumption, to 40–45 per cent in 2025, 55–60 per cent in 2035, and at least 80 per cent in 2050. What can be deduced from this is a trajectory with a 1.5 per cent increase per year. In addition, the Energy Concept of 2010 includes the objective of raising renewable energies' share to 50 per cent by 2030:

Table A6: Estimated sectoral trajectory: electricity – renewable energy share in gross electricity consumption*

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
34–39 %	35.5–40.5 %	37–42 %	38.5–43.5 %	40–45 %	42–46.5 %	44–48 %	46–49.5 %	48–51 %	50–52.5%** 65%**

* Indicative trajectory, based on the Energy Concept and on the Renewable Energy Sources Act 2017, is provisional and can turn out to be different in the final NECP

** The Federal Government is aiming to attain an increase in the renewable energy share in the electricity sector to around 65 per cent in the light of the challenges of improving synchronisation of renewable energies and grid capacities.

In addition, the government's coalition parties – namely CDU, CSU and SPD – have made provision in their coalition contract for renewable energies to have a circa 65 per cent share of gross electricity consumption in 2030; this objective was set in view of the challenges of better synchronisation of renewable energies and grid capacities. This almost matches the target originally set for 2040. The electricity grids' capacity to absorb output is crucial to this. The Federal Government will draw up an ambitious plan of measures to expand the electricity grids more rapidly. In order to deliberate on measures aimed at raising acceptance of onshore wind power, a working group was set up, and is scheduled to present its results by the spring of 2019. Additionally, the Federal Government has assigned tasks to the Commission on 'Growth, Structural Change and Employment'; the commission is formulating an action programme with proposals for gradually phasing out coal-fired electricity, and for accompanying the structural change that this entails. Based on these results, by the autumn of 2019 the coalition will decide on specific measures for raising acceptance of the changes, and on conditions for providing funding support. It must also decide regarding continuation of renewable energies' deployment trajectories in the electricity sector up to 2030. The coalition treaty sets out the aim for renewables to have a market share of circa 65 per cent by then.

Renewable energies' share must be significantly raised; this must be done not only to reach the national environment-protection target in the energy sector, but also to cover the additional demand for electricity as they pursue the national climate-action targets in transport, in buildings and in industry (sector coupling).

Heating and cooling

In the heating and cooling sector, buildings account for the largest share of energy consumption (comprising around two-thirds of final-energy consumption for heating and cooling); alongside this, process heating and cooling in industry also play a key role (around one third of final-energy consumption). Back in 2015, the Federal Government adopted its strategy for the energy transition in the context of buildings, with its Energy Efficiency Strategy for Buildings. Implementation of this strategy thereby substantially contributes to reaching the target set for renewable energies in heating and cooling, and simultaneously to raising energy efficiency (see Chapters 2.2. and 3.2.).

In the heating and cooling sector, according to the Renewable Energies Heat Act, and derived from the new version of the EU directive promoting renewable energy sources – the Renewable Energy Directive (RED II) – the target set for renewable energies' share in final-energy consumption for heating and cooling uses is 14 per cent in the year 2020. At European level, according to this new version of the Renewable Energies Directive, the Member States must strive to achieve an increase in renewable energies' share in the heating and cooling sector that consists of 1.3 per cent annually (calculated as an annual average for the years 2021–2025 and 2026–2030 respectively). This amounts to a 27 per cent share in 2030. This is the level of ambition that the Federal Government takes as its basis for its contribution to attainment of the EU targets in 2030. It also makes clear that the future deployment of renewable energies must be

significantly speeded up, in order to reach the national climate-action targets for 2030 in industry (primarily process heating) and in buildings (primarily heating indoor areas).

Table A7: Estimated sectoral trajectory: heating and cooling – renewable energy share in final-energy consumption for heating and cooling*

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
15.3 %	16.6 %	17.9 %	19.2 %	20.5 %	21.8 %	23.1 %	24.4 %	25.7 %	27 %

* Indicative trajectory is based on the EU Renewable Energies Directive, is provisional, and can turn out to be different in the final NECP

Transport

In the transport sector, according to the amended Renewable Energies Directive, fuel suppliers have a binding obligation to raise renewable energies' market share in transport uses to at least 14 per cent by 2030 (including instances of double-counting). Among other methods, the target is to be reached by further developing the GHG reduction quota. There are not yet any national target values established for the period after 2020. The Federal Government will adhere to the minimum targets set in the Renewable Energies Directive. In the course of 2019, a check will be made on a possible adaptation of the GHG quota for the period 2021–2030, as well as further measures, where applicable.

Not least because of the ambitious CO₂-reduction target set for the year 2030 in the National Climate Action Plan 2050, renewable energies' share of the transport sector must go up significantly by 2030. Here the most effective measures are the deployment of electromobility in road transport, as well as raising renewable fuels' market share. The Federal Government's support for this ranges from plug-in hybrids, via battery drives and fuel cells, through to biofuels and, most recently, to sector-coupling by use of electricity-based fuels.

By now, CO₂ emission levels are once again above the year-1990 level, despite reduced CO₂ emissions in new vehicles (per km). The CO₂ reduction target set for 2030 in the Climate Action Plan 2030 is another factor that necessitates rapid introduction of measures to reduce the CO₂ emissions.

A specific trajectory for renewable energies' share in the transport sector will form part of the final NECP.

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 and also total planned installed capacity (divided by new capacity and repowering) per technology and sector, in MW

Renewable energies' technology-specific deployment serves the purpose of attaining the target in the sectors of electricity, heating and cooling, and also transport; it does not constitute a target in itself but rather it highlights the way in which a target can be reached. There is flexibility regarding the given sector's technology mix.

Electricity

In the electricity sector the Renewable Energy Sources Act 2017 determines the technology-specific deployment trajectories. For onshore wind, provision is made for an annual gross additional build of 2,900 MW. To reach this gross additional build, tenders are under way. For offshore wind, the deployment trajectory provides for an increase in installed capacity that takes it to 15 GW in the year 2030. For the additional build, for the period up to 2025, two tenders were conducted in the years 2017 and 2018, accounting for 3,100 MW in all. For photovoltaics, the target figure set is a gross additional build of 2,500 MW annually. The Federal Government is striving to reach an increase in renewable energies' share of the electricity sector that takes it to 65 per cent, in the light of the challenges involved in a better synchroni-

sation of renewable energies and grid capacity resources. Depending on further political decisions made on this topic, the technology-specific deployment trajectories are subject to a monitoring review (cf. Table A6). For biomass installations, the Renewable Energy Sources Act 2017 makes provision for tenders that involve 150 MW per year up to 2019 and 200 MW per year between 2020 and 2022.

From 2021, a lot of older Renewable Energy Sources Act installations will receive no further remuneration, after their 20-year remuneration period elapses. For technical or economic reasons, what will follow is a scaling down or a repowering of old facilities. Starting in the early 2020s, this will apply to a large extent to onshore wind installations and, from 2025 onwards, also to biomass. Taking the scale-down into account, electricity production from renewable energy sources in 2030 will be in the order of magnitude of circa 300 TWh. Almost half Germany's gross electricity consumption will then be supplied by renewable energies.

To make an extra contribution to attainment of the environment-protection targets, according to the Renewable Energy Sources Act 2017, special depreciation measures are implemented from the year 2019 onwards. In total, up to the year 2021, tenders are to be launched for an additional 4 Gigawatts each of solar installations and onshore wind energy installations respectively. Depending on the projects' specific implementation, these come into effect as early as 2020 or in the years that follow. The quantities involved in the tenders will not be taken into account from the perspective of the existing 52-gigawatt limit on solar installations. The special tenders form a constituent part of the so-called Omnibus Energy Act (EnSaG – Federal Government draft legislation, dated 05 November 2018).

In addition, the aim is that renewable energies' share of gross electricity consumption will be raised to around 65 per cent by 2030, according to the coalition agreement. Depending on gross electricity consumption, this would require electricity production from renewable sources that amounts to between 360 and 400 TWh, or respectively an installed renewable-energy capacity of between 180 and 220 GW; this amounts to a significant deployment of renewables. The challenge is to better synchronise renewable energies and grid capacities. In the context of the grid development plan for 2019–2030, a review is being made on which measures must be implemented in the transmission grid, in order to safeguard the electricity grids' take-up capacity for this purpose.

Heating and cooling

The technology-specific trajectories (estimated deployment trajectories) depend on measures that underpin them and must therefore be submitted at a later date.

Transport

The technology-specific trajectories (estimated deployment trajectories) depend on national implementation of the Renewable Energies Directive and the measures that underpin this; they must be provided at a later date. In the transport sector, the Federal Government will meet the targets stated in the new version of the Renewable Energy Directive. This includes the obligation, for those introducing fuels into use, to raise renewable energies' share of the transport sector to at least 14 per cent by 2030. To calculate this share, the following multipliers have been agreed upon: renewable electricity in electromobility, factor 4; rail transport: factor 1.5; aviation and waterborne transport: factor 1.2; cutting-edge biofuels will be allocated factor 1 or factor 2, a figure that will be decided upon at national level. First-generation biofuels' market share is not permitted to exceed 7 per cent.

In Germany first-generation biofuel's share is to consist of up to 5.3 per cent. By contrast, by 2030 progressive biofuels' share is expected to rise to a share comprising between at least 1.75 per cent (double inclusion in the calculation) and 3.5 per cent (single inclusion). Beyond this, the total quota is expected to be implemented by means of electricity from renewable energy sources, both in electromobility and in rail transport respectively. Renewable energies' technology-specific shares will be addressed in the final NECP.

However, the EU's minimum targets for conventional biofuels and new renewable technologies combined are not sufficient to fulfil the Federal Government's energy and environment targets for the transport sector, nor the European agreements on the non-ETS sectors. Therefore it is purposeful to have discussions about ambitious national implementation of RED II.

Similarly, the present government's coalition parties have established it in their coalition agreement that they will put into place the correct framework conditions for sustainable mobility.

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 sinks

The sustainable amount of biomass, available for energy-supply use in Germany, still needs to be quantified from the viewpoint of sustainability aspects that require compliance. For the future, the potential for bio-energy use in energy applications is mainly to be found in efficient use of waste and residual materials, taking into account the cascade of use. What must be avoided is a disadvantageous impact on climate-protection efforts in potential countries of origin, as a consequence of importing from those countries.

In the electricity sector, use of biomass is decreasing, while it is rising in the heating and cooling sector and also in transport, in the period up to 2030. Use of biomass for electricity purposes is decreasing because, compared to other technologies such as wind energy and photovoltaics, when used for electricity it proves to be a relatively costly renewable energy source. This is especially true for electricity production from raw materials that grow back, and even when taking into account the provision of adjustable capacity, or greater overall flexibility. In order to reach the national climate-action targets cost-efficiently, it is an option to use biomass for energy supply in air travel, seaborne travel and heavy-load transport, in high-temperature industrial processes, and in buildings that are hard to insulate. Alternatively, synthetic fuels also provide an option for GHG reduction – albeit costs are mostly higher.

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 waste water)

Renewable energies' share in heating grids and cooling grids

Renewable energies' share in district heating and cooling will continue to be raised. The positive development so far in renewable energies' share in heating grids and cooling grids is to be further promoted, by financial incentives but also by legislative measures. This point is elaborated more fully in Chapter 3.1.2. At European level, the Renewable Energies Directive's new version requires the Member States to endeavour to attain an increase in renewable energies' share of heating grids by 1 per cent annually between 2020 and 2030. This target level will also be carried over into the NECP. As a result, the expectation is a share of approx. 21 per cent for 2021, 25 per cent for 2025, and 30 per cent for 2030.

Table A8: Estimated trajectory of deployment for renewable energies' share in heating grids*

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
21 %	22 %	23 %	24 %	25 %	26 %	27 %	28 %	29 %	30 %

* Trajectory based on EU Renewable Energy Directive

Use of renewable energies in buildings

To reach the energy-policy and environment-policy targets, and depending on the transformation path taken, the buildings sector must get to a 25 – 35 per cent share for renewable energies by 2030, according to the Energy Efficiency Strategy for Buildings. The path is dependent on the measures underpinning it; these must be developed within the framework of national processes with regard to buildings.

2.2. Dimension energy efficiency

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

National contributions to the European Union target for 2030

At European level, the Member States reached an agreement with the European Parliament and the European Commission in June 2018 (entry into force: end of 2018). It states that the primary energy consumption in 2030 must be reduced by 32.5 per cent as compared to the consumption value forecast for 2030 in a reference scenario. This has been anchored in the recast of the EU's Energy Efficiency Directive – EED). To reach this target, the Member States must submit national indicative contributions. The basis for determining the German contribution to reaching the EU's target is the national objective which has been derived from the Energy Concept 2010 and been confirmed in the current government's term of office and. This states that primary-energy consumption should decrease by 20 per cent by the year 2020 and by 50 per cent by 2050 (base year: 2008). The necessary measures as well as specifications on the German contribution to the EU Energy Efficiency Target 2030, are to be drawn up and formally adopted in the framework of a Federal Government Energy Efficiency Strategy in 2019. Building upon this, in accordance with the Governance Regulation, an indicative trajectory is also being formulated.

With a linear interpolation of the currently-existing targets, the national target volume of primary-energy consumption for 2030 amounts to 230 Mtoe, based on Eurostat's figures; this equates to a consumption level 30 per cent lower than in 2008. Taking current data sourced from PRIMES 2016 as the basis, this would also correspond to Germany making an 'average' contribution of at least 32.5 per cent to attainment of the EU target.

Cumulative energy saving according to the EU Energy Efficiency Directive, Article 7

The provisional cumulative saving target according to the Energy Efficiency Directive, Article 7, Paragraph 1, 1b), amounts to 4,045.8 PJ or respectively 96.6 Mtoe, based on currently available statistical data for the period 2021–2030. Here, reference is made to Annex II, according to the Regulation on the Governance System for the Energy Union and for environment protection, which can be found at the end of this draft. In this regard, the calculation basis for determining the savings objective is a provisional one, consistent with the Energy Efficiency Directive, Article 7, Paragraph 1, 1b). By way of help, it is based on the average annual final-consumption level of 2016 and 2017 in the Federal Republic of Germany (based on the national energy balance). For the definitive NECP to be submitted by the end of 2019, the provisional values will be updated as soon as possible, according to the requirements stated in the Governance Regulation, Annex II, Item 1 (a).

Long-term renovation strategy, according to Article 2a of the Energy Performance of Buildings Directive

Buildings play a key role in the energy transition. In Germany, final-energy consumption attributable to buildings amounted to 35.3 per cent of total energy consumption in 2015. The largest portion of this was caused by private households, followed by the commercial and tertiary business sectors respectively, and industry. In 2015, final energy consumption in buildings was around 3,069 PJ. Primary energy demand in that year amounted to 3,685 PJ. The foundation for the national long-term strategy for renovation of buildings are the resolutions adopted in the Energy Concept 2010; this was when the Federal Government established for the first time, regarding the year 2050, the goal of a total stock of buildings that is almost climate-neutral. This corresponds to an 80 per cent reduction of non-renewable primary energy demand, taking it to around 880 PJ, as compared to almost 4,400 PJ in the base year, 2008.

Complementary, the Federal Government has put into place a national strategy for buildings by means of the Energy Efficiency Strategy for Buildings of 2015. This strategy highlights how it is possible to attain the goal of an almost climate-neutral stock of buildings in 2050, by a combination of energy efficiency and the use of renewable energies. For the path leading to this savings-objective for 2050, the Energy Efficiency Strategy for Buildings points out a solution corridor considering threshold values for increase in energy efficiency and renewables' shares of energy consumption; from today's perspective and based on today's state of the art, the solution will be put into effect within that corridor. Depending on the scenario, this strategy forecasts a reduction in final energy consumption by about a half,

with renewables accounting for a 60–70 per cent share of the remaining final energy consumption. Related to the year 2030, this means that the non-renewable primary energy demand has to be reduced by 55 per cent, taking it to around 2,000 PJ (cf. 2008: almost 4,400 PJ).

The Climate Action Plan 2050 presents the Federal Government strategy of ‘Environment-friendly building and living at home,’ as part of the chapter on ‘Environment protection with regard to buildings’. The strategy builds upon the Energy Efficiency Strategy for Buildings, and also upon the results of the ‘Alliance for affordable building and living’. It summarises climate-friendly construction, while also examining further issues raised by residential living and by developing residential districts and cities. The CO₂ reduction target for the buildings sector, set for 2030 and adopted by the Federal Government in 2016, also corresponds with the Energy Efficiency Strategy for Buildings. Overall, this strategy shows that the target of having a stock of buildings by 2050 that is almost neutral in its environmental impact is ambitious but attainable, provided that new measures and tools are introduced and implemented successfully (see Chapter 3.2.). The long-term renovation strategy, proposed here with the NECP, is the further implementation of the Energy Efficiency Strategy for Buildings.

Moreover, according to the amended Energy Performance of Buildings Directive (EPBD), Article 2, a range of new targets is established at EU level, and the Federal Government is working on implementing them.

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 Directive 2010/31/EU, Article 2a

Indicative milestones regarding progress indicators from the long-term renovation strategy, according to the EPBD, Article 2a, Paragraph 2

Table A9: Indicative milestones for the long-term renovation strategy*

	2030	2040	2050
GHG emissions, including preceding chains (mn. t of GHG eq.)	152–153	not calculated	55–57
Final-energy consumption (PJ)	2,453–2,757	1,966–2,465	1,597–2,243
Non-renewable primary-energy consumption (PJ)	1,997–2,008	1,299–1,309	827–840
Renewable energies’ share of use (direct use only; final-energy use)	24–32 %	30–43 %	34–50 %

* Trajectory based on Energy Efficiency Strategy for Buildings, direct emissions including preceding chains of activities in the buildings sector, for heating indoor areas, hot water, ambient cooling (residential and non-residential buildings), and also for lighting in non-residential buildings

Total area to be renovated/energy saving to be achieved, according to Article 5, EU Energy Efficiency Directive, Article 5, taking public buildings as the example

The EED (2012/27/EU), Article 5, calls on the Member States to bring central-government buildings into accordance with the energy-performance level set out in national minimum requirements. This requires at least 3 per cent of the stock of buildings not fulfilling the required standard to be renovated accordingly each year. Alternatively, other measures can be taken that result in a comparable amount of energy savings. The GOV’s Article 4, Paragraph 4, provisional final version requires reporting on the total area to be renovated or on the annual energy-savings of equal value also covering the 2021–2030 period. It is an option to calculate these savings to be attained by using the methodology in the BBSR Report II7-01-10-01-2017. A suitable systematic methodology is being developed for monitoring the savings reached.

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 Energy Concept 2010 adopted the decision to lower final-energy consumption in transport (in relation to 2005), by around 10 per cent by the year 2020, and by around 40 per cent by 2050. Additionally, in the Climate Action Plan 2050 the Federal Government decided that the transport system in Germany in 2050 must be almost independent of fossil-based carbon fuels and thereby virtually GHG-neutral.

Heating and cooling

For the buildings sector, the Energy Concept defines the objective of an almost climate-neutral stock of buildings by 2050; this target is carried over to the operational level by means of the Energy Efficiency Strategy on Buildings.

2.3. Dimension energy security

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

Security of energy supply forms part of the energy-transition triangle (see Illustration A1). In qualitative terms the objective means security of supply, that the demand for energy in Germany can be covered at all times, in all activity areas. Quantitative targets are not established to underpin this. However, in principle the objectives described in 2.1. and 2.2. (in addition to the measures in Chapter 3.3.) also have a stabilising effect on security of supply; the reason is that domestically-produced renewable energies and improved energy efficiency will reduce the demand for fuels that are mostly imported (over 70 per cent of Germany's primary energy demand is met by imports) and of limited availability.

As regards overcoming restrictions and interruptions in supply of energy resources, there is a specific framework for this in the European Union, one that is further developed on an ongoing basis. This establishes how the respective Member States must respond in crisis situations. This relates both to an interruption of petroleum supply and also of gas and electricity supply. Key targets for security of supply are defined in the Energy Industry Act (EnWG).

Natural gas

Natural gas remains a substantial part of energy supply to Germany and the EU as a whole. Therefore a major disruption to supply can affect Germany and the other Member States, causing a lot of damage. So resilience in relation to supply crises must be acquired and - where necessary - further strengthened; the aim is to further reduce the probability that supply crises will emerge, and also to guarantee precautionary measures in the event that the supply situation worsens. In Germany it is primarily the task of companies active on the market to guarantee security of supply based on the established network of power lines. All gas-supply firms in Germany have been given clearly established obligations in relation to the community as a whole, for supplying the population and, in particular, protected customers:

- The Energy Industry Act, Articles 1 and 2, give them the task of ensuring that the population gets a gas supply that is as secure, favourably priced, consumer-friendly, efficient, and environment-friendly as is possible.
- The Energy Industry Act, Art. 15, requires the operators of long-distance grids to safeguard the grid's stability. The tools referred to in Art. 16 are available to them for this purpose.
- According to the Energy Industry Act, Art. 53a, the gas-supply companies must supply natural gas even in the event of partial interruption to the natural-gas supply, or in the event of extraordinarily high demand for gas, particularly to that group of 'protected customers', doing so 'as long as it is reasonable, in economic terms, to expect them to supply.'

On this basis it is a matter of principle that the companies, particularly the operators of long-distance grids and gas distribution grids, are set the task of eliminating risks or disruptions by grid-related and market-related measures. To ensure the best possible preparation, and to prevent a disruption of gas supply, or respectively to mitigate its consequences, the relevant public authorities also produce preventive action plans and emergency plans for a particular risk-group, after giving a hearing to those who represent their interests. Such plans are required in Regulation (EU) 2017/1938, Articles 8, 9 and 10, regarding measures that guarantee secure supply of gas (previously: Regulation (EU) No 994/2010, Arts. 4, 5 and 10). These are formulated in a way that makes it possible to overcome national risk, in fully using the advantages of regional cooperation. The plans are of a technical and operational nature, aimed at stopping an emergency from taking place, at preventing it from worsening, or at limiting its consequences, as well as taking into account the security of the electricity systems. Further information on these matters is in Chapter 3.3. on measures and strategies.

Petroleum

German precautionary plans for an oil crisis are integrated both within the European Union and on a supranational basis, within the International Energy Agency (IEA) framework. The EU and the IEA both have targets for German precautionary plans to deal with an oil crisis; these were centrally implemented into national law by means of the Oil Stockpiling Act and the Petroleum Data Act. In Germany these are the legislative foundations for a comprehensive stockpiling of petroleum and petroleum-based products for the purpose of pre-empting a crisis. Germany maintains stocks comprising 90 days' worth of net imports, of crude oil, petroleum, diesel, HEL heating oil, and the fuel JET A-1. The EBV – petroleum stockpiling association and a body established according to public law – safeguards the stockpiling of the fuel in good order. In the event of a supply crisis, the following organisations cooperate, according to established procedures, to release the EBV's stocks: the Federal Ministry for Economic Affairs and Energy, the Federal Office of Economics and Export Control (BAFA), EBV and the KGV – the supply coordination group in which the petroleum industry is represented.

Electricity

Germany has a secure electricity supply; together with Denmark it ranks among the EU countries with the most secure supply system (Council of European Energy Regulators (CEER), 2016). Due to Germany's geographical location, it is crucial to have a stable electricity supply for the whole European internal market.

The balancing of demand and supply, even in times of shortage, and consequently security of electricity supply, is in the first instance guaranteed by the Electricity Market 2.0. Thanks to its integration into the European electricity markets, the cross-border exchange of electricity also contributes to Germany's supply security. In this context, the expectation is that the capacity resources needed are to be refinanced via the market mechanisms. Instead of a capacity market, a capacity reserve additionally secures the Electricity Market 2.0 (see also Chapter 2.4.3.ii).

Beyond this, just like in the gas and oil sectors, in Germany guaranteeing the security of electricity supply is primarily a task for the companies supplying electricity. The companies are subject to the following national requirements:

- According to the Energy Industry Act, Arts. 1 and 2, they have the task of securing for the population an electricity supply that is as secure, favourably-priced, consumer-friendly, efficient and environment-compatible as is possible.
- The Energy Industry Act, Art. 13, determines that the distribution-grid operators have responsibility for the system. For this, they have available to them the grid-related and market-related measures stated in Art. 13 of this Act.
- According to the Energy Industry Act, Art. 14, operators of electricity-distribution grids have the corresponding measures available to them as is the case for transmission-grid operators. As part of this, they must take measures of their own to provide support to the transmission-grid operator, or to an upstream operator of electricity distributor networks, into whose grid they are connected, according to that operator's requirements.

In the electricity sector, as elsewhere, the European requirements for risk-precaution are playing an increasingly important role. On 30 November 2016, in the context of the package of measures called 'Clean Energy for All Europeans', the European Commission submitted a proposal for a Regulation of the European Parliament and the Council on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC, of the European Parliament and the Council. The Regulation improves the Member States' cooperation in precautionary measures for crises, limiting the consequences of electricity-supply crises in the EU, determining procedures for the Member States to provide support to one another, and increasing transparency in the precautions taken to prepare for crises. The trilogue negotiations were successfully concluded on 22 November 2018.

Coal

There is a functioning international market for hard coal. Lignite is an energy resource obtained from within Germany. Also, coal's future role as a fuel for electricity supply is currently being discussed at the national Commission on 'Growth, Structural Change and Employment' (see Chapters 1.2. and 2.4.). This is why Chapter 3.3., on measures to ensure security of supply, does not address the topic of coal as an energy resource.

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

The Federal Government is constantly monitoring in order to ensure there is appropriate diversification of German energy supply. It is continually observing the energy-supply developments, providing monitoring reports on this, issued according to the Energy Business Act, Art. 51. These state that a relatively wide production mix among the energy sources serves as the basis for electricity supply in Germany, thereby to a large degree minimising the risk presented by a supply bottleneck on the part of an individual type of energy. An essential supporting pillar for German gas supply is diversification of supply sources and transport channels. The gas industry is making intensive efforts to expand the natural-gas infrastructure (distribution lines and storage capacity) and to further broaden-out the sourcing of natural gas.

Natural gas/petroleum

There are relatively many import routes available for supplying the German market with natural gas. Likewise, the neighbouring markets can source via a variety of paths. This means that the risk of disruptions to supply is reduced, both for the German market and also for the neighbouring markets. There are cross-border flows of energy resources with all neighbouring countries; in addition, gas supplies from Russia and Norway respectively come via pipelines, without a transit through other countries. Germany commands a sufficiently secured oil pipeline network. The oil supply operates on the basis of market-economy criteria. There is no requirement for the state to regulate matters. The natural-gas and petroleum businesses make sure that the sourcing of natural gas and petroleum is sufficiently diversified and set up precautions to ensure that diversification is maintained.

Coal

Lignite in Germany is extracted entirely within the country itself. Supply can be deemed to be secure. Conversely, imports of hard coal are widely diversified. Due to the liquidity of the world market and the international supply structures, the evaluation is that security of hard coal supply is high.

Electricity

The plan for electricity is to raise the so-called interconnectivity, as the ratio between border-coupling capacity levels and maximum national capacity. The target-value for interconnectivity (as thermic interconnector capacity) is set at 30 per cent for the year 2030. Chapter 2.4. gives further clarification.

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 continually takes care to ensure that there is an appropriate diversification of German energy supply (see 2.3.i. on this).

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 stated in Chapter 2.1.2., the Federal Government is continually pursuing an deployment, both of renewable energies' share of gross final-energy consumption, and of their share in the electricity, heating and cooling, and transport sectors. The national objectives are stated in this chapter.

The integration of renewable energies into the electricity market and the increasing electrification of other sectors demands flexibility on the demand side and the supply side; this is needed to balance out the fluctuating supply coming from wind power and solar power in Europe, and specifically from Germany. 2.4.3.ii. studies this more closely.

2.4. Dimension internal energy market

2.4.1. Electricity interconnectivity

Germany treats it as a key concern to strengthen the European internal market for electricity. The greater the market area for electricity and the greater the liquidity in the trading of electricity, the easier, more precise and more price-favourable it is for the fluctuating feed-in of wind energy and solar energy to be balanced out, throughout Europe. Such a large, high-liquidity European market area is important to bring about a European energy transition cost-efficiently and with security of supply. To master the structural challenge, it is also important to note that, in Europe, the most cost-favourable locations for electricity production and the centres of greatest electricity consumption are geographically far apart in many instances.

To be able to trade electricity at all times among all EU Member States, grid expansion is absolutely needed. This is because only if an actual exchange of electricity takes place, after a transaction on a trade balance, that the Member States can rely on the electricity from their neighbouring countries; in this way they make their respective national energy transitions more efficient by making less production available on a country-internal basis. Grid expansion forms the backbone of the European internal market for electricity by distributing the traded electricity to the Member States. Germany will invest substantially in the national and cross-border grid expansion.

Europe needs the grid expansion and Germany needs it to a particularly high degree. This is because Germany will continue to expand renewable energy sources in the future, thereby contributing significantly to the EU 2030 target. In addition, the German electricity network not only brings about a flow from northern to southern Germany but also, due to Germany's central geographical position, electricity from southern Germany goes to Austria or from Denmark to Italy. The demand to expand the grid presents Germany with particularly demanding challenges and the Federal Government is resolutely tackling them.

2.4.1.i. The 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. Price differential in the wholesale market exceeding an indicative threshold of EUR 2/MWh between Member States, regions or bidding zones.
2. Nominal transmission capacity of interconnectors below 30% of peak load.
3. Nominal transmission capacity of the interconnectors below 30% of installed renewable generation.

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

In principle, the Federal Government supports the expansion of further interconnectors to other Member States, serving the interests of a functioning internal European market for electricity. Due to the great significance that electricity grids have for the European trade in electricity, Germany also supports the EU 2030 objectives for grid expansion.

Two aspects are important in implementing the objectives: firstly, due to the new requirements in the EU Electricity Market Regulation, Arts. 13 and 14, it is crucial to coordinate the national and the European grid expansion. Thus, in future Germany will synchronise the expansion of interconnectors with the expansion of the corresponding national networks. Secondly, regarding the general objectives for interconnectivity requirements, the correct indicator is needed, one that takes into account differences between the Member States, as regards geography and the energy mix. Specifically, this means the following:

Regarding the general objectives behind EU interconnectivity requirements, installed generation capacity must be taken into account (interconnection target of 10 per cent of installed generation capacity by 2020, 15 per cent by 2030). In Germany, because of the additional construction of renewable energy resources, installed generation capacity is growing over-proportionally in relation to the interconnector expansion. Against this background, it is essential to use the three differentiated indicators as the basis for decisions on interconnector expansion, in accordance with the Governance Regulation, Article 4(d)(1)-(3). Through making available the interconnectors already under construction and those planned up to 2020, Germany is striving to adhere to these indicators. This applies particularly to the share of transmission capacity as compared both to the peak load and to the installed power-generation capacity of renewable energies.

2.4.2. Energy transmission infrastructure

Germany is aware of the significance that expansion of the national grid has for the functioning of the European internal electricity market. So the Federal Government is determinedly tackling grid expansion. Up to the year 2030, substantial measures are planned for expanding and reinforcing the German electricity grids, with a scope of approx. 8,700 km. The transmission-grid operators calculate that there will be an investment requirement of approx. EUR 50 billion by 2030. These are investments in the European internal electricity market and in Europe as a business location. Yet such extensive investment plans need sufficient time to be implemented. So, in parallel, the Federal Government is drawing up an action plan to reduce grid bottlenecks, within the framework of the Electricity Market Regulation; this includes measures relating to the grid, power generation, and redispatch (see Section 3.4.3.i.).

The following sections examine the Federal Government's individual plans.

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

2.4.2.ii. Where applicable, main infrastructure projects envisaged, other than Projects of Common Interest

The sub-chapters 2.4.2.i. and 2.4.2.ii. are presented grouped together.

To expand the energy-transmission infrastructure for electricity and gas, the transmission-grid operators are formulating new grid-development plans, in a regular activity cycle; for electricity, this is in accordance with the Energy Industry Act, Art. 12 b.; for gas the long-distance grid operators are doing the same, according to Art. 15 A, Energy Industry Act, Art. 15a. The grid-development plans for electricity and for gas respectively are produced in a multi-stage process; grid operators have a crucial participating role in this, as does the Federal Network Agency (BNetzA), operating as a public monitoring authority.

Infrastructure of energy transmission

Based on the grid development plans for around 7,700 km of power lines in total, the Federal Government has determined the priority-demand projects, backed up by legislation (see below); these include around 1,000 km of interconnectors. In addition, the current grid development plan of 2017 endorsed a further 15 grid-expansion projects for electricity (total length of approx. 1,000 km); of these, there are 10 three-phase AC projects solely within Germany, as well as 5 interconnectors with a total length of around 250 km. Confirmation is also given to 9 'ad-hoc measures' that are to be installed by 2023 and that serve the purpose of optimising the existing electricity network in the short term.

Legislative approval was already given in 2009, in the Power Grid Expansion Act, to interconnectors with a total length of 1,800 km. The Federal Demand Planning Act passed legislation, based on previous grid-development plans, approving interconnectors with a total length of 5,900 km. After the second quarter of 2018, current status on the projects set up pursuant to these two Acts is as follows:

- The Federal Demand Planning Act's expansion objectives: total length – approx. 5,900 km; currently approved: 600 km (around 10 per cent; 150 km (around 3 per cent) implemented. 16 of the 43 projects are designated as transnational or cross-border. Of the 43 projects pursuant to the Federal Demand Planning Act, 9 are PCI projects (nos. 2, 3, 4, 5, 8, 29, 30, 32, 33).
- Expansion objectives of the Power Grid Expansion Act: total length – approx. 1,800 km; currently 1,150 km approved (around 64 per cent of the total length); 800 km (around 45 per cent) are implemented. Project No. 1, set up according to the Power Grid Expansion Act, is likewise a PCI project.

Against this background, the 2018 coalition agreement provides for intensified efforts to expand the electricity grids. Germany is drawing up an ambition plan of measures, the Electricity Grid Action Plan. On the one hand, this includes measures to accelerate the grid expansion and, on the other, measures to improve use of capacity and optimisation of the existing grid. The Grid Expansion Acceleration Act (NABEG) is to be amended and simplified. In order for all grid-expansion projects originating from the grid expansion plan to be put into effect on time, it is highly important to have regular, transparent and realistic monitoring. So the monitoring review, published quarterly by the Federal Network Agency, is continually being developed and supplemented by a forward-looking controlling process.

Long-distance gas-interconnector infrastructure

For the gas sector, the grid development plan for gas determines the expansion and restructuring of the long-distance gas-interconnector grid, according to the Energy Industry Act, Art. 15 a. This plan is produced in each even-numbered calendar year by the operators of the long-distance interconnector grids. The grid development plan for Gas 2016–2026 entails 113 measures and additional interconnector construction of approx. 848 km.

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

The sub-chapters 2.4.3.i., 2.4.3.ii. and 2.4.3.iii. are presented grouped together.

A large, high-liquidity market area for an efficient balancing-out of production and consumption

To guarantee that electricity generation is secure and cost-favourable, and simultaneously to integrate increasing shares of renewable energies into the electricity system, Germany has opted in favour of the energy-only market and the uniform German bidding zone. The large market area makes it possible to use geographical balancing-out effects in terms of production and consumption. The electricity market's high liquidity helps in bringing supply and demand together flexibly and efficiently, also amid fluctuating electricity generation from renewable energy. That liquidity also reduces the power of major suppliers via the market outcome, enabling innovative players to enter the market. Uniform wholesale prices make sure that it is the most cost-favourable generation technologies that prevail in the electricity mix, independently of the location. The installations with the lowest cost of use of resources will be used on a cross-regional basis. This reduces the variable costs of the overall system. The uniform German bidding zone and a large European market area for electricity reduce the overall demand for generation capacity, load management and storage capacity. This also lowers the overall system's investments costs and maintenance costs.

The Federal Government is convinced that the best way for securing cost-efficient electricity supply is the European internal market for electricity and thus the expansion of electricity grids. By contrast, creation of local price signals generates the risk that there is a blurring of the price signal that merit-based orders send; this ensures that, throughout Germany, the cost-efficient power plants initially produce electricity. Yet from the Federal Government's viewpoint, expansion of the electricity grids, flanked by other measures, can bring about the reduction of grid bottlenecks; such measures include decentralised construction of power plants.

The uniform German bidding zone and a large European market area for electricity reduce the overall demand for generation capacity, load management and storage capacity. Yet the trade in electricity between the various European states is becoming ever more important: cross-regional synergies in power generation and consumption can be used to make the electricity system even more flexible. European capacity resources can thus jointly guarantee supply security. Both factors lower the total costs of electricity generation in Europe as a whole.

Coupling the electricity, heating and transport sectors (sector coupling)

Sector-coupling, i.e. the efficient use of electricity from renewable energies, is to be further advanced in order to further decarbonise the heating and transport sectors. Thus, through sector coupling, electricity from renewable energies will play an increasing role in the buildings, transport and industry sectors, as elsewhere. So the framework conditions are to be improved for sector-coupling, consistent with a level-playing-field for various fuel technologies in these sectors.

Step-by-step reduction and phasing out of coal-based electricity production

The Energy Concept maps out the path for modernising energy supply in Germany: as stated in Chapter 2.1., the objective is to reduce GHG emissions by 80–95 per cent by 2050, compared to 1990 (virtual greenhouse-gas neutrality); it is also the objective that renewable energies' share of electricity consumption is raised to at least 80 per cent. The use of fossil fuels in power-plants is to be much reduced, so that in 2050 electricity can be generated on an almost fully decarbonised basis. Step-by-step reduction and phasing out of coal-based electricity will make an important contribution to this. The Federal Government set up a commission on this matter: the latter has to draw up an action programme enabling the German climate targets to be reached in the energy sector, coal-based electricity production to be reduced step-by-step, and the economy to be steered through this structural adjustment (Commission on 'Growth, Structural Change, and Employment', see Chapters 3.1.1. and 3.4.3.).

More strongly coupling the electricity markets

The strengthened coupling of the German electricity market with the neighbouring markets is a crucial step towards making Energy Union and European market integration into reality. In this, the European target model is a harmonised method for capacity calculation, used in day-ahead and intra-day trading; the method has guidelines for making capacity available and for bottleneck management.

Reducing grid bottlenecks

At EU level the proposals from the European Parliament and the Council regarding the Electricity Market Regulation make provision for the Member States to reduce their internal structural bottlenecks. The demand for electricity for transport in the German power-transmission grid will continue to rise, at least until completion of the large high-voltage direct-current transmission lines, and more and more bottlenecks will emerge on the grid. A reason for this is that production and consumption are becoming increasingly separated in geographical terms. A large portion of the load centres is located in Germany's south and west, whereas new wind-power facilities are mostly emerging in Germany's north and east. At the same time, as part of ending the use of nuclear power, power stations in southern Germany are being retired. Due to its geographical location between the Scandinavian electricity markets, with comparatively low prices, and the western and southern European countries respectively, with relatively high electricity prices, Germany is also a hub in the international trading of electricity: Driven by the market, Germany frequently exports to its southern neighbouring countries.

Thanks to the planned EU stipulations on opening-up the interconnectors (Electricity Market Regulation, Art. 14), the cross-border trade in electricity, and thus the demand for transport, is increased – in the future, internal grid bottlenecks and circular flows can be taken into account only to a very limited degree when awarding capacity on cross-border interconnectors. In this regard, the provisions make possible a step-by-step opening of interconnectors, rising to a specified level by the end of 2025. Therefore, grid bottlenecks and the redispatch quantities associated with them should be limited to a tolerable amount and the capacity usage within the grid networks should be increased (see Electricity Grid Action Plan – Section 3.4.2.i.).

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

Ensuring adequacy

It is Germany's objective to maintain the functional capability of the Electricity Market 2.0 and to guarantee security of supply on a joint basis. In Germany the Electricity Market 2.0 safeguards security of supply. In the electricity market 2.0 the capacity resources needed can be financed via the market mechanisms. In this context the issue is not only price peaks but also long-term price signals that an intact Electricity Market 2.0 sends. In the Electricity Market 2.0,

the refinancing of power-plants, flexible demand and further dimensions of flexibility function subject to two pre-conditions. Firstly, the electricity prices must continue to be freely determined by the market; secondly, electricity suppliers must have strong incentives to fulfil their supply obligations and be subjected to financial penalties if they fail to do so. The Electricity Market 2.0 is more cost-favourable than an electricity supply-system with an additional capacity market, because the latter creates over-capacities that are not needed. In addition, competition means that the solutions that prevail are the most cost-favourable ones for integrating renewable energies. A capacity reserve gives the Electricity Market 2.0 security. In contrast to the capacity market, the capacity reserve encompasses only power stations that do not participate in the electricity market and that do not distort competition and price formation. Monitoring activities directed at security of supply provide additional security.

European capacity resources jointly safeguard security of supply. In a large, high-liquidity European market area, synergies can be used between different locations that have different production conditions. This makes it possible to react efficiently to fluctuations in power generation and consumption; the total costs of electricity production and the demand for capacities are reduced. The precondition for this, firstly, is that security of supply is considered on a European basis, no longer solely a national one; secondly, that sufficient capacity resources are available in the shared internal market, even in times of scarcity, and thirdly that the electricity can indeed be transmitted across borders.

Safeguarding flexibility

The integration of renewable energies into the electricity market and the increasing electrification of other sectors demands flexibility on the demand side and the supply side; this is needed to balance out the fluctuating supply coming from wind power and solar power in Europe, and specifically from Germany. The Federal Government is aiming at a flexible electricity system, consisting of well-expanded electricity grids, and also at flexible power stations and consumers. In addition, storage installations should play a role, where using them makes sense. The requirement that the electricity market becomes more flexible has become even more urgent, against the background that the EU 2030 target for renewable energies' market share has been raised to at least 32 per cent. This means that, by 2030, renewable energies' share in the EU's electricity sector must rise to almost 50 per cent.

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

In Germany, competition is high among the suppliers in the retail energy sector. The aim is to maintain the very intensive competition on the market for retail electricity and gas customers. The basis for this is competition-based price formation and market liberalisation. To the degree that it appears appropriate to do so, the Federal Government is systematically further developing the legislative framework in order to protect private household customers. For instance, consumer protection is to be further strengthened by increasing transparency, in implementing the EU Internal Electricity Market Directive, currently still being coordinated.

Section 3.4.3.iv. includes further details on protection of energy consumers and also competitiveness in the retail market.

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

It is important for Germany that energy remains affordable even in the process of effecting the energy transition. That is why the Federal Government is aiming to ensure affordability for everyone in society. Energy savings can make an important contribution to this. Not least, affordability is an element in Germany's energy-transition triangle of objectives (see Chapter 1.1.), one to which the present government's coalition agreement makes explicit reference.

The Federal Government does not use the term 'energy poverty' as a stand-alone term. Instead, as it combats poverty, it pursues a comprehensive approach in public law, one that does not concentrate on individual elements of demand, such as energy. If financial support is necessary to secure a person's livelihood, payments are made by systems that safeguard a minimum standard of living, in accordance with the second and twelfth Code of Social Law (Basic Income Support for Job-Seekers (SGB II) and Social Assistance (SGB XII)). Among other things, the so-called standard needs also covers the costs for general household electricity. As regards needs for accommodation and heating, outgoings for heating-energy are taken into account, taking as the basis the appropriate amount actually spent. Beyond this, energy debts can usually also be taken over but as a loan.

2.5. Dimension research, innovation and competitiveness

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, development and the demonstration of innovative energy technologies – reinforced by commitment of private business resources – are also dependent on public funding support for research. Public funding support of research is aimed at assisting research establishments' and higher-education institutions' technological developments and innovation activities in business, also driving their cooperation forward. Such projects range from basic research, via applied research, through to transfer of technology or innovation into the market. As a core element in energy policy, publicly-supported energy research takes as its orientation the Federal Government's political goals and addresses the energy transition's major challenges. A key research-policy framework in provision of support to energy research in Germany is an Energy Research Programme by the Federal Government; this is set up across subject-area disciplines, as a leading programme spanning several years, to coordinate the support activities of the various ministries involved. The 7th Energy Research Programme of the Federal Government was adopted in September 2018. It pursues the following goals:

- **Expediting the energy transition:** The key aim of funding research is to develop innovative, integral solutions to meet the challenges of the energy transition and launch them onto the market quickly. This will be supported with a broad funding approach along the entire energy chain with a special focus on results transfer. In addition to technological aspects, close attention will also be paid to non-technological factors in the energy transition, such as social processes or an enabling environment for innovation and their interaction. Particular priority will be attached to innovative technologies and concepts that can contribute to making substantial advances in raising efficiency and integrating renewable energies in demand sectors, while also attaching importance to the complex tasks in the heating sector (space heating and process heat).
- **Strengthening industrial locations:** Funding energy research makes major contributions to modernising the German and European economies and securing them as a location for industry. The concern is to take up new trends, such as digitisation, where appropriate, maintain and upgrade technological competencies in the energy sector and also improve export opportunities for innovative energy technologies. This is why research funding will also be directed at technologies for the world markets, especially in developing and newly industrialised countries. Mobilising innovation potential in small and medium-sized enterprises and young businesses will also play a special role.
- **Managing societal risks:** With its technology-neutral programmatic approach, energy research contributes to developing a broad range of technological options for the energy transition and making them available for practical application. This affords the requisite scope to be able to respond to currently unforeseeable developments in future. As climate and environmental impacts are not confined to national borders, high-efficiency renewable energy technologies and system solutions must also be developed with a view to contributing to solving problems worldwide. These long-term, overarching aims go beyond commercial perspectives and timeframes, which is why government engagement is necessary in the strategically important energy sector to pave the way for innovative technologies, from development to testing to market penetration and social acceptance. Known 'market deficits' need to be offset when it comes to specific problems, such as the prolonged time horizons for technological innovations or the associated high economic and technological risks

The Federal Government's support to research addresses a wide spectrum of sustainable energy technologies, adopting a technology-neutral approach in terms of the technology used. In subject-matter terms, the 7th Energy Research Programme also reflects the core priorities and special priorities stated in the European Strategic Energy Technology (SET) plan, or respectively in the Energy Union; these are also relevant for Germany.

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-intensive and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

CO₂ emissions are one of the primary drivers of anthropogenic climate change. In Germany, CO₂ emissions primarily arise in the context of the use of fossil energy sources such as coal, oil and gas. The reduction of energy-related CO₂ emissions is therefore a key energy policy objective. Energy research addresses this goal by increasing energy efficiency, integrating renewable energy into the energy system and developing alternative industrial processes that generate lower greenhouse gas emissions, or no emissions.

In the area of industrial processes, two mutually complementary strategies are pursued. On the one hand, an increase in energy efficiency thanks to the lower use of energy leads to a sustainable reduction in energy-related CO₂ emissions in the industrial sector (see Section 4.1.2). At the same time, technologies for closing the carbon cycle are being developed for certain industrial processes for which the formation of CO₂ is difficult or impossible to avoid. For example, CO₂ can be used in the chemical industry as the starting point for base materials (conversion to polymers, basic chemicals, etc.). It can also be used to produce liquid fuels and combustibles in the context of sector coupling (see Section 4.3.3). Closing the carbon cycle requires technologies for separating CO₂ from waste gases or the atmosphere. This can be achieved biologically (plant growth) or by using technical methods. CO₂ technologies for separating, transporting, storing and using CO₂ require more intensive research so that domestic companies and research institutions can assume a pioneering role in them, including for exporting the relevant technologies.

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

According to the September 2017 industry-policy statement, the EU is striving to attain an EU-wide industrial share in total economic output that comprises 20 per cent (current level in Germany: 23 per cent). Against this background, a successful energy transition must be structured in a way that safeguards the industrial base, because the latter contributes so importantly to growth and job retention. In the energy transition, three aspects are essential for energy-intensive industry as matters of principle – namely cost development, maintenance of security of supply, and reliable framework conditions. Extra energy and emissions-trading costs, especially for companies that operate globally, can lead to competitive disadvantages. The challenge is to maintain planning and investment security for the firms in Europe, and for them to remain internationally competitive, in order to prevent the relocation of production and jobs abroad, due to what is called ‘carbon leakage’.

For this, it is decisively important to have innovative energy technologies that harmonise climate protection and industry-policy objectives with one another. In mastering the economic consequences of climate change, and of increased efficiency of energy and resources, it is notably industry that takes on a role of outstanding significance. Industrial processes alone account for around 7 per cent of Germany’s greenhouse-gas emissions. Added to this is industry’s demand for energy, with the resulting emissions.

Simultaneously, the switch to a reduced-CO₂ business model offers opportunities for growth and employment, as well as potential for industrial production or to build up technological chains of supply. Germany’s industry, particularly its mechanical engineering and plant engineering, measurement, control and regulation technology, as well as electrical engineering, occupies top positions internationally in the export of potential assets for protecting the environment and climate. Thus Germany can, on the one hand, particularly benefit from this development; on the other, through its expertise it can also make an important contribution to overcoming these challenges.

Research, industry, investors and public authorities cooperate closely to use the opportunities emerging; this is about targeted innovation processes for energy-efficient, climate-friendly solutions in all leading markets and key technologies relevant to Germany. For instance, this involves exhausting the potential on offer regarding sector-coupling, storage and efficiency technologies, in plant engineering, in microelectronics, and in basic-materials industries. Such a research and industry policy means that first-mover advantages are to be expected domestically and on international markets, with a positive impact on competitiveness and employment.

3. Policies and measures

3.1. Dimension decarbonisation

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 Point 2.1.1., and policies and measures to comply with Regulation (EU) 2018/841, covering all key emitting sectors, and also sectors for the enhancement of removals, with an outlook to the long-term vision and objective to become a low emission economy, and achieving a balance between emissions and removals, in accordance with the Paris Agreement

Programme of measures to implement the Climate Action Plan 2050

The Federal Government is drawing up a programme of measures to implement the Climate Action Plan 2050, aimed at attaining both the overall climate-protection target for the year 2030 and the respective sectoral targets of the climate-protection plan. The measures contained in the plans are to ensure Germany's conformity with the European obligations on climate protection. Taking 1990 as base year, what these targets mean for the energy sector is a reduction to 175–183 m. t of CO₂ (equal to a reduction of 61–62 per cent); for the buildings sector, a reduction to 70–72 m. t CO₂ (equating to a 66–67 per cent reduction); for the transport sector, to 95–98 m. t CO₂ (equalling a 40–42 per cent reduction); for the industry sector, to 140–143 m. t of CO₂ (equating to a 49–51 per cent reduction); for agriculture, to 58–61 m. t of CO₂ (this is a reduction of 31–34 per cent), and for the LULUCF sector to be maintained on a lasting basis as a net carbon sink. Among other aspects, this programme of measures is to include activities to reduce the energy sector's GHG emissions. For this, the Commission on 'Growth, Structural Change and Employment' is drawing up proposals for a step-by-step reduction and phasing out of coal-fired electricity (see also Chapter 3.4.3.i).

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

European Climate Action Initiative

To intensify cross-border cooperation and the exchange of experience gained in the realm of greenhouse-gas reduction at the non-state level, the Federal Ministry of the Environment created the 'European Climate Initiative' in 2017. Backing is given to projects that foster the exchange of good practices among players below state level, in civil society and the business and science communities. Also in other respects, the Federal Government engages in regular exchange with other Member States. There are firmly established bilateral formats for this, involving numerous EU Member States.

Meseberg Working Group on Climate

In the Meseberg Declaration of 19 June 2018, Germany and France agreed to establish a cross-departmental, high-ranking working group on climate issues. This Working Group on Climate renders support to implementation of the Paris Climate Protection Agreement. This includes development of joint views on the energy transition and on instruments to use to provide sustainable financing, as well as on economic incentives; aspects of CO₂ pricing form part of this. The Working Group on Climate's constituent meeting took place in Paris on 06 September 2018. The Working Group will report on its work at the next Franco-German Council of Ministers. The plan is for it to convene at least once per year, led by the state secretaries with subject-area authority on 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 activity area at national level, where applicable

National Climate Action Initiative (NKI)

Since 2008 the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety uses the NKI to initiate and render support to numerous projects that contribute to the lowering of greenhouse-gas emissions. Their programmes and projects cover a wide spectrum of climate-protection activities. In developing long-term strategies, in supporting professional climate-protection management, and in investment-based support measures, the NKI contributes to reinforcement of climate protection right at the heart of activities. Its main target groups are the municipalities, businesses and consumers, in addition to schools and other educational institutions. Around EUR 150 million was disbursed in the year 2017.

3.1.2. Renewable energy

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 described in point 2.1.2., including sectoral and technology-specific measures

Electricity

Renewable Energy Sources Act

Since the year 2000, the Renewable Energy Sources Act (EEG) has been the central instrument of control for expanding the use of renewable energies in Germany. Its aim is to raise renewable energies' share of electricity supply to at least 80 per cent by the year 2050. This makes it the central foundation for reaching this target in the electricity sector. With the EEG 2014, the Federal Government already introduced obligatory direct marketing. Installation operators must themselves sell their electricity on the market; for this they receive a so-called sliding market premium from the grid operators.¹ The market premium balances out the difference between the fixed remuneration for the feed-in of power into the market and the monthly average of the price of electricity on the energy exchange.² This way, the support provided is reduced as soon as the electricity prices rise. Taking the monthly average as the reference value, the installation operators have an increased incentive to react to the electricity price.

Whereas the first years saw this Act's emphasis placed on raising renewable energy's volume in the electricity mix, since 2014 there has been significant progress made in reducing the cost of power generation. In the case of photovoltaic open-area installations, these costs were cut from 9 ct/kWh in 2015 to 4 ct/kWh in 2018 (in 2005 the power-generation costs for PV open-area installations were much higher still, at around 40 ct/kWh).

At the same time, conversion to the market premium was accompanied by market integration of renewable energies. The Renewable Energy Sources Act 2017 has resulted in the funding-support now being mostly determined by competition factors, because the remuneration amount is determined via tenders. What is offered in tenders is the respective quantity of product to be remunerated, for onshore and offshore wind energy, photovoltaics and biomass. Small installations are excluded. This means that the further deployment of renewable energies is taking place at prices determined by competition.

For technologies for which there are tenders, the Renewable Energy Sources Act 2017 determines deployment quantities and dates, or respectively quantities and dates for the tender, also stipulating the conditions that apply. The tenders are conducted at various intervals by the Federal Network Agency. It is to be assumed that many projects will not be put into operation until the implementation period ends. Comprehensive monitoring is set up for this activity.

Per technology, the quantities for tender up to 2030, as established in the Renewable Energy Sources Act 2017, are as follows:

- For onshore wind, starting in 2017, calls for tender are being conducted for 2,800 MW each year for three years; from 2020 the figure is 2,900 MW each year; the Omnibus Energy Act provides for special tenders, relating to an additional 4 GW, spanning the period 2019–2021.
- For offshore wind facilities, in all, 3,100 MW are put up for tender for the period 2021–2025 (for 2021 and 2022, the plan is to add an additional 500 MW annually; 700 MW are to be added annually between 2023 and 2025); this is in addition to an annual average of 840 MW in the period 2026–2030.
- For photovoltaic installations from a size of 750 kW, each year 600 MW are to be made available for tender. In total, an deployment corridor of 2,500 MW per year is the goal for photovoltaics; the Omnibus Energy Act provides for special calls for tender that involves an additional 4 GW, spread over the years 2019–2021.

1 Exceptions apply to small installations, below 100 kW.

2 For older installations and small new installations, the market premium is optional. Instead of this, those eligible can continue to claim a fixed remuneration.

- For biomass installations, a quantity of 150 MW per year is the subject of tenders, applying to the period 2017–2019; for 2020–2022 the respective annual figure is 200 MW.

Alongside the adaptation of the funding-support system, a key instrument for market integration of renewable energies is that of making the electricity market flexible (see Chapter 3.4.3.). Regarding further questions with regard to increasing levels of acceptance, a working group will submit its results in March 2019.

Better synchronising the deployment of renewable energies with the electricity grid expansion

In the Renewable Energy Sources Act's current phase, emphasis is on getting renewable energies integrated into the grid and the system. So, because the Federal Government represents a large EU Member State in the centre of Europe, a main task it has is to expand the grid network and also to modernise and optimise the grid's current stock of power-generation resources. Likewise, optimisations or respectively further-development measures for the management of grid operations, including redispatch, come into consideration. At its core, this is a European challenge: A precondition for generating electricity at the most price-favourable locations is an adequate arrangement for transporting the electricity to the centres consuming that electricity. Because Germany developed renewable energies at an early stage, this challenge is especially evident in Germany. To better harmonise renewable energies' deployment in the electricity sector with the grid expansion, what is to take place, alongside grid-related measures, is also a direct control of renewable energies' deployment. This includes quantity control in relation to the grid-expansion area for onshore wind, and also the time-related control of quantities regarding the North Sea and the Baltic Sea in the context of offshore wind. The reference yield model exercises an indirect control in the case of onshore wind.

Monitoring the regional control of renewable energies in the electricity sector

In particular, regional control has ramifications for the deployment plans and targets that individual German Länder (states) have for renewables, and also for grid-development planning and for acceptance of renewable energies' deployment; the topic is thus of much political relevance. The control system thus contributes to better synchronisation of renewables' deployment with the electricity grid's expansion. The possibilities for shaping a regional control arrangement in expanding renewable energies are very flexible. For large power stations the flexibility lies in the power-generation itself. Yet there is scope to manage the renewable energies' power generation capacity, in terms of the physical location, over the short to medium term; this is the case due both to the accepted need to ease the burden on the grid and also to the relevant political framework conditions. In recent years the proportion that additional construction has accounted for in southern Germany has been at around 25 per cent of additional construction in Germany. In the first round of tenders in 2017, only around 10 per cent of the wind projects were given the go-ahead in southern Germany. Stronger regional management could at least result in additional construction's 25-per-cent share in southern Germany (around 750 MW) also being reached in tenders. Beyond this, a regional management arrangement, with a lower level of installed wind capacity in the north, would lead to reduced curtailments because of a reduced requirement to transport energy to the south. It was against this background that it was decided, in the 2018 coalition agreement, to introduce management of the deployment of renewable energies – a minimum renewables' share is established, across all types of power generation, for the tenders with regard to installations located south of the grid bottleneck. It is also planned to review possible introduction of a 'South Bonus', one that can be awarded in tendering processes, with the goal of advancing regional management.

Pilot-project: technology-neutral and also innovation-specific tenders

In the context of the approval procedure for the Renewable Energy Sources Act 2017, regarding the law on state financial aid, the Federal Government has consented to test out tenders that cut across technological boundaries, in a pilot project for the period 2018–2020. By launching tenders both for photovoltaics and for onshore wind-power installations, the technologies compete with one another. The Regulation on Joint Tenders for Onshore Wind-Energy Installations and Solar-Power Installations (GemAV) has been in force since August 2017. Initially, for the years 2018–2020, this regulation initially puts 400 MW per year up for tender on a technology-neutral basis, for onshore wind and large photovoltaic installations. The results are evaluated with an open-ended outcome, also in comparison with the tendering processes specific to a given technology. Within the framework of the so-called Omnibus Energy Act (Federal Government draft legislation of 05 November 2018), innovation-based tendering processes are to be used to test out new price-structuring mechanisms and tendering procedures. The objective is that this leads to more competition, and to the grid and the system better serving their purpose. Thus the authorisation to issue a regulation for innovation-based tenders is adapted in the Renewable Energy Sources Act 2017. As part of the innovation-based tenders, 250 Megawatt (MW) are now to be put up for tender in 2019, 400 MW in 2020, and 500 MW in 2021. These quantities will be deducted from the regular tendering quantities for onshore wind-energy facilities and solar installations.

Special tendering processes for onshore wind and solar installations

As the current Federal Government's coalition agreement states, it is planning special tendering processes regarding renewable energies, to help reach the 2020 climate target and to reduce the CO₂ emissions. It is planned to build an additional 4 Gigawatt of offshore wind energy and of photovoltaics each respectively, with offshore wind energy also contributing (an unspecified amount). This is to help in reaching the national climate targets and the binding deployment targets for renewable energies, in accordance with the Renewable Energies Directive. These special tendering processes are to take place in the context of an amendment to the Renewable Energy Sources Act 2017. In total, 4 Gigawatt of onshore wind and of solar respectively are to be additionally put up for tender. To increase competition, the amounts involved in the tendering processes for solar and onshore wind installations respectively are to rise from 1 Gigawatt respectively for each category in 2019, to 1.4 Gigawatt for each in 2020, and then 1.6 Gigawatt per category in 2021. The special tendering processes form part of the so-called Energy Accumulation Act (Federal Government draft legislation of 05 November 2018).

Offshore Wind Energy Act

Simultaneously with the Renewable Energy Sources Act 2017, the Offshore Wind Energy Act entered into force on 01 January 2017. This legislation additionally determined that the amount of generated power to be sourced from offshore wind installations is also to be determined in competitive tender processes. The Offshore Wind Energy Act also introduces a better, more cost-efficient way to dovetail area and spatial planning, the approval of installations, the amount of support from the Renewable Energy Sources Act, and the connection to the grid. For 2021–2025 the Offshore Wind Energy Act provides for a quantity control on additional constructions, taking it to a maximum of 3,100 MW. The sharing out of this additional construction between the North Sea and the Baltic Sea is managed by means of a minimum quantity for the Baltic (500 MW); the time-related management of the remaining quantities is a result of the distribution of the offshore interconnectors in the offshore grid development plan. What is envisaged in principle is a deployment of 500 MW each year for 2021 und 2022, whereby the additional build in 2021 will take place only in the Baltic Sea, and an annual deployment of 700 MW in the period 2023–2025. From 2026 onwards, the area development plan will take over the management of the additional construction between the North Sea and the Baltic Sea, in terms of time and place; this will be done in the context of the tendering processes, so that these capacity resources form part of the central model. In 2019, for the first time, the Federal Maritime and Hydrographic Agency will produce the area development plan. It is the stated objective to raise renewable energies' share of gross electricity consumption to around 65 per cent by 2030, keeping in mind the challenges presented by better synchronisation of renewable energies and grid capacities. In this connection, adaptation of the Offshore Wind Energy Act will, among other things, be a topic of discussion in a newly-created working group. The group has the task of producing proposals to raise acceptance levels for the deployment of wind-power installations.

Heating and cooling

For buildings, the measures for putting into effect the Energy Efficiency Strategy for Buildings are presented in the long-term renovation strategy (see heating-related and cooling-related measures in the buildings sector in Chapter 3.2. on energy efficiency). Simultaneously, many of these measures also contribute to attainment of the targets in the 'Renewable Energies' dimension, especially the energy-conservation legislation for buildings and the Renewable Energies Heat Act.

Transport

For strategies and measures to adopt regarding low-emission mobility, refer to Chapter 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 Point 2.1.2

A further driver of renewable energies' market integration is the strengthening of regional cooperation with other Member States. The Federal Government is placing emphasis on this in the years to come.

Opening of tendering processes in the electricity sector

Consistent with the endorsement of the Renewable Energy Sources Act, in accordance with the law on state aid, from 2017 onwards the Federal Government must open tenders for electricity from renewable energies, comprising 5 per cent of the output to be newly installed annually, for installations located in other EU Member States. This opening up is aimed at strengthening regional cooperation that is to contribute to a joint understanding of market integration and the promotion of renewable energies; the desired result is greater convergence of the national systems for sourcing energy. Preconditions for cross-border tenders are the principle of reciprocity, a cooperation agreement with the partner country, and that the partner country physically imports the electricity generated. Cross-border tendering processes can be implemented both through reciprocally-opened tendering processes and also through tendering processes conducted jointly with one or more partner country. The Cross-Border Renewable Energy Regulation already provides a legal foundation for cross-border tenders regarding onshore wind and photovoltaics. Experience of implementation has also already been gained: a pilot cooperation was set up with the Kingdom of Denmark in 2016, with reciprocally-opened tendering for photovoltaic open-area installations. In this open tendering process, only photovoltaic open-area installations in Denmark have been given the project go-ahead. In addition, the Federal Government is actively committing itself to gaining partners for further cooperation; in particular, it is currently holding discussions with Luxembourg and France. It also plans to draw up a 'shop-window concept', based on all the experience gained; the aim is to raise the transparency of the cross-border tendering processes for stakeholders in other Member States. This concept is intended to serve as an offer for other Member States' governments and companies to take part in the Federal Government's cross-border tendering, and to make clear which conditions of tender would apply in the event of a cooperation.

Baltic Energy Market Interconnection Plan (BEMIP) – Working Group on Renewable Energy

The BEMIP Working Group on Renewable Energy presents a platform for the Member States involved to exchange experience gained in the deployment of renewable energies, particularly with regard to planning and promoting those energies' further deployment. Beyond this, the group's objective is to build up a joint vision, among the EU Member States flanking the Baltic Sea, for the development of renewable energies, particularly regarding offshore wind energy, and to identify potential cooperation projects. Germany actively supports this initiative; it commits its efforts to the exchange of inputs within this working-group framework, between the EU Member States flanking the Baltic Sea, regarding the relevant parts of their National Climate and Energy Plans (NECPs). As part of this, opportunities should be used to gain synergy effects with the North Sea Energy Cooperation (see below). For instance, potential for cooperation in the Baltic area exists in joint use of electricity infrastructure, for deployment of offshore wind energy.

North Seas Energy Cooperation on renewable energy

This cooperation's points of emphasis are cooperation on expanding offshore wind energy, on expanding grid infrastructure and on area planning in the North Sea. Within this initiative the relevant Member States, including the Federal Republic of Germany, have also begun exchanging experience and insights on the relevant parts of the North Sea countries' NECPs. In the North Sea cooperation, emphasis is on coordination of objectives and deployment strategies, including the individual dates for tenders on offshore projects; other key areas are the exchange of experience and insights as part of the deployment of offshore wind-power (support systems, area planning and grid planning). In this way, as part of the NECP cooperation, the aim is to create aggregated deployment planning for offshore wind energy in the North Sea area, with a project pipeline that is continuous and coordinated, as far as is possible. Beyond this, in the context of North Sea Energy Cooperation, the relevant Member States, including the Federal Republic of Germany, are also working on concepts for possible joint offshore wind-energy projects, or respectively on so-called hybrid projects. On these, the offshore wind installations' grid connection can be used simultaneously both as an interconnector and also to draw off the electricity generated. The Federal Government is actively taking part in the North Sea cooperation (including through its leading role in Working Group 3 on promotion and financing of offshore wind energy). The Federal Government views the North Seas Energy Cooperation as a great opportunity, also for further integrating the (EU's) internal energy market; it will continue to commit itself to an intensified exchange of best-practice, to better coordination on energy use in the North Sea, and also to the preparation and conception of specific joint projects. The Federal Government supports a continuation of this initiative beyond 2019.

TARES project in Greece

Since 2013 there has been a strategic partnership between the Federal Republic of Germany and Greece, on renewable energies and energy efficiency. As part of the European Commission's Structural Reform Support Service (SRSS), the Federal Government is financing the provision of technical support in Greece, as that country reforms its renewables sector and optimises its energy-efficiency measures (TARES and TARES+ project). This assistance is provided in the form of consultancy services by the company GIZ, directly on the spot in Berlin and Athens. Points of emphasis in the consultancy are these: support provided to reform measures for further deployment of renewable energies and energy efficiency; attainment of Greece's national targets up to 2020; and the necessary adjustments to the Greek electricity market, to accommodate increasing shares of renewable energies. The project also renders support to the exchange of experience and insights between the Federal Republic of Germany and Greece in producing their respective National Climate and Energy Plans (NECPs) for 2030. The technical implementation also provides for development and implementation of specific pilot projects on renewables, for instances on public buildings or on a Greek island. The objective is to use specific examples to highlight the feasibility and the cost-efficiency of projects in Greece, using a high proportion of renewables.

Concerted Action on Renewable Energies

The forum called 'Concerted Action for Renewable Energies' (CA-RES) was founded in 2010; its goal is to enable experts from the Member States to engage in an informal exchange of their experience gained as they put the Renewable Energies Directive into effect. From the outset, Germany has embraced an active role in the forum, by taking on the leadership of certain topic-specific sub-groups. In the context of the current CA-RES phase since 2016, Germany is managing the 'Core Theme 1 RES Electricity', adopting responsibility for the preparation and subsequent follow-up of the plenary meetings, in terms of content, as well as organising and taking care of task forces between the plenary meetings. In this role Germany is emphasising improvement of coordination of the national energy policies on renewable energies. Thus, at Germany's initiative, the April 2018 plenary meeting in Warsaw included a session regarding exchange of experience gained on NECPs; several Member States, including Germany, presented the broad outline of the 'Renewables' chapter in their respective NECPs.

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

Electricity

Surcharge system in the Renewable Energy Sources Act

In Germany, access to the capital market is very good, also through the risk-minimisation for installation operators in the realm of renewable energies, via the Renewable Energy Sources Act. As a key funding-support instrument for renewables in the electricity sector (see Section 3.1.2.i.), this act safeguards the funding support (guaranteed payment of the remuneration, priority to feed-in of energy) and financing of the additional costs, via the Renewable Energy Sources Act surcharge. The act is continually being further developed and legislation provides for it to be re-evaluated regularly. In line with the Renewable Energy Sources Act 2017, Art. 97, on 30 June 2018 the Federal Government will present a report to the Bundestag on its experiences thus far; after that, an Experience Report will follow once every four years. In particular, this report will evaluate current status on the deployment of individual technologies and their market integration, experiences with the tendering processes, and also the cost developments.

Investments in storage technology

In the present Federal Government's coalition agreement, it has established that it wishes to invest in storage technologies and intelligent marketing concepts, in order to continue both to safeguard security of supply throughout Germany and also to minimise the Renewable Energy Sources Act costs and system costs.

KfW Renewable Energies' Programme

This programme serves the purpose of long-term financing, at favourable interest rates. It is used for measures to use renewable energy to generate electricity, for producing electricity and heating in combined heat-and-power installations, and for measures to integrate renewable energies into the energy system. Up to 100 per cent of the investment costs eligible for funding-support are financed, up to a maximum of EUR 50 m. per project.

Heating and cooling

For buildings, the measures for implementing the Energy Efficiency Strategy for Buildings are presented in the long-term renovation strategy (see heating-related and cooling-related measures in the buildings sector in Chapter 3.2. on energy efficiency). Simultaneously, many of these measures also contribute to reaching the target in the ‘renewable energies’ dimension. In particular, this applies to the Market Incentive Programme for Renewable Energies in the Heating Market (MAP) and to provision of support to innovative model projects related to the heating grid 4.0, for renewables-based local heating and district-heating systems respectively.

Transport

For strategies and measures to adopt regarding low-emission mobility, refer to Chapter 3.1.3.iii.

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

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

Central contact points

Federal Network Agency

Inter alia, this agency receives reports from electricity-generation facilities, grid development and the implementation of tendering in the context of the Renewable Energy Sources Act.

Federal Maritime and Hydrographic Agency

Holds responsibility for area-planning and preliminary examination of areas, in addition to issuing approvals in the realm of offshore wind energy.

Nationale Organisation Wasserstoff (NOW) GmbH

NOW GmbH is a company coordinating and managing the Federal Government’s NIP - the national innovation programme on hydrogen and fuel-cell technology, in addition to the Federal Ministry of Transport and Digital Infrastructure’s (BMVI’s) support guidelines on electromobility and on power-charging infrastructure (for vehicles). This ministry has also assigned NOW to render support in the further development of the Mobility and Fuels Strategy, as well as in implementation of Directive 2014/94/EU on the build-up of infrastructure for alternative fuels.

Electricity Grid: Citizens’ Dialogue

The citizens’ dialogue serves the aim of open and transparent exchange of views and inputs between all those involved in the build-up of the electricity grid in Germany. This dialogue provides basic information and answers questions on expansion of the grid.

Strengthening consumers of self-generated energy and also landlord-to-tenant electricity models in the electricity sector

Renewable sourcing from one’s own supply is an important supporting pillar in the supply of electricity in Germany. Estimates state that, each year, approx. 4 Terawatt hours are produced and consumed by those supplying their own needs. EU-wide, consumption of self-supplied renewable energy was strengthened by the reworked EU Renewable Energies Directive. Yet it is also important that self-supply of renewable energy appropriately contributes to financing of the energy transition. In Germany there is a well-balanced concept in place for this: self-suppliers benefit from exemptions and limitations with regard to various taxes, levies and remunerations. For instance, in the case of small installations, below 10 kW, self-produced and self-consumed electricity is fully exempted from fees, grid payments and

electricity tax, provided that the electricity is not transported through a grid. On principle, self-suppliers with facilities above 10 kW and producing more than 10,000 kWh per year are favoured in the same way. However, as regards the obligation to pay the Renewable Energy Sources Act surcharge, they receive only a proportional exemption (60 per cent). Thus, in view of the higher profitability of larger facilities, this proportional surcharge can see to it that over-production is avoided. Also, larger consumers of self-produced energy thereby contribute appropriately to securing the long-term financing of the Renewable Energy Sources Act. The electricity-tax exemptions for electricity generated for own consumption are currently undergoing a legislative rework and are being adapted, consistent with the EU state aid rules.

Landlord-to-Tenant Electricity Act (Mieterstromgesetz)

The Landlord-to-Tenant Electricity Act has established an entitlement to financial support for tenants' electricity in the Renewable Energy Sources Act 2017. Tenants' electricity is electricity generated on the roof of a residential building and supplied to end-consumers (especially tenants) in that building or in residential buildings and neighbouring facilities that are directly, physically connected without a grid link. The tenants'-electricity surcharge is financed from the Renewable Energy Sources Act surcharge. In addition, the German Bundestag has passed at the end of November 2018 an amendment of the Corporation Tax Act (KStG), Art. 5, Para. 1(10) based on assistance in formulation by the Federal Government. The context was a consultation on the draft of a law to provide tax-based incentives to support the construction of residential buildings for rental. This amendment to the Corporation Tax Act means that, in the case of residential cooperatives and associations, the tax exemption of their rental income is retained if they operate tenant-electricity facilities. The amendment also applies for trade tax purposes via Art. 3(15) Trade Tax Act (GewStG). This puts into effect a measure resulting from the 21 September 2018 summit regarding policy on residential buildings.

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

For the buildings sector, the measures to implement the Energy Efficiency Strategy for Buildings are stated in the long-term renovation strategy (see measures relating to heating and cooling in the buildings section – Chapter 3.2. on energy efficiency). At the same time, many of these measures also contribute to target attainment in the 'Renewable Energies' dimension, especially the expansion of the support-funding programmes for heating grids, heating storage, and investments related to a specific residential quarter (see Chapter 3.2.), as well as topping-up and continuing the 'Model project on heating-grid systems 4.0.'

Heating-Grid Systems 4.0

Fourth-generation heating grids can be supplied effectively by renewable energies and open-up additional areas for flexibility for the electricity market. With the funding scheme 'Model projects on Heating-Grid Systems 4.0', systemic support is being provided for the first time, in the context of heating infrastructure, not solely to individual technologies and components but also to whole systems. Heating Grid Systems 4.0 are characterised by a low temperature level (20–95° Celsius), by very high proportions of renewables and waste heat and often they contain seasonal, large-scale heat-storage facilities as an essential component. Providing incentives for the market introduction of fourth-generation heating grids into large-scale application contributes crucially to the transition of the heating sector. The reason is that Heating-Grid Systems 4.0 can contribute noticeably both to attainment of the goal of almost fully climate-neutral energy supply of the stock of buildings by the year 2050, and to integrate renewable energies in the heating sector; they can also provide flexibility options for the electricity sector in a cost-efficient and energy-efficient way. At present this support-funding measure has a validity period up to 31 December 2020 but is to be continued beyond 2020. The programme also contributes to implementation of the Energy Efficiency Strategy on Buildings (see Chapter 3.2.ii.).

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 that has been produced and used.

Support programme 'Use of biomass as an energy source'

This promotional programme underwent a reorientation in 2015. In particular, it provides for support to practically-oriented solutions, of a demonstration-model and pilot-project type, that help to achieve greater flexibility in generating electricity and heating from biomass. It is primarily the potential of biomass residual matter and waste material that is to be opened up, to improve sustainable use for energy in the (coupled) activity areas of heating and electricity.

Support programme: 'Renewable raw materials'

This programme aims to provide support to research, development and demonstration projects directed at use of renewable resources to supply energy. Alongside research and development projects, the focus is particularly on optimisations of procedure and process, of a demonstration-model and pilot-project kind, close to working practice.

3.1.3. Other aspects of the dimension

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

National implementation of Directive 2003/87/EC by the Greenhouse Gas Emissions Trading Act (TEHG)

National strategies and measures to attain the targets in the Climate Action Plan 2050 in the sectors of European emissions-trading reduce CO₂ emissions effectively across the EU, if unused emissions certificates do not lead to emissions in other Member States (the so-called ‘water-bed effect’). Whether such a water-bed effect exists and for how long, depends (among other factors) on the effect that the market-stability reserve has in the emissions-trading system.

Retirement of electricity-generation capacity resources

If additional national measures result in retirement of electricity-generation capacity, the ETS Directive (Article 12, Paragraph 4(2)) gives Member States the opportunity to delete certificates from national tendering quantities. With its draft law to amend the Greenhouse Gas Emissions Trading Act, the Federal Government is proposing to convert this possibility into national law, according to the rules in the ETS Directive, Article 12, Paragraph 4, and to place it at the Federal Government’s discretion to decide as it deems appropriate on this matter. In this discretionary decision, it is also essential, in particular, to take into account the reduction of the surplus; this reduction is already being put into effect through the market-stability reserve (MSR) that is launched in 2019. A precondition for such a deletion is that the Federal Government passes a ruling to that effect. As the Federal Government decides regarding the deletion of certificates, the relevant framework conditions of budgetary law must be taken into account.

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

Sector coupling

Through direct use of electricity from renewable energies (sector coupling), potential for greater efficiency can be exploited and the use of fossil-based energy sources can be reduced. Likewise, for those applications in which it is hard to use other GHG-reduction options (e.g. in aviation or marine transport or, in particular, industrial processes), sector-coupling technologies are an important option for reaching energy and climate targets. Sector coupling is the topic of a whole range of support measures, projects and programmes. The detailed descriptions of the measures can be found in the corresponding chapters – see heating-grid systems in Chapter 3.1.2.vi.; low-emission mobility in Chapter 3.1.3.iii.; the Market Incentive Programme for Heating, and the programme for renovating buildings to reduce CO₂, in Chapter 3.2.ii.; market integration in Chapter 3.4.3.i.; real-life laboratories and SINTEG in Chapter 3.5.1.

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

The Federal Government wants to structure mobility in as sustainable, affordable and climate-friendly a way as possible. Important approaches for strengthening low-emission mobility, in order to reach the transport sector’s climate targets, are the following (among others): market uptake of electrically operated vehicles and also the expansion of vehicle-charging infrastructure, as well as increasing cyclists’ and pedestrians’ share of traffic. Especially in order to expand electromobility quickly, it will be crucial to create sufficient incentives for sector coupling.

National Platform: ‘Future of Mobility’

The new national platform ‘Future of Mobility’ (NPM) is developing concepts and opportunities for action, involving politics, business and civil society, in order to secure future mobility that is affordable, sustainable and climate-friendly. The platform began its work in September 2018. With the platform as the ‘roof’, a steering group and seven working groups are established. After the concluding reports are presented the Federal Government will further develop its strategy.

Additionally, as regards low-emission mobility the following key measures are in progress or are planned:

Support for electromobility

To speed up the development of the electromobility market, on 18 May 2016 the Federal Government adopted a package of measures with an investment volume of just under EUR 1 billion. Three financially-effective measures are at the forefront of the market incentive package: limited-duration purchase incentives; expansion of the vehicle-charging infrastructure; and public-sector acquisition of electric vehicles.

- A purchase premium, the so-called environment bonus, is paid for new vehicles – EUR 4,000 for purely electric cars and EUR 3,000 for plug-in hybrids. The environment bonus is paid for vehicles with a list price not above EUR 60,000. The total funding support available is fixed at EUR 1.2 billion. The Federal Government and the automotive industry each respectively cover half this amount. The funding support by the Federal Government is provided subject to corresponding funding support from the manufacturer.
- Tax regime for private use of electric mobility: in the Income Tax Act, there is tax exemption on advantages granted by the employer for electric charging of an electric vehicle or a hybrid electric vehicle at the employer's premises (Income Tax Act, Art. 3 (46)).
- To improve the battery-charging infrastructure, the Federal Government is providing EUR 300 million: EUR 200 million for the rapid-charging infrastructure and EUR 100 million for the normal-charging infrastructure.
- It remains the objective that, in the future, electric vehicles will account for at least 20 per cent of the vehicles owned by the Federal Government. If employees charge the battery at their employer's facilities, this no longer constitutes an advantage that has a monetary value.

Changing the Battery-Charging Column Regulation

The effect of amending the battery-charging column regulation has been that users can order electricity and pay for it, using a standard web-based and established mode of payment, at all publicly-accessible charging points. The support directive 'Battery-charging infrastructure for electric vehicles in Germany' continues to provide support to the expansion of publicly-accessible battery-charging infrastructure. At present EUR 300 million of Federal funds are available for the period 2017–2020; at least 15,000 battery-charging stations are to receive funding support from this. As a non-priority measure, the coalition agreement provides for a further 100,000 battery-charging points to be set up.

National Strategic Framework for the Expansion of Infrastructure for Alternative Fuels (NSR)

The strategic framework encompasses the battery-charging infrastructure for electric vehicles, the infrastructure for natural-gas supply (compressed and liquefied natural gas), and infrastructure for hydrogen supply to fuel-cell-powered vehicles. Implementing Directive 2014/94/EU, the NSR sets objectives for the publicly-accessible infrastructure of tanking up and of battery-charging, rendering support to these facilities with relevant measures.

Further development of the National Innovation Programme on Hydrogen and Fuel-Cell Technology (NIP 2)

Further development of the National Innovation Programme on Hydrogen and Fuel-Cell Technology (NIP 2) both secures the technological base and provides support for ramping-up the product launch. The key challenges that this addresses are these: fuel cells for electric drives and fuel-station infrastructure; hydrogen production from renewable energies and integration into the energy system; as well as fuel cells for stationary energy supply. On 28 September 2016 the Cabinet adopted a Federal Government framework programme on this. The programme is to continue until 2025.

Strengthening Germany as a business location for battery-cell production

The business community is expressing interest in building-up battery-cell production in Germany and the Federal Government supports this endeavour. This must be accompanied by strengthening research into battery cells.

Specific measures for reducing emissions in urban road traffic

At the second municipal summit, on 28 November 2017, the Federal Government set into motion a package of measures to promote better air in towns and cities, with the 'Immediate Programme on Clean Air'. EUR 1 billion have been made available for this immediate programme. The programme's subject matter is measures for the electrification of urban

transport and for setting-up battery-charging infrastructure, measures to digitalise transport systems, and also measures for retrofitting diesel buses in public passenger transport with exhaust-gas treatment systems. All the measures are scheduled to come into effect by 2020.

Support to alternative drives in public passenger transport

As part of the relevant funding-support guidelines on electromobility, produced by the Federal Ministry for the Environment and the Federal Ministry of Transport and Infrastructure respectively, the Federal Government provides funding assistance to numerous projects aimed at further technological development, or respectively acquisition of electric buses and hybrid buses.

Further development of the Mobility and Fuels Strategy 2013

This strategy, adopted by the Federal Cabinet in June 2013, serves as an important implementation tool for the energy transition in transport. Up to now, it provides an overview on technologies and also energy and fuel options for the various means of transport. A crucial role is played in this by the efficient integration of renewable energies in electric motors and by the use of renewable fuels in liquid and gas form, for the purpose of decarbonising vehicles.

Biofuels

Biofuels introduced into the market are expected to at least maintain the current quantity level and be supplemented by renewable fuels with scope for the future. On the one hand, safeguarding the present stock of vehicles secures the contribution to decarbonisation, made by those means of transport that cannot be converted to use of electricity in the foreseeable future. On the other, this maintains trust in transport's energy transition on the part of those assessing the regulatory framework's reliability when making their investment decisions.

Funding-support to natural-gas-powered electromobility

With its tax-based funding support to natural gas as a fuel until 2026, in addition to dispensing with the toll until 2020, the Federal Government has shown its interest in substantially expanding natural-gas-powered mobility. Especially through using biogas, this can contribute to savings in the use of CO₂.

Purchasing promotion on electrovehicles – Information campaign

The Federal Government will conduct an information campaign, jointly with the Länder; its aim is to increase electric-drive vehicles' market share among the vehicle fleets of public authorities.

National cycling plan

In striving to reach the objectives in the strategic document that states principles for the transport policy regarding cycles- the National Cycle Transport Plan – the Federal Government is putting into effect investment-based and non-investment-based measures and model projects. Among other initiatives, this includes financial assistance for fast cycling-paths, and financing the construction of cycle paths on Federal roads, research projects, studies (e.g. cycle monitor) and congresses.

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

Peer-review process in the G20 context

In 2009 the G20 states reached agreement on a medium-term discontinuation of inefficient subsidies for fossil fuels. This resolution states: "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". To act on this, the states agreed on a voluntary peer-review process. In September 2016 Germany presented a 'self-report' on the relevant German subsidies.

Federal Government's Subsidy Report

In the context of the Federal Government's reporting on subsidies, a check is regularly undertaken every two years on the sustainability of all subsidies. This examines the long-term economic, environmental and social effects that the given subsidy has, e.g. regarding economic prosperity and provision for the future, climate protection and sparing of resources, or the securing of employment; it also documents the results in the Subsidy Report.

Expiry of the grants for hard coal

Germany's most important current measure in reducing subsidies for fossil fuels is the expiry of grants for hard coal. Germany's hard coal-mining is not competitive, particularly due to the high extraction costs, attributable to geological factors. To make possible a socially acceptable exit from hard coal-mining, Germany provides grants to boost turnover, to deal with the necessary measures involved in ending production, and for bridging-assistance for employees leaving this sector of work. The subsidies to raise the turnover level are being paid for the last time in 2018. Follow-up measures of discontinuing operations will receive financial assistance until the end of 2022. The payment of grants for employees will cease at the end of 2027.

3.2. Dimension energy efficiency

Planned policies, measures and programmes to achieve the indicative national energy-efficiency contributions for 2030, as well as other objectives referred to in Point 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:

To reach the energy-efficiency targets, a mix of instruments and measures is developed in the context of the national energy-efficiency strategy, with far-reaching and cross-sector effects. The foundations for shaping the measures are taken from current national processes and consultations (research and development, National Action Plan on Energy Efficiency 2.0 (NAPE 2.0), a basic-principles study, the ‘Green Book on Energy Efficiency’ process, the Energy Efficiency Strategy for Buildings process, the Mobility and Fuels Strategy, the Masterplan for Rail-Based Goods Transport, the Action Plan on Goods Transport and Logistics, etc.). The order of magnitude for the effect required from additional measures in the final-consumer activity-area amounts to a reduction of around 1,000 PJ in primary energy consumption in 2030. This emerges from the first calculations for the gap that is to be expected when a ‘linearised’ 30-per cent target is contrasted with continuations of existing energy-consumption trends for 2030, based on the Projection Report for Germany – 2017.

The Federal Government’s energy-efficiency policy is based on a broad mix of instruments for all sectors, built up on the principle of ‘Consulting, providing information, promoting, demanding and researching’. The current key measures are stated individually 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 and to be prepared in accordance with Annex II of this Regulation

To implement the EU Energy Efficiency Directive, Article 7, in the first period of savings (2014–2020) the Federal Government has hitherto made avail of strategic measures and thereby of a wide package of measures, which it is also the intention to use for the second period of savings (2021–2030). The measures planned by Germany to attain the final-energy savings, namely 4,045.8 PJ or respectively 96.6 Mtoe, can be found in Appendix II at the end of this draft.

National Action Plan on Energy Efficiency (NAPE and NAPE 2.0)

The NAPE defines immediate measures and more far-reaching work processes, for attaining the national efficiency and climate-action targets. The most important areas for action in energy-efficiency policy are: to advance energy efficiency in the buildings sector, and in industry, commerce, and the tertiary sector; to establish energy efficiency as a business model and a model for economic return; in addition, to raise users’ own sense of individual and group responsibility for energy efficiency. The NAPE measures are currently being reworked and transferred into a NAPE 2.0, using an effective set of measures to pre-empt any shortfall regarding attainment of the energy targets.

Drawing-up an energy-efficiency strategy

In its coalition agreement, the current Federal Government undertook to draw up a cross-sector energy-efficiency strategy, one in which a trajectory was to be developed, as well as a proposal for a package of measures to reach Germany’s medium-term efficiency targets. The intention is also that the strategy is to anchor the guiding principle of ‘Efficiency First’ in energy policy.

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

Energy-Efficiency Strategy for Buildings (ESG)

In the buildings sector the Energy-Efficiency Strategy for Buildings (ESG) serves as the strategic foundation for policy. The long-term renovation strategy stated here is the implementation of the ESG. The ESG is the Federal Government’s strategy paper for the energy transition in the buildings sector. The Federal Government has set itself the ambitious target of attaining an almost climate-neutral stock of buildings by the year 2050. This means that, in the buildings sec-

tor, the primary demand for energy must be reduced by 80 per cent by 2050, compared to 2008. The ESG highlights how this target can be attained, through a combination of energy efficiency and the use of renewable energies. The target of an almost climate-neutral stock of buildings is assessed as being attainable in principle, despite restrictions in energy efficiency and certain limits to potential regarding renewable energies. Yet huge additional efforts are needed to achieve this, both in the realm of energy efficiency and in the use of renewable energies in the buildings sector. Alongside the technical and energy-related aspects, the ESG also considers first approaches to economic issues and the future outlook on social-policy issues, as these relate to the buildings sector. Beyond this, the energy-policy aspects, spanning a variety of disciplines (for instance questions on how electricity and heating interact), are addressed in terms of the future prospects. The ESG's results are taken up in the Climate Action Plan 2050.

In the buildings sector, a successful mix of instruments was already put into place; this will be continued and further developed in future years. In the buildings sector this includes the following measures, in particular:

Energy consultation on residential buildings (in-situ advice/Individual Renovation Plan)

Energy consultation for residential buildings is directed at owners of residential buildings (private owners of houses or flats, home-building companies and also home-owner communities). In this context a qualified energy consultant inspects the building and produces a comprehensive energy-consultancy report. This includes funding-support programmes and the individual possibilities open to those advised. Since 2017 the Individual Renovation Plan is available as a tool for consultation purposes. This software-supported tool helps the building-energy consultant to produce a comprehensible overview of the renovation measures to be taken in a building, especially in order to carry out measures that are built up, one upon the other. Alongside energy-saving potential, opportunities to use renewable energies and the investments needed for this are also assessed, in addition to highlighting the reduced heating costs and reduced use of CO₂. In particular, this is a way to avoid misguided investments that do not result in energy savings. Initial consultations and brief consultations for private households are conducted with the independent consultancy that forms part of the Federal Association of Consumer Affairs (vzbv) and get financial support via the Federal Ministry for Economic Affairs and Energy (BMWi) (see Chapter 3.2.iv.: Consumer Information).

Energy consultation for non-residential buildings owned by municipalities/not-for-profit organisations

Since 2016, this measure has given support to municipalities, municipally-owned companies and not-for-profit organisations in carrying out energy-based renovation of their stock of buildings (examples: schools, kindergartens and administrative-authority buildings) and in erecting energy-efficient new buildings. Thanks to qualified energy consultation and with funding support, these buildings' owners get a good overview on where most energy is wasted in their buildings, which investments make economic sense, which areas of potential they have for savings, and how to avoid misguided investments. The plan is that the concept of the individual renovation 'roadmap', already implemented in the energy consultation for residential buildings, is to be further developed in a next step to include municipal buildings. In this way, municipalities also honour the public sector's obligation to serve as a role model.

Energy consultation among small and medium-sized enterprises (SMEs)

With energy consultation for SMEs, energy-related weak-spots are examined in SMEs (this also includes buildings) and an inspection of the premises is carried out (see also Chapter 3.2.iv.).

National efficiency label for old heating facilities

With the efficiency label for old heating facilities, the efficiency label is being awarded by installation engineers since 2016 and by municipal-district chimney sweeps since 2017, step by step and starting with the oldest heating boilers. The measure's aim is to raise the replacement rate for old heating installations by 20 per cent annually, taking it to 3.7 per cent per year, and to provide incentives for energy savings via the boiler replacement. The plan is for approx. 13 million heating boilers to get the label over a seven-year period.

New version: Energy for Buildings Act (GEG)

The coalition agreement states that the existing rules in the legislation on energy conservation for buildings must be summarised, stripped of bureaucracy, and simplified, in a modern Energy for Buildings Act. This implements EU law requirements regarding public non-residential buildings, coming into effect on 01 January 2019, and those applying to all buildings, becoming valid on 01 January 2021. In this regard, the current energy-related requirements for the existing stock and for new-build retain their validity. In addition, the geographical quarter (locality) is introduced as a unit for approaching this task.

Tax-based provision of funding support to building renovation for energy-optimisation purposes

According to the coalition agreement, the energy-related renovation of buildings is to receive tax-based support: Applicants are to be able to choose between a funding grant and a reduction in their taxable income.

Federal Government's programme of CO₂-related renovation of buildings

Via the programmes administered by the KfW bank, promoting energy-efficient construction and renovation, this programme provides support to energy-optimising renovations and highly-energy-efficient new buildings, to implement the long-term renovation strategy for buildings. As regards efficiency, it is the highest-volume instrument of funding support (disbursement of funds in 2016 and 2017: EUR 2 billion per year). Funding support goes to energy-efficiency measures in the buildings sector, with loans at favourable interest rates, in part with grants on repayment of the principal, or alternatively with grants towards the investment.

Market-incentive programme for funding-support to measures to use renewable energies in the heating market (MAP)

The MAP provides funding support to installations using renewable energy to supply heating and cooling and certain heating storage units and local-heating grids, both in residential and in non-residential buildings. Here it is almost exclusively installations in the existing stock of buildings that get funding support; installations in new builds only do so in exceptional cases. The programme includes two elements of support. For smaller installations, investment grants are provided by the Federal Office of Economics and Export Control (BAFA). What is eligible for funding here is solar-collector installations, biomass facilities and efficient heating pumps. For larger installations, in the context of the KfW Programme on Renewable Energies Premium, the Federal Government provides grants for part of the redemption of KfW loans made at favourable interest rates. What is eligible for funding support in this part is the following: large solar thermal installations; biomass-fuelled heating (and power) installations; large efficient heating pumps; bio-gas power lines; deep geothermic power installations; local-heating grids for heating from renewable energies; and large heating storage units for heating from renewable energies. At present, annual disbursement funds of approx. EUR 320 m. are available for the MAP. The MAP's funding-support guidelines in force ('Guidelines on funding support for measures to use renewable energies in the heating market') do not at present have a fixed expiry date.

Funding programme: energy efficiency and process heating from renewable energies in business – 'grant and credit' and also 'competition'

In view of the Federal Government's ambitious targets for raising energy efficiency and reducing CO₂ emissions in the industrial sector, it is essential to also take measures to avoid waste-heat and to use it in order to improve companies' energy efficiency. The funding-support programmes 'Energy efficiency and process heating from renewable energies in business – grant and credit' and also 'Energy efficiency and process-heating from renewable energies in business – competition' make an important contribution in incentivising companies to make the relevant investments, on a prompt and sustainable basis, that enable very substantial CO₂ reductions to be made. In industry there are major areas of potential with regard to waste heat that are not yet being used. Among other aspects, these programmes are intended to provide the necessary incentives to trigger off the relevant investments for avoiding waste heat, and for using it. On an open basis in terms of technology used, funding support is to go to all investments in replacement, modernisation, extension or new construction of facilities, if the result is that waste heat is avoided or that hitherto-unused waste heat is used efficiently within the company or outside it. A large part of the existing scope for avoiding waste heat and for using it cannot solely be exploited by standardised measures, such as installation of heat exchangers. In fact, what the respective company needs are tailored projects, for integrating the heat into the production process optimised for that purpose, or for the waste heat to be used internally or externally. Accompanying the avoidance and use of waste heat, the support programmes give incentives to the use of renewable energies to provide process heating.

Incentive programme on energy efficiency (APEE)

The MAP support funding was reinforced by the introduction of the Incentive Programme on Energy Efficiency. This covers three areas of funding-support for investment: 1) the installation of ventilation facilities (ventilation package) combined with a refurbishment measure performed on the building's casing to avoid damage to the building (including the onset of mildew); 2) replacement of inefficient heating units by efficient heating (heating package); 3) market introduction for stationary fuel-cell-based heating units in new-builds and in already existing buildings. The funding support comes in the form of a grant for stationary fuel-cell-based heating units with an electrical capacity range of 0.25 to 5.0 kilowatt via the KfW programme 'Energy-efficient building and refurbishment – fuel-cell grant'

Funding-support programme on heating optimisation

This programme's aim is to provide an incentive for inefficient circulation pumps used for heating and for warm water, to be replaced by highly efficient pumps and the optimisation of existing heating facilities by means of so-called hydraulic balancing. The programme acts as an entry into implementation of more comprehensive measures to raise energy efficiency in buildings.

Expansion of support programmes for heating grids, heat storage installations and investments to supply to two or more buildings

The Federal Government is planning to group together, in one new 'column' of support, those programmes for heating grids, heat storage installations and investments relating to two or more buildings, in which buildings, installations or processes use renewable energies to obtain heating or cooling (cf. also 3.2.vii. in this regard). In the market-incentive programme context, assistance currently goes to investments that supply buildings, installations or processes with heating or cooling. This includes heating grids, cooling grids and storage installations fed by renewable energies as well as larger installations for producing heat from renewable energies (e.g. deep geothermic installations, biomass heating installations). This measure is also relevant for the reduction of greenhouse gases – see Chapter 3.1.1.

Construction research initiative – 'Efficient House Plus'

Since 2011, with its 'Efficient House Plus' initiative, the Federal Government has been backing a buildings standard that is open in technology terms and is suitable for the future; this involves a nationwide network of 'Efficient-House-Plus' model projects for prompt transfer of knowledge from research into practice. The Efficient House Plus standard provides sustained support to positive developments in annual primary-energy and final-energy needs as well as the use of renewable energies in the buildings sector. First model projects in home-building (new-build, rework of existing structure, residential quarter) have passed their practical test in scientific terms; they make a case for themselves with innovative approaches to construction solutions that take the climate into account. Measured over a year, an Efficient House Plus gains more energy than it needs for its own use. Within the given residential quarter, a network can be set up to use an energy surplus, either to help those buildings not reaching the energy-related requirements set in the buildings standard 2030, or (switching sectors) to help the transport sector. The initiative gives new impetus to the market introduction of innovations benefiting the climate with regard to building and living at home; it also activates the CO₂ reduction potential in the buildings sector; in addition, it opens new fields of business such as e-car-sharing in the residential sector.

Support initiative 'Energy Efficient Building 2050' (EnEff.Gebäude.2050)

With its 'Energy Efficient Building 2050' initiative, the Federal Ministry for Economic Affairs and Energy provides assistance to showcase projects that demonstrate widely-applicable solutions for climate-neutral buildings and residential quarters; this advances a market introduction or wide-based implementation for such projects. The goal is that this contributes to the whole stock of buildings having an almost climate-neutral impact by 2050. Projects eligible for funding-support can make their subject-matter the development of individual key technologies and procedures on new-builds or refurbishments; it should be noted that they can also have some elements of research input (so-called innovation projects).

Likewise, projects that demonstrate ambitious examples of implementation for almost climate-neutral buildings and residential quarters (so-called transformation projects) can get support funding. In addition, particularly promising conceptual developments are awarded prizes in competitions of ideas. From 2019, Energy Efficient Building 2050 will be continued in the context of the 7th Energy Research Programme.

Role-model function of publicly-owned buildings

The public sector is to adopt a role-model function with regard to its buildings: this requirement applies both to new-builds and to the existing stock of buildings. The Federal Government has issued relevant decrees for more than 20 years now regarding how it exercises this role-model function. At present, for instance, it is obligatory to achieve performance at least 20 per cent better than is specified by the legislative minimum requirements on energy efficiency for the refurbishment of existing building-stock, while satisfying economic-viability needs. The present government's coalition agreement provides for a continuation of the existing decree requiring Federally-owned buildings to exercise a role-model function. It is also the plan to conclude an energy-related refurbishment roadmap for Federally-owned property. According to the Renewable Energies Heat Act, on principle, public authorities must use renewable energy

to a defined, proportional degree in meeting the heating-energy and cooling-energy needs of existing public buildings that form part of their property and are being thoroughly renovated. On all measures, climate-protection targets must be reached, taking into account the demands of economic viability and of cost-efficiency.

The overview regarding the national stock of buildings and the expected share of renovated buildings will be submitted at a later date; this overview is required as a result of amendment of the European directive on buildings (EPBD). The latter forms part of the long-term renovation strategy's further development (implementation deadline: 09 March 2020). This likewise applies to the determination regarding cost-efficient concepts for renovations, split according to building type and climate zone.

3.2.iii. Description of policy 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 adopted extensive strategic measures to eliminate the obstacles to the spread of use of energy services in the public sector. These range from offers of information, via tuition opportunities, through to funding-support programmes.

Funding-support for consultation on contracting related to energy-saving in the context of the 'EBK' consultation programme (namely 'Energy Consultation for non-residential buildings owned by municipalities/not-for-profit organisations') Within the framework of the EBK consultation programme, referred-to above (see Chapter 3.2.ii.), (among other initiatives) a 'contracting check' for municipalities receives funding support. In this, a qualified energy consultant checks whether and how the measure proposed in a previous energy audit (also given funding-support) or respectively in an energy consultation (refurbishment roadmap) can be implemented by a suitable contracting model. The intention in this is to make municipalities aware of the possibilities, often little known, for various contracting models; this approach can promote a greater uptake of energy-saving contracting.

Dialogue on Contracting between the Federal Government and the Länder

This project provides a platform for intensive interaction between representatives of Germany's Federal Government and its Länder about contracting aimed at energy-saving purposes. The project strives to remove obstacles to energy-saving contracting and to building up regional competences in this activity area. Also offered are annual plenum meetings and workshops in addition to a mentoring programme and the exchange of 'best practice'. Support is also given to the build-up of regional competence centres.

Model projects on contracting

In the context of this Federal Government/Länder Dialogue on Contracting, support is also given to the specific implementation of approx. 10–15 ambitious model contracting projects in representative properties at municipal and Land level; the projects present role models, highlighting contracting's potential. The idea is to give impetus to the establishment in Germany of a functioning market for ESC – Energy-Saving Consultancy. The model projects are also to be used to train key individuals involved and to develop standards and guidelines for similar projects.

Information on sample contracts and guidelines

The Federal Energy Efficiency Centre offers information on its website about sample contracts for contracting services and guidelines on energy-saving contracting, both available free of charge. Also included there are offers directed specifically at public properties or municipalities.

Municipalities' energy-efficiency and resource-efficiency networks

In the context of this support-funding programme, municipalities can join forces to create a network in order to improve their energy efficiency and/or resource efficiency. Jointly, by providing support to a network team, they can recognise and implement savings opportunities. Municipalities and municipal companies can likewise obtain qualified consultancy in the energy-related refurbishment of their stock of buildings. In this regard, reference is made to Chapter 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 Point 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)

Fostering public institutions' function as a role-model

Role-model function of publicly-owned buildings

See Chapter 3.2.ii.: 'Long-term renovation strategy'

Promoting energy efficiency in the award of public orders

Energy-efficient purchasing by public institutions

It is the public purse that has the largest demand for goods and services in Germany, with a total value of approx. EUR 300 billion per year (around 13 per cent of Gross Domestic Product) (German Environment Agency, 2014). The Renewable Energies Directive, Article 6, requires Member States – outside the scope of narrowly-defined exceptions – only to acquire products, services and buildings that are of high energy-efficiency. Accordingly, in past years rulings and acts of law were issued that demand and foster energy-efficiency in purchasing. The Regulation on Award of Public Contracts (VgV), which all public purchasers must comply with in Europe-wide tenders for goods and services, establishes the following in Art. 67 (Purchasing of goods and services relevant to energy consumption): the highest performance level in energy efficiency and, provided this is available, the highest energy-efficiency class should be required of suppliers whenever goods relevant to energy consumption are purchased or they are an essential precondition in providing a service. Energy efficiency must also be taken into account as an evaluation criterion in ascertaining the most economically-viable offer. Likewise, for the award of orders for construction services, the EU VOB/A (Ruling on Award of Orders and Contracts for Construction Services), Art. 8, contains a ruling requiring the same thing. Beyond this obligation, purchases of this kind are promoted by the following: the Act against Restraints on Competition (*GWB*); the Regulation on VgV; the Regulation on the Award of Orders and Contracts for Services, Part A (*VOL/A*), Section 1; the Ruling on Award of Orders and Contracts for Construction Services, Part A (*VOB/A*); and the Defence and Security Award Regulation (*VSVgV*). The Federal Energy Efficiency Centre also publishes lists stating energy-efficiency criteria for various product categories as supplementary help for those issuing purchase orders.

Energy audits/Energy Management System

Energy audit for non-SMEs (non-small and medium-sized enterprises)

Large companies have an obligation to perform energy audits. Alternatively, the companies can introduce an Energy Management System or an Environment Management System.

Funding support to Energy Management Systems

In the public-funding programme 'Energy efficiency and process heating from renewable energies in business', funding support is awarded to the acquisition and installation of measurement, management and regulation technology and sensorics, aimed at monitoring and at efficiently regulating energy flows, for these to be integrated into an Energy Management System. Likewise, acquisition and installation of energy-management software are given funding support, as is third-party training of staff on how to work with the software. Beyond this, in the context of energy consultation for SMEs, funding support also goes to a consultation on introducing and maintaining an Energy Management System in SMEs.

Federal Energy Efficiency Centre (BfEE)

Supplementing this, the Federal Energy Efficiency Centre maintains a free-of-charge, public list of providers for energy services, energy audits and energy-efficiency measures.

Consumer information/training measures

For the buildings sector, the measures to implement the Energy Efficiency Strategy on Buildings are stated in the long-term renovation strategy; the Federal Government provides funding-support to energy consultation, both for residential and for non-residential buildings.

Independent consultation at the Federal Association of Consumer Affairs (vzbv)

Initial consultations and brief consultations are conducted with the independent consultancy that forms part of the Federal Association of Consumer Affairs (vzbv); such consultations get financial support via the Federal Ministry for Economic Affairs and Energy. Finally, the energy consultations from the consumer-affairs' offices take the various interests of private households as their orientation point. The consultations held nationwide are intended to help in reducing misgivings and obstacles, regarding refurbishment measures aimed at energy-optimisation and also regarding renewable energies. They are also a low-threshold entry into a consultation specific to a given building. At present more than 100,000 consultations per year are conducted nationwide. These are followed by energy-optimisation measures or an order is placed for a more far-reaching consultation, via the 'energy consultation for residential buildings (in-situ consultation, individual refurbishment roadmap)'.

Energy consultation for residential buildings (in-situ consultation/individual refurbishment roadmap)

See Chapter 3.2.ii. 'Long-term renovation strategy'

Energy consultation for non-residential buildings owned by municipalities/not-for-profit organisations

See Chapter 3.2.ii. 'Long-term renovation strategy'

Energy consultation for SMEs

In the context of energy consultation for SMEs, funding-support is provided to refurbishment concepts for SMEs' business premises. This involves examining companies' weak-spots in terms of energy and inspecting their premises. A more in-depth energy analysis is carried out according to DIN EN 16247-1, including clear information about potential savings and a specific plan of measures. Support funding is also given to consultation on introducing and maintaining an Energy Management System and also a 'contracting check'. The latter examines the degree to which the measures proposed can be implemented by a suitable contracting model; this is combined with a specific recommendation for implementation (see also contracting consultancy in the context of the 'EBK' energy consultation for municipalities/not-for-profit organisations: 3.2.iii.). A concept for use of waste heat can also get funding support. Other consumer groups' energy consultations get funding support with the 'energy consultation for residential buildings (in-situ consultation, individual refurbishment roadmap)' and the 'energy consultation for non-residential buildings owned by municipalities and not-for-profit organisations' (see 'long-term renovation strategy').

SME initiative on energy transition and environment protection

The SME initiative on energy transition and environment protection is to be extended to 2021. This is a joint initiative by the Federal Ministry for Economic Affairs and Energy, the Federal Ministry of the Environment, the German Chambers of Industry and Commerce (DIHK) and the German Confederation of Skilled Crafts (ZDH); its goal is to familiarise small and medium-sized firms with topics relating to improved energy efficiency and the reduction of greenhouse-gas emissions. In the context of this initiative, materials specific to the given facility are produced and presented to the companies. In addition, exchanges of professional experience appropriate to skilled craftspeople on practical energy topics are to be organised and implemented by creating informal rounds for discussion on energy efficiency.

National Top Runner Initiative (NTRI)

This initiative develops national measures for energy-efficient products; since January 2016 it has been implementing them in close dialogue with key stakeholders. It aims to introduce energy-efficient and qualitatively high-calibre equipment ('top-runners') to the market more quickly, thus bringing forward the market penetration of such equipment.

Germany makes it efficient!' campaign

The aim of the 'Germany makes it efficient!' campaign of informing and activating is to build awareness of the Joint Energy Transition Project, among all players involved within society, convincing them of the need for an even more efficient use of energy.

Information and Competence Centre for Construction with a Future' (IKzB)

The IKzB promotes knowledge transfer and overall dialogue within society on the further development of energy-efficient construction in the future.

3.2.vii. Regional cooperation in this area, where applicable***Franco-German Energy Platform***

Germany cooperates closely with France on energy efficiency, based on the 'Joint Energy Declaration' made on 31 March 2015. The Franco-German Energy Platform, created as part of implementing the energy declaration, consists of dena (German Energy Agency) and ADEME (*Agence de l'Environnement et de la Maîtrise de l'Energie*) and encompasses two efficiency projects; on the one hand, the projects aim at processing 'best-practice' examples, and at effecting a cross-border exchange of such examples with regard to refurbishment of buildings; on the other hand, it is about working together to promote energy efficiency in industry. Funding support goes to the Franco-German Energy Platform from the Federal Ministry for Economic Affairs and Energy.

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

Financing-measures, taking the form of intensive promotion or price and incentive mechanisms, serve as crucial components of the activities pursued in the realm of efficiency. They supplement other measures by targeted financial incentives, enabling implementation of energy-efficiency measures in the various fields of application. Accordingly, energy consumers can reduce their energy costs long-term. Investments in energy efficiency not only open up cost advantages for companies; they also give firms new opportunities on the international markets.

Funding-support

With its funding support for efficiency measures and activities aimed at use of renewable heating, among other initiatives, the Federal Government has created framework conditions for strengthening the development and spread of innovative energy technologies from Germany. Investment-based promotional programmes thereby supplement the offers of consultation and information by means of targeted financial incentives, making it possible to implement energy-efficiency measures in the various realms of application. This means that energy consumers can reduce their energy-costs long-term (see 'Long-term renovation strategy'). Investments in energy efficiency not only open up cost advantages for companies; they also give firms new opportunities on the international markets. Accordingly, to an extent that deserves mention, Germany exports goods used in connection with efficiency measures and renewable heating, in the activity area of rational energy use and conversion; this includes energy-efficient electrical devices, insulation materials, building-installation technology, or components for production processes. For buildings, the measures aimed at putting into effect the Energy Efficiency Strategy for Buildings are stated in Chapter 3.2.ii. of the 'Long-term renovation strategy'.

Promotion strategy on energy-efficiency and renewable heating

Since 2017, all promotional programmes are being fundamentally reworked, through the 'Promotion strategy on energy-efficiency and renewable heating' run by the Federal Ministry for Economic Affairs and Energy. They are being extended to include the latest status on relevant topics; the elements are also being better coordinated: the emphasis is on taking the existing promotional programmes and raising their promotional efficiency, making them more effectively oriented towards their recipients, and making them clear and user-friendly, as well as using and grouping together synergies between them. The goal is to strengthen the combination of efficiency and renewable energies in carrying out the refurbishment of buildings for energy-optimisation, by more closely interlocking the existing instruments for funding-support; for instance, this is done by taking particular account of package solutions that combine efficiency measures with the installation of new units, generating renewable heating. Additionally, the Federal Ministry for Economic Affairs and Energy's 'Funding-support strategy for energy efficiency and renewable heating' provides for a new pillar of funding support - 'Heating infrastructure'; the 'model project on heating-grid systems 4.0', described in detail in Point 3.1.2., will take its place in this at a future date. The funding-support programmes already referred to in 3.2.ii. form part of the funding-support strategy.

Promotional strategy in the realms of industry, commerce, and the tertiary sector

As part of the promotional strategy, the current six funding-support programmes for enhanced energy efficiency in business were evaluated and summarised. This involved placing the existing promotional programmes under scrutiny, adopting elements that have proven themselves, and making necessary optimisations, to increase the support measures' effectiveness and their efficiency. In future, the provision of support for investments in optimisation of facilities and of processes, and also in renewable process-heating technology, are being grouped into two programmes: classic funding-support by means of a grant in the programme 'Energy efficiency and process heating from renewable energies in business – grant and credits' and competition-based funding-support in the programme 'Energy efficiency and process-heating from renewable energies in business – competition'. Both programmes will offer an internally-consistent point of access to funding, directed at increasing energy efficiency or respectively at using heat from renewable energies in processes. This restructuring addresses the challenges of replacing individual components, using a low-threshold basic-level of funding support, of effecting systemic optimisation (open in terms of technology used), and of using renewable energies to generate process heating.

Further development of the programme of 'Funding-support to electricity-savings in the context of competition-based tendering: STEP up!'

With 'STEP up!' – the acronym means 'Use the potential for electricity efficiency!' – the Federal Government tested out a new tool, aimed at offering an incentive to achieve maximum electricity savings with the best possible cost-benefit-ratio: The measures that took the honours in the competition were those that achieved the biggest electricity savings 'per Euro of funding-support'. Because of the insights gained from this, the programme was further developed, becoming the open-technology programme 'Energy efficiency and process-heating from renewable energies in business – competition'.

Funding-support initiative 'Solar building/energy-efficient cities'

This funding-support initiative is managed by the Federal Ministry for Economic Affairs and Energy and the Federal Ministry of Education and Research (BMBF) respectively, promoting the energy transition in the urban domain. Here the focus is on refurbishment and on new-construction of residential buildings of several storeys, and on comprehensively and systemically arranged 'showcase projects' at residential-quarter level. This project, started in mid-2017, has total funding-support of EUR 120 m.

Funding-support for mini-engine-based cogeneration systems

Up to 20 kW, funding-support is available to installations that provide energy particularly efficiently in residential and non-residential buildings.

Energy Tax Act and Electricity Tax Act

The tax-breaks for manufacturing industry are intended to prevent companies that operate in international competition from being at a disadvantage because of high expenditure on energy. There is a general tax-relief, amounting to 25 per cent for manufacturing companies, and also the balancing-out of the peak level, with a tax relief of up to 90 per cent for high-energy-use companies; additionally, there are complete tax breaks for certain energy-intensive and electricity-intensive processes (e.g. electrolysis, metal-processing, manufacture of glass products, ceramic goods). Via the balancing-out of the peak load, high-energy-use manufacturing companies gain exemption from up to 90 per cent of electricity tax and energy-tax. This balancing-out of the peak level is granted solely if the company is operating an Energy Management System or respectively an Environment Management System (in the case of SMEs: implementation of an alternative system), and the manufacturing sector as a whole reaches the annual target value for reduction of its energy-consumption intensity. At present, all the favourable tax arrangements hitherto mentioned are being evaluated in terms of how well they attain their target and how necessary they are.

3.3. Dimension energy security

Natural gas

In Germany a range of market players and all gas-supply companies hold responsibility for supplying the general public with gas; they take on these tasks under their own responsibility. Before presenting the measures taken in the natural-gas sector, a look at the key protagonists:

- **Long-distance grid operators:**
These firms operate grids with border-crossing points or market-area crossing-points that, in particular, safeguard the integration of large European import connections into Germany's long-distance energy-transportation grid; (...) (they) hold responsibility for running operations in good order, for maintaining and (where necessary) for expanding a grid (...) cf. Energy Business Act, Art. 3 (5).
- **Distribution-grid operators – gas:**
The distribution-grid operators take on the task of distributing the gas, are responsible for operation, maintenance and, where necessary, expansion of the distributor grid in a certain area and, where applicable, the connection lines to other grids [cf. Energy Business Act, Art. 3 (7)]; municipal gas-works can form part of this category.
- **Operators of underground-storage facilities:**
These companies undertake to store natural gas, holding responsibility for operating a storage facility [cf. Energy Business Act, cf. Art. 3 (9)].
- **Party responsible for a market-area:**
This organisation is a natural person or a juridical person, designated by the long-distance grid operators, who provides services in a given market area that ... must be provided ... in order to effect an efficient implementation of gas-grid access in a given market area (...) [cf. Gas Grid Access Regulation (GasNZV), Art. 2 (11)]. It sources balancing energy to balance out physical differences between feed-in and feed-out. Has information at its disposal about that market area's supply situation.
- **Party responsible for the balancing group – gas:**
This organisational unit is a natural person or juridical person holding responsibility, in relation to the party responsible for a market-area, for ensuring that the balancing group functions as it should [Gas Grid Access Regulation, Art. 2 (5)]. They nominate gas quantities, interacting with the long-distance grid operators and the parties responsible for market areas as they do so, on behalf of their transport customers; they are responsible for managing the balance-circles; they are obliged to safeguard the availability of the given quantity and also to ensure that the balancing groups are well-balanced within the given market area.

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

Measures directed at attaining and – where necessary – improving security of gas supply in Germany

Securing supply to household customers

Because gas supply is only possible with secure and reliable grids, the long-distance grid operators and the distribution-grid operators take on a crucial role. In the case of measures taken according to the Energy Business Act, Art. 16, they must take into account the securing of supply to household customers. Above all, where there is a risk of bottlenecks in gas supply, the grid operation and the making available and planning of capacity resources, including transport capacity, must be put into effect in a way that safeguards household customers' security of supply for as long as possible.

Providing information

To ensure the gas supply, the long-distance grid operators/distribution-grid operators have the obligation, according to the Energy Business Act, Art. 15, Para. 2, to provide the necessary information to each other operator of gas-supply grids that is connected with their grid. Operators of storage facilities also have this obligation.

Grid-development plan – gas

The Energy Business Act, Art. 15, obliges the long-distance grid operators to jointly formulate the grid-development plan at two-year intervals. In it they jointly establish the infrastructure demand for the next ten years. The distribution-grid operators make necessary information available for this purpose. A ‘security-of-supply scenario’ is also always modelled into the grid-development plan, one in which assumptions are made regarding the ramifications that possible disruptions to supply could have (Energy Business Act, Art. 15a, Para. 1). After endorsement by the Federal Network Agency, this plan is binding for the long-distance grid operators. The grid-development plan is once again put under the spotlight, in more detail, under the term ‘infrastructure projects’ in Chapters 2.4.2. and Chapter 3.4.2., and (further down) for electricity.

Capacities for flows of load in both directions (‘Reverse Flows’)

The long-distance grid operators hold responsibility for creating lasting bidirectional capacity for load-flows in all interconnectors that cross borders. For this purpose, they cooperate with the long-distance grid operator adjacent to them. Of the 29 border-crossing-points in all, at present seven border points have bidirectional, physical load-flow capacity resources (not taking into account cross-border gas-storage connections). These capacities are available on a lasting basis. There is not at present a necessity for investments in ‘reverse-flow’ capacities to be made by adjacent, foreign grid-operators, to raise Germany’s security of supply; yet it is in prospect for such projects to get support.

Storage facilities

It is crucial for safeguarding security of natural-gas supply, especially in the case of bottlenecks, and for managing seasonal fluctuations in consumption, that sufficient storage capacity is available with a high storage performance. At present, 280 underground storage facilities are operated commercially, at 51 locations. They are spread over almost the whole of Germany, yet the north-west has regional points of emphasis due to its geographical characteristics. Consistent with the obligations that the companies running them have to secure supply, the responsibility for use of the commercial storage facilities lies with them; this is because they keep sufficient quantities in the underground storage facilities, especially to get through the cold period and to cover unexpected disruptions to supply.

Preventive Action Plan/Gas

The measures stated above, for attaining and, where necessary, improving supply security in Germany, are written in the Preventive Action Plan/Gas for the Federal Republic of Germany. This plan must be produced, according to Regulation (EU) No 2017/1938, Articles 8 and 9, on measures for safeguarding secure gas supply (previously Regulation (EU) No 994/2010, Articles 4 and 5). The Preventive Action Plan/Gas is built upon the results of the risk analysis that each Member State must undertake, according to Regulation (EU) No 2017/1938, Article 7, about measures to safeguard a secure gas supply (previously Regulation No 994/2010, Article 9). The Federal Network Agency conducts this risk analysis for the Federal Government, jointly with the Federal Ministry for Economic Affairs and Energy, with the gas industry’s support. The Preventive Action Plan/Gas determines measures to pre-empt a bottleneck in natural-gas supply; these fulfil the infrastructure and supply standard, reduce the likelihood of supply crises emerging, avoid regional supply bottlenecks, and increase resilience against crises in supply. With the entry into force of Regulation (EU) No 2017/1938, on measures to safeguard the secure supply of gas (amended Regulation (EU) No 994/2010), the national Preventive Action Plan, and the national rulings referred-to above, require a certain amount of adaptation.

Measures for eliminating or limiting the consequences of a disruption to natural-gas supply

Even if the supply situation for natural gas in Germany is secure and reliable to a high degree, for the event of a worsening of the supply situation companies and public authorities have the necessary national framework conditions and rights to shape what happens; this is the case in order to take appropriate precautions and to safeguard necessary cooperation by all those involved, and to ensure that the corresponding measures can be taken. In particular, alongside the already-mentioned Energy Business Act, it is the following national laws that provide the legal foundations for implementing the plans to deal with a crisis and emergency in Germany.

Act on Securing the Energy Supply – Natural Gas

This Act’s range of instruments, combined with the Gas Supply Regulation (GasSV), comes into use solely in the event of an emergency; its purpose is to secure vital supplies to meet the demand for natural gas if, firstly, natural-gas supply were directly in danger or disrupted and, secondly, measures consistent with a market solution cannot eliminate this endangerment or disruption at all, cannot do so in time, or can only do so by using disproportionate means. The

supply of resources to fulfil public tasks and international obligations, defined in the Act on Securing the Energy Supply, is also of vital importance. This Act's set of instruments is activated if the Federal Government establishes, by means of a Federal statutory instrument, that the energy supply is endangered or disrupted. Consent from parliament's upper house (the Bundesrat) is not necessary for this. To reach the above-stated objectives in an emergency, a Federal statutory instrument can issue rules, through the Act on Securing the Energy Supply, Art. 1, Para. 1, on

- 'production, transport, storage, distribution, supply, ordering, and use, and also maximum prices, for (...) fuels in the form of gas (...),
- (And can issue) requirements regarding book-keeping, proof, and reporting regarding the ... economic activities referred to, regarding quantities and prices, and also regarding other market relationships in connection with these goods.'
- In particular, a provision can be made, according to Paragraph 3 of this Federal statutory instrument, so that 'the supply, the ordering or the use of the goods may be restricted in terms of time, location or quantity, or may only be undertaken for certain prioritised supply purposes.'
- The duration of validity of such Federal statutory instruments is not permitted to extend beyond six months. Their duration of validity may be prolonged solely with the consent of the Bundesrat (parliament's upper chamber).

The Gas Supply Regulation was issued on the basis of the Act on Securing the Energy Supply. While gas-supply companies' market-based instruments and measures in Germany are anchored in law, especially in the Energy Business Act, it is the Act on Securing the Energy Supply and the Gas Supply Regulation respectively that establish sovereign authority to intervene.

Regulation on securing the gas supply in a supply crisis (Gas Supply Regulation)

Based on the Act on Securing the Energy Supply, i.e. solely in an emergency, the Gas Supply Regulation manages the transfer of gas-load distribution to the suitably authorised state bodies. If the Federal Government establishes that an emergency exists, by a Federal statutory instrument according to the Act on Securing the Energy Supply, the Federal Network Agency can issue decrees as energy-load distributor and intervene in the market. It may do so if an intervention serves the cross-regional interest, and there is a need to manage a balancing-out of electricity-business and gas-business issues, or to manage the use of gas storage facilities and other gas-supply installations that have supra-regional significance. The Länder can issue such decrees if an intervention has no cross-regional ramifications. Because a massive supply bottleneck usually has cross-regional effects, in an emergency the Federal Network Agency takes on a crucial role as energy-load distributor. The energy-load distributors can issue a decree requiring companies and business facilities that produce, source or supply gas, in addition to consumers, to amend existing contracts within a certain period or to conclude new contracts to this effect, if existing contracts cannot bring about the desired behaviour, or cannot do so quickly enough. In the decree, the customary charge must be established for a service; if no such charge exists yet, an appropriate remuneration must be established. The same principle must be applied to the remaining contractual conditions. The energy-load distributors are permitted to issue decrees solely if these are absolutely necessary to eliminate an endangerment of or disruption to the vital supply of gas, or to lessen its effects. The Gas Supply Regulation, Art. 1, empowers the state bodies entrusted with responsibility, as the energy-load distributors, to issue decrees to companies and business facilities that produce, source or supply gas, and also to consumers. Such measures constitute predetermined, non-market-based measures that execute sovereign state authority.

Possible measures in the context of the decrees, according to the Gas Supply Regulation, Art. 1

This can include the following measures and stipulations, for instance: increased supply of gas from storage facilities; replacing natural gas by petrol; replacing natural gas by other fuels; use of electricity not generated by using gas; restricting electricity generation in gas-fuelled power stations; raising the production level of natural gas; introducing rules governing the heating of public buildings; restriction of cross-border gas-flows; ordering the use of stored stocks of alternative fuels; in addition to further rules issued to end-consumers, large-scale consumers, and industrial customers.

Solidarity

For the first time, Regulation (EU) No 2017/1938 on measures guaranteeing secure gas supply, introduced a solidarity mechanism between Member States; its aim is to boost substantially the European gas system's capacity to withstand challenges that face it. Solidarity-based supplies serve as a final resource in a far-reaching, grave situation of gas scarcity in Europe. Solidarity-based measures mean that the effects of a severe emergency are distributed more evenly within the Union and are lessened. Bilateral agreements, among the Member States directly linked with one another, set rules for the technical, legislative and financial framework conditions for supplying gas on the basis of solidarity; this is done to guarantee the Member States' capacity to act as effectively as possible in a crisis. Germany is working intensively on structuring the possible sequence of activities for solidarity-based gas supplies and the ruling on reimbursement, connected with this. An intensive exchange of inputs between the Member States, especially in the realm of the Gas Coordination Group, is a feature of the solidarity mechanism's development. Agreements on items of the content, regarding the solidarity mechanism's basic principles, are scheduled to be reached bilaterally among the Member States by the end of 2018.

Emergency Plan/Gas

The above-mentioned measures to eliminate or to limit the consequences of a disruption to natural-gas supply, as defined in Regulation (EU) No 2017/1938, Article 10, are written in the Emergency Plan/Gas for the Federal Republic of Germany. It is a requirement to produce this plan, according to Regulation (EU) No 2017/1938, Articles 8 and 10, on measures to guarantee secure supply of gas (previously Regulation (EU) No 994/2010, Articles 4 and 10); the plan allocates three crisis-stages to the measures (early-warning stage, alarm stage and emergency stage). When a given crisis-stage is reached depends on the degree of severity of the disruption, the expected economic and technical consequences, and the urgency of eliminating the disruption at national level. With the entry into force of Regulation (EU) No 2017/1938, about measures to guarantee secure supply of gas (amended Regulation (EU) No 994/2010), the national emergency plan and the national rulings, referred-to above, must be adapted to a certain degree.

Petroleum

The most important legislative foundations, stating preventive-action measures to prepare for an oil crisis, are the Act on Securing the Energy Supply, the Oil Stockpiling Act, and the Petroleum-Related Data Act.

Act on Securing the Energy Supply – Petroleum

This Act's area of application encompasses, inter alia, petroleum and petroleum products. By Federal statutory instrument, rulings can be issued about the following (inter alia): production, transportation, storage, distribution and ordering of energy resources, including petroleum. In particular, measures restricting consumption can be provided for, where applicable, such as speed limits or driving-bans, through to possible rationing of the petrol supply. In the event of oil-supply disruptions that the market participants cannot absorb, or cannot absorb alone in the short-term, the release of oil reserves according to the Oil Stockpiling Act constitutes the first, priority action. Measures such as speed limits and (partial) driving-bans only come into consideration (at most) in the event of very severe and long-lasting supply crises.

Oil Stockpiling Act

In Germany, since 1966, there has been an obligation by law to stockpile petroleum and petroleum products. This was introduced with the aim of increasing energy security, at least in the short-term, against interruption to the inward flow of energy, in view of growing dependence on petroleum imports. The Oil Stockpiling Act was adapted more than once since then, not least due to European requirements and international developments.

This Act establishes comprehensive rules for stockpiling petroleum and petroleum products, to take precautions against any future crisis. Accordingly, the German National Petroleum Stockpiling Agency (EBV) was set up as an organisational body established in public law. It is directly owned by the Federal Government, has its headquarters in Hamburg, and is assigned with obtaining stock resources. It maintains 90 days' net import volume of petroleum in the form of crude oil, petrol, diesel, EL heating oil, and JET A-1 respectively. In the event of a supply crisis, the Federal Ministry for Economic Affairs and Energy issues a release regulation, in order to balance out the supply interruption by means of stock from the EBV.

Petroleum-Related Data Act

The Petroleum-Related Data Act serves as the legislative foundation for obtaining data on petroleum, from all the key companies that trade petroleum. The data on petroleum serves as the basis for regularly monitoring Germany's petroleum supply, but also for taking measures in the event of a crisis. To this end, each month the Federal Office of Economics and Export Control (BAFA) obtains, from the companies obliged to report their results, the data on import and export, on stocks and domestic turnover, for crude oil and for petroleum products. The data obtained serves the aim of preparing national and international precautions, particularly in providing information on the German petroleum market's latest developments.

Transport Performance Act (VerkLG)

A demand can emerge to obtain transport capacity resources, in the case of severe oil-supply crises in which the Federal Government, consistent with the Act on Securing the Energy Supply, has ascertained an energy-supply disruption; this disruption either cannot be eliminated by means consistent with market forces, cannot do so quickly enough, or cannot do so without deploying disproportionate means. In the event of a crisis, the 'public authority authorised to issue rulings', pursuant to the Transport Performance Act, Art. 7, is the Federal Office of Economics and Export Control; in such an event that organisation must issue an order that the 'coordinating public authority' (the Federal Office for Goods Transport; BAG) is required to perform transport services for the area of operation of the Federal Ministry for Economic Affairs and Energy. In the specific case of an oil-supply disruption, the Federal Office of Economics and Export Control would, in particular, have to specify which quantities of petroleum or petroleum products must be brought where. It must also highlight the available connections to transport providers, for instance, whether a particular storage facility or a refinery is linked up to the rail network or to waterways, or whether the product must be transported by road. The Federal Office of Economics and Export Control has this information.

Fuel Supply Restrictions Regulation

This regulation establishes the rules for possible rationing of fuels by means of rationing coupons. The basis for this is the Act on Securing the Energy Supply, combined with the determination made by the Federal Government that the energy supply is disrupted.

Heating-Oil Supply Restrictions Regulation

This regulation establishes the rules for possible rationing of light heating oil, based on a reference quantity for a preceding period. The basis for this is the Act on Securing the Energy Supply, combined with the official conclusion made by the Federal Government that the energy supply is disrupted.

Regulation on Balancing of Petroleum Resources

This Regulation enables supply to be balanced-out ('fair sharing') between over-supplied and under-supplied companies in the petroleum sector. In this regard the market structure should be maintained, as far as is possible, and petroleum supplied at market prices. The regulation can be applied accordingly, to fulfil international obligations arising from the international energy programme of the International Energy Agency. The legal basis for this is the Act on Securing the Energy Supply, combined with the official conclusion made by the Federal Government that the energy supply is disrupted.

Regulation on Management of Petroleum Resources

This Regulation establishes rules for a possible rationing of fuels and heating resources, and also their generation, distribution and use, to the benefit of the population, of the Federal German Army, and of the armed forces allied to them; it does so based on the Act on Securing the Operation of Industry and Trade and of Transfer of Money and Capital (WiSiG), in a case in which Germany's Basic Law (Grundgesetz), Article 80a, applies. Here also, the last-resort principle is used.

National Emergency Strategy Organization (NESO)

Alongside the previously-mentioned organisations, the National Emergency Strategy Organization (NESO) was set up. The term NESO summarises the public authorities, institutions and companies who, in the event of oil crises, actively cooperate on assessing such crises, on deciding about reaction measures, and also on such measures' implementation. What sustains NESO is a close cooperation between the public authorities and companies, including their associations. The secretariat of Germany's NESO coordinates the activities of the NESO participants. It provides support to the

crisis-supply council and the coordination group on supply, as they take care of their tasks; additionally, alongside the Federal Ministry for Economic Affairs and Energy and in coordination with it, this body has contact with the International Energy Authority.

The NESO Manual, a set of instructions on managing a crisis, has just recently been reworked.

Electricity

In Germany a range of market players, together with all electricity-supply companies, hold responsibility for supplying the general public with electricity; they take on these tasks under their own responsibility. Before presenting the measures in the electricity sector, a look at the key market players:

- **Transmission grid operators:**
Operate grids that serve the transportation of electricity via an ultra-high-voltage and high-voltage interconnectivity grid (respectively), including cross-border interconnectors (cf. Energy Business Act, Art. 3(10) and (32)).
- **Distribution-grid operators – electricity:**
Take on the task of distributing electricity, i.e. transporting electricity with high, medium or low voltage respectively (Energy Business Act, cf. Art. 3 (3) and (37)).
- **Responsible party for the balance-group – electricity:**
This organisational unit is responsible for a well-balanced interplay of feed-ins and withdrawals in a balance group, each quarter-hour; as the interface that connects grid-users and transmission-grid operators, it takes on the economic responsibility for deviations between a balance group's feed-ins and withdrawals (cf. Electricity Grid Access Regulation, *StromNZV*, Art. 4, Para. 2).

Because electricity supply is only possible in the context of secure and reliable grids, the long-distance grid operators and the distribution-grid operators take on a crucial role. According to the Energy Industry Act, Arts. 13 and 14, they must take the appropriate measures to safeguard the security and reliability of the electricity supply system. In fulfilling their supply obligations, the grid operators must coordinate their activities closely.

Measures for attaining and, where necessary, improving supply security in Germany

By itself, a functionally-capable Electricity Market 2.0, with free formation of prices, brings about the correct investments in power generation and flexibility. The Federal Government's strategies and measures to secure the energy system's adequacy and flexibility simultaneously create stronger incentives for the market players to secure their electricity supplies (see Chapter 3.4.3.ii.). Accordingly, the electricity market can refinance the necessary capacities, from within itself. In addition, security of supply in Europe must be safeguarded jointly.

The Federal Government also takes further measures that serve to achieve security of electricity supply, and to further improve it.

Operation of energy-supply grids

According to the Energy Business Act, Art. 11, energy-supply grid operators are obliged to run a secure, reliable energy-supply grid, capable of supplying its services, and not exercising discrimination; they must also maintain the grid and optimise it according to demand, strengthen it and expand it, provided that doing so does not constitute an unreasonable expectation in economic terms.

Providing information

The Energy Business Act, Art. 12, Para. 2, states that transmission-grid operators must provide the necessary information to operators of another grid, with which their own transmission grids are technically connected, in order to safeguard secure and efficient operation, coordinated expansion, and interconnectivity.

Grid Development Plan – Electricity

The transmission-grid operators have an obligation, according to the Energy Business Act, Art. 12b, to jointly formulate a Grid Development Plan every two years. In it, they jointly establish the infrastructure demand for the next 10 to 20 years. After the Federal Network Agency has confirmed these projects and included them in the Federal Demand Plan according to the Energy Business Act, Art. 12e, the projects included in it are binding. The Grid Development Plan is once again put under the spotlight, in more detail, under the term ‘Infrastructure projects’, in Chapters 2.4.2. and Chapter 3.4.2. and, further up in this document, for gas.

Grid reserve

According to the Energy Business Act, Art. 13d, the transmission-grid operators reserve facilities to safeguard the security and reliability of the electricity-supply system. In particular, they do this to manage grid bottlenecks, to maintain the voltage, and also to safeguard a possible re-establishment of supply (grid reserve).

Capacity reserve

The Energy Business Act, Art. 13e, requires the transmission-grid operators to retain reserve output; this is done, in the event of the electricity-supply system’s security or reliability being endangered or disrupted, to balance-out any shortfalls in output balance; such shortfalls may emerge due to an incomplete balancing-out of supply and demand on the electricity markets, in Germany’s regular grid system (capacity reserve).

Monitoring the security of electricity supply

The Federal Ministry for Economic Affairs and Energy continually monitors the security of electricity supply. Among other aspects, the monitoring relates both to the supply and demand on the European electricity markets, and to the grids. This involves modelling numerous scenarios that reflect the various supply/demand situations in the EU Member States and the cross-border trade in electricity, associated with it. So a realistic picture of security of supply in Germany can be produced, taking into account the country’s close integration into the European electricity system. To monitor the level of security of supply, it is necessary to assess realistically the contribution that cross-border trade in electricity makes to supply security, also in times of crisis. Standards are currently being developed in Europe for this purpose, regarding how a calculation of the level of security of supply is made, so as to reflect all relevant effects appropriately. Prior to this, the German Report on Security of Supply will already apply its own standards. Germany also takes part in production of a regional Report on Security of Supply, in the context of the Pentilateral Energy Form (see Chapters 3.3.ii. and 3.4.); this is likewise based on these standards.

Measures for eliminating or limiting the consequences of a disruption to electricity supply

The measures and rules referred-to above for the gas sector, in the event of a disruption to the gas supply, are very similar to those used for the electricity sector. Firstly, the transmission-grid operators are entitled to take grid-related and market-related measures, according to the Energy Business Act (*EnWG*), Art. 13, and also to deploy the grid reserve and the capacity reserve, to eliminate risks or disruptions to the electricity supply. In a next step, if these instruments are insufficient, the transmission-grid operators are entitled and obliged to adapt all incoming supplies of electricity, electricity-transit activities, and electricity withdrawals. If this is also not enough, and there is the threat of a disruption of the energy supply, endangering the ability to cover essential energy demand, the body of measures available according to the Act on Securing the Energy Supply, and regulations accompanying it, are put into effect:

Act on Securing the Energy Supply – electricity

This Act includes rulings for the event of an acute energy crisis; its aim is to eliminate disruptions to supply, introducing counter-measures, and to maintain the energy supply. It relates to all energy forms and fuels. A characteristic feature of this Act is its detailed framework of authorisation to issue Federal statutory instruments. In the event of a risk to, or disruption of, imports of petroleum, petroleum products, natural gas, or also of electrical energy, Art. 1 includes authorisation to deploy Federal statutory instruments to take the necessary measures in securing the vital need for energy. Based on the Act on Securing the Energy Supply, the Electricity Securing Regulation (*EltSV*) has been issued for the electricity sector.

Regulation on Securing the Electricity Supply in a Supply Crisis (Electricity Securing Regulation – EltSV)

This Regulation converts the Act on Securing the Energy Supply into specific arrangements for the electricity sector. It empowers the energy distributor, who takes up this task in the event of a crisis, to take measures at all stages of the energy-sector's value chain. That distributor can issue decrees to consumers regarding the allocation, the supply and the use of electrical energy, and regarding exclusion from supply of electrical energy. Whereas the Electricity Securing Regulation is in force, it can be applied solely if a further Federal statutory instrument establishes that an endangerment or a disruption to the energy supply has emerged and that it should be applied.

Regulation on Electricity-Load Distribution (EltLastV) and General Administrative Ruling on the Regulation on Electricity Load Distribution (EltLastVwV)

In the event of tension and issues of defence, special rulings are applied to eliminate or lessen the consequences of a disruption to the electricity supply. If the parliament (*Bundestag*) has ascertained that a case of tension or of relevance to defence exists, or it has given particular consent to such a measure, the Federal Government can use power of decree to manage the electricity supply, for purposes of defence, based on the Act on Securing the Operation of Industry and Trade and of Transfer of Money and Capital. It was on the basis of this Act that the Regulation on Electricity-Load Distribution has been issued. The Regulation's objective is to maintain the electricity supply in the event of tension or of a case relevant to defence, with the help of state measures to manage the resources. This item of legislation encompasses the whole sphere of generation, distribution and use of electricity, according to the General Administrative Ruling on the Regulation on Electricity-Load Distribution. Like the Electricity Securing Regulation, the Regulation on Electricity Load Distribution cannot be applied unless a further precondition is met – its applicability must be established by means of a further Federal statutory instrument. In addition, like the Electricity Securing Regulation (*EltSV*), the Regulation on Electricity Load Distribution (*EltLastV*) also authorises the power-load distributor to take measures at all stages of the energy-sector value chain.

Measures in the event of a production shortfall

If a production shortfall threatens, as defined by the Act on Securing the Energy Supply, the transmission-grid operators must notify the Federal Network Agency of this immediately. Faced with such a production-shortfall, the Federal Government can issue a Federal statutory instrument, determining that a crisis has emerged, as defined by the Act on Securing the Energy Supply; it can then transfer to the Federal Network Agency, with the latter operating as the Federal distributor of energy loads, based on the Electricity Securing Regulation, the task of issuing decrees to cover the essential demand for electricity; this is done, for instance, by switching-off certain resources, or by supplying on a priority basis to installations that perform vital functions.

Conducting stress tests

The Federal Government announced in its coalition agreement that it will use stress tests regularly to check how events are developing in terms of grid bottlenecks; this is in order to deduce from this what action is essentially needed to secure supply (see Chapter 3.4.).

3.3.ii. Regional cooperation in this area**Natural gas*****Solidarity among EU Member States within the framework of the SOS Directive (EU) No 2017/1938***

In the context of precautions to combat crises, and alongside the national structures, regional structures will be outstandingly significant in the future. The amended SOS Directive means that, for the first time at European level, stipulations were introduced on solidarity among the EU Member States, to safeguard security of gas supply in extreme situations. Germany is pursuing the objective of developing a solidarity mechanism, making it possible to provide fast and effective support to the Member States afflicted in a gas-supply crisis. The aim is to strengthen the contribution that market-based measures make in overcoming the gas crisis, in order to utilise, as much as possible, the potential in market participants' voluntary, demand-side-based reactions in mastering the crisis. The plan behind developing a robust ruling on reimbursement is security of planning and transparency, for the Member States that request solidarity and for the market participants affected. It is a priority to Germany to interact with the neighbour states, early and intensively, in developing the solidarity mechanism; this is so that the requirements resulting from the respective national legislative frameworks can be identified in good time and taken into account.

Gas Coordination Group

Within the framework of the Regulation (EU) No 2017/1938, a so-called Gas Coordination Group must be set up, to be used as the platform for all topics relating to security of supply or respectively to a disruption to security of natural-gas supply.

Consultations on the Preventive Action and Emergency Plan

In the future, in the context of crisis precautions stated in Regulation (EU) No 2017/1938, and alongside production of national risk analyses, it is also essential to produce the above-mentioned national preventive action and emergency plans, to make provision for risk. Consultations on these are held with the relevant public authorities of all neighbouring EU states (including Italy, Sweden, and Slovakia), in addition to Switzerland.

Risk groups

With the entry into force of the Directive (EU) No 2017/1938, regarding measures to safeguard secure supply of gas, the national Preventive Action and Emergency Plans must be supplemented by a chapter on regions. These chapters are being jointly formulated in so-called risk groups. Germany has taken over the role of chairing the 'Baltic Sea' risk-group; it also collaborates in six other risk groups.

Pentalateral Gas Forum

Since 2009 the following five countries – Belgium, Luxembourg, the Netherlands, France and Germany – have been interacting on the topic of securing gas supply and on the latest gas-related issues. The Netherlands already announced years ago that it will reduce the provision of support to low-calorie gas, so-called 'L-Gases'. Subsequently the exports of L-Gas to Belgium, France and Germany will be reduced. This is why market-area switchover operations were launched in France, Belgium and Germany, where the gas-consumption equipment is being changed to work with higher-calorie gas. In the Pentalateral Gas Forum, the countries affected exchange information and viewpoints on how the market-area switchovers are developing.

Cooperation in regional groups in the context of the trans-European energy networks (TEN-E regional groups) – Gas

As regards gas infrastructure, there are four priority energy-infrastructure corridors within the TEN-E regional-groups' framework, in which Germany is listed as a Member State affected and thus a member of the corresponding regional group. This includes the Baltic Energy Market Interconnection Plan (BEMIP) on gas (note that this is not the BEMIP cooperation forum – see Chapter 1.4.), the North South Interconnection (NSI) East Gas, and NSI West Gas, as well as the Southern Gas Corridor.

Petroleum

Germany's precautions for an oil crisis are internationally integrated both within the European Union (EU) and supranationally in the International Energy Agency (IEA) context. The respective petroleum stockpile-building organisations are integrated into the activities of the EU and IEA working groups.

Cooperation in regional groups in the context of the trans-European energy networks (TEN-E regional groups) – Oil

For oil-infrastructure, within the TEN-E regional groups' framework, there is also an energy-infrastructure corridor for oil – namely Oil Supply Connections in Central Eastern Europe (OSC) – in which Germany participates as a member.

Annual Coordinating Meeting Entities Stockholding (ACOMES)

As part of the ACOMES framework, petroleum stockpiling associations are established. They exchange inputs annually on specific, subject-specialist topics and new developments.

Electricity

In future, in the context of precautions to combat crises, and alongside the national structures, regional structures will also gain greater significance. Consistent with the draft presented by the European Commission, for a regulation on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC, provisions are to be introduced (for the first time) on EU Member States' support among one another, in order to jointly safeguard the security of electricity supply, even in extreme situations (see Chapter 2.3.i.). The trilogue negotiations on this draft regulation were successfully concluded on 22 November 2018. It is to be expected that the regulation will come into force in 2019.

Cross-border consideration of security of supply in the electricity market

Security of supply in the electricity market must be considered on a cross-border basis, because the individual electricity markets are coupled together to a large degree. A purely country-specific consideration would incorrectly estimate the actual level of security of supply. Yet the evaluation of security of supply should take degrees of probability as its orientation point. The Federal Government plans to further develop the monitoring of security of supply, with probability-based approaches of this kind. The target level is established as part of this, to assess the actual security of supply and, where applicable, to be able to determine necessary measures. More information on this is to be found in Chapter 3.4.

Pentalateral Energy Forum – Security of Electricity Supply

Since 2015, the Penta States' transmission-grid operators have been regularly publishing a joint regional report on security of supply. This is built up using the same methodology as the national report (see above) and the European Mid-Term Adequacy Forecast. In addition, in 2018 the Member States held a first joint crisis exercise, conducted with the transmission-grid operators, the regulatory authorities and the ministries in the region. The exercise's intention was to prepare the Member States for a closer cooperation, consistent with the regulation on risk-precautions in the electricity sector. More information on this is to be found in Chapter 3.4.

3.4. Dimension internal energy market

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)

Projects for expansion of interconnectors in the Power Grid Expansion Act (EnLAG) and the Federal Requirement Plan Act (BBPIG)

To reach the requirements stated in Article 4(d), provision is made for ten interconnector projects in the Federal Republic of Germany, in the context of the Grid Expansion Act or respectively the Federal Demand Planning Act (Tables A11 and A12). For the most part these are also designated Projects of Common Interest (PCI). The projects in Table A11 are already under construction and their operational launch is planned before 2020. If these projects are implemented the Article 4(d) indicators could be fulfilled. In the current Grid Development Plan – 2017–2030 – a further five projects were confirmed by the Federal Network Agency (Table A13); one of these is likewise a PCI. However, these projects are subject to a renewed examination, based on the cost-benefit analysis provided for by the Governance Regulation's Article 4(d) (1). When these projects are reviewed once again, based on a cost-benefit analysis, the price difference in relation to the neighbouring countries affected (France, Switzerland, Sweden, and Belgium) will play an important role. The year-2030 objective of 15 per cent could likewise be reached, subject to complete and on-schedule implementation of all projects named in Tables A11, A12 und A13.

Table A11: Interconnectors under construction, scheduled to commence operation by 2020

Projects	No. acc. to EnLAG/BBPIG	TYNDP no	Target date acc. to current BNetzA Monitoring	Europ. Status
Germany–Denmark (Kriegers Flak Combined Grid Solution, P64)	BBPIG No. 29	36/141	2018	PCI 4.1
Germany–Poland (Uckermark line) Neuenhagen – Krajnik	EnLAG No. 3	94/139	2020	PCI 3.15.1
Germany–Norway (NordLink Germany–Norway, P68)	BBPIG No. 33	37/142	2020	PCI 1.8
Germany–Netherlands Niederrhein/Wesel – NL Doetinchen	EnLAG No. 13	113/145	implemented	PCI 2.12

Table A12: Further interconnectors scheduled to commence operation 2020–2030 / ENLAG und BBPIG plan*

Projects	No. acc. to EnLAG/BBPIG	TYNDP no	Target date acc. to current BNetzA Monitoring	Europ. Status
DEU–DK (Mittelachse) Kassø – Hamburg Nord – Dollern	EnLAG No. 1	39, 251	2020	PCI 1.4.1
DEU–PL ('third interconnector') Eisenhüttenstadt – Baczyňa	EnLAG No. 12	229/230	(2030) (PL moved this back)	
DEU–DK (west-coast line, Niebüll – DK border, P25)	BBPIG No. 8	183	2021	PCI 1.3.1
DEU–AT (Measures M94b/M95: Lake Constance/Neuravensburg – national border AT)	BBPIG No. 25	198	2020/23	
DEU–BE (Alegro Oberzier – border with BE, P65)	BBPIG No. 30	92	2020	PCI 2.2.1
DEU–AT (Isar – St. Peter: Altheim – national border with AT, P67/P112)	BBPIG No.. 32	47/187	2020/22	PCI 3.1.1

* Acc. to Federal Network Agency information (www.netzausbau.de/leitungsvorhaben)

Table A13: New Interconnectors (not yet in the BBPI Plan (BBPI); confirmed in the Grid Development Plan 2017–2030)*

Project	TYNDP-no.	Targeted launch of operation acc. to ÜNB	Europ. Status
DEU–FR (Uchtelfangen – FR border, resizing, P170)	244	2030	
DEU–FR (Eichstetten – FR, new construction in existing track, P176)		2025	
DEU–CH (Tiengen – CH, new-build in existing road, P204)	231	2025	
DEU–SWE (Hansa PowerBridge, P221)	176	2025/26	
DEU–BE (ALEGRO II, P313)	225	2025	PCI 2.2.4

* Acc. to Federal Network Agency information (www.netzausbau.de/leitungsvorhaben)

3.4.1.ii. Regional cooperation in this area

Regional cooperation projects and cooperation reach beyond electricity infrastructure; for Chapter 3.4., on the internal energy market as a dimension, they are presented grouped together in Chapter 3.4.3.vi.

3.4.2. Energy transmission infrastructure

3.4.2.i. Policies and measures related to the elements set out in Point 2.4.2., including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

Electricity Grid Action Plan

The Electricity Grid Action Plan contains a double strategy in response to the growing challenges surrounding the increasing demand for transport, described in Point 2.4.1. On the one hand, the existing grids will be optimised and will have higher use of capacity. This includes technical optimisations and modernisations, new technologies and operating concepts, in addition to an improved management of bottlenecks. On the other, the grid expansion is being speeded up. This includes forward-looking controlling operations on the grid expansion; acceleration of the planning and approval procedures by means of easier procedures, and economic incentives for the grid operators. The following provides further details on some of the measures in the Electricity Grid Action Plan.

Monitoring the grid-expansion projects for electricity and gas

For the energy transition to succeed, it is extraordinarily important to promptly expand the German and also the cross-border transmission-grid infrastructure. As far as possible, the Federal Government also wants to use the latest technologies for the grid expansion. Simultaneously, for all grid-expansion projects stemming from the Grid Development Plan for electricity and gas to be implemented on time, it is important to have regular, transparent and realistic monitoring. This is why, since early 2016, the Federal Network Agency produces and publishes a quarterly monitoring report for the grid expansion, about the individual Power Grid Expansion Act and Federal Requirement Plan Act projects, as well as offshore windparks' connection lines (www.netzausbau.de). In addition, regular discussions are held between the Federal Ministry for Economic Affairs and Energy, the Federal Ministry of the Environment, the Federal Network Agency and Germany's Länder. For expansion of the long-distance power-line infrastructure used for gas, according to the Energy Business Act (*EnWG*), Art. 15b, the long-distance grid operators are obliged to produce a joint implementation report for the respective Grid Development Plan in the following year. This report must contain information on the implementation status of the most-recently published Grid Development Plan, i.e. the current implementation projects from the last Grid Development Plan, the actual planning status and, if implementation is delayed, the key reasons for this. The Federal Network Agency checks and publishes the respective implementation reports, giving all actual and potential grid-users opportunity to state their position. The outcome of any such observations can be integrated into rules for the next Grid Development Plan or for other regulatory procedures.

Controlling on the grid-expansion projects for electricity and gas

To reach the approval and implementation targets for all Power Grid Expansion Act and Federal Requirement Plan Act projects respectively, the plan for the future is that specific target agreements are to be reached with a forward-looking Controlling operation that includes all participants in the procedure. The aim with such a forward-looking Controlling activity, including the already-existing monitoring and checking on the degree of success, is that the target agreements will indeed also be fulfilled.

Optimising and modernising the existing grids

It is an aim anchored in the present government's coalition agreement to optimise and modernise the existing grids. The grid operators are obliged to operate, optimise, reinforce and expand the electricity grid in accordance with demand. Priority is given to grid optimisation, rather than to reinforcing and expanding the grid. To optimise the existing grids, various measures are planned that raise the transmission capacity of the existing electricity grids. Among other things, this includes the comprehensive roll-out of free-line monitoring (temperature measurement enables higher transmission capacity of the lines, dependent on the weather); short-term interim measures (especially phase-shifters); the optimisation of redispatch processes, and introduction / further development of modern, digital technologies and system-management concepts.

Faster expansion of the electricity grids

To speed up the expansion of the electricity grid, still urgently needed, the Acceleration of Grid Expansion Act – Transmission Grid (NABEG) is to be amended; this is to simplify planning and approval procedures without thereby lowering European environment standards or limiting the general public's involvement. Especially regarding grid optimisa-

tion and reinforcement, approval procedures are to be speeded up, for instance through notification procedures in the case of recabbling and additional cabling. A forward-looking planning process is also to be made possible to address future demand. In December 2018 the Federal Government adopted a draft act of law to this effect.

Remuneration incentives and regulation of incentives

The aim of regulating incentives is to incentivise grid operators to pursue behaviour consistent with being in a situation of competition. As natural monopolists, they are permitted to retain only those revenues which a company would have attained in a competition-based business environment. Regulation of incentives thereby aims at cost-efficiency among electricity and gas grid operators, as monopolising suppliers; it also aims at limiting grid costs, in the interests of all industrial, commercial and private customers. In this, the costs of each grid operator are checked every five years for their 'efficiency' (so-called 'efficiency comparison'). This is about having a total-costs benchmark, including capital costs and operating costs. The efficiency value, calculated from the efficiency comparison, reflects the grid operator's expenditure of resources, made in fulfilling its assignment to supply energy. For a five-year period (regulation period) the grid operators then have a certain budget made available to them to fulfil their tasks (upper limit of revenue). If the grid operators exceed the efficiency requirements, they are permitted to keep the additional income flows for the duration of the current regulation period. It is now being checked to what extent important economic incentives can be given for the grid operators, to prompt them to expand the grid faster, and to advance an optimisation and modernisation of the electricity grid. For instance, up to now the costs of bottleneck management are not subject to the efficiency comparison, as costs not subject to influence, on a lasting basis; thus there is no economic incentive to minimise bottleneck costs. Against this background, alternatives are being examined for dealing with the costs of managing bottlenecks.

3.4.2.ii. Regional cooperation in this area

Regional cooperation projects and cooperation go beyond energy-transmission infrastructure; for Chapter 3.4. on the dimension 'internal energy market', they are shown grouped together in Chapter 3.4.3.vi.

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

Sector coupling

Sector coupling, i.e. efficient use of electricity from renewable energies, is to be driven forward in order to replace fossil fuels in the activity areas of heating and transport. For this, a check is to be made on how obstacles to sector coupling can be reduced. The aim is to create a 'level playing field' for the various sector-coupling technologies. Initially, provision and further development of the cross-regional and local energy infrastructure serve as preconditions for a functional sector coupling. This is why the energy infrastructure elements are to be expanded, and further developed in a cost-efficient way that prepares them for the energy transition, so as to make them usable for sector coupling. This is supported by programmes and demonstration projects, e.g. for options which can be implemented quickly and at favourable costs, for expanding the energy-charging infrastructure, or efficient heating-grids that use renewable energies. In addition, fair competitive conditions are being created to decide, out in the marketplace, which technologies prevail and thus come into use. This gives incentives to innovations and modern technologies are introduced to the market. Ideally an efficient sector coupling, and thereby CO₂ reduction, would primarily be made possible on a market-driven basis, without lock-in effects via price signals. For sector coupling to be able to contribute substantially to attainment of the Energy Concept and the Climate Action Plan 2050 targets, there are preconditions; in all sectors the framework conditions must be improved for efficient use of electricity from renewable sources, with additional power-generation capacity being provided, together with the transport capacity that then becomes necessary in the electricity transmission and distributor grids.

Stepwise phase out of coal-based electricity production

A step-by-step reduction and phasing-out of coal-based electricity production is envisaged. On 06 June 2018 the Federal Cabinet set up a Commission on 'Growth, Structural Change and Employment' (see also Chapter 3.1.1.i.). This brings together various market players, from politics, business, environment associations and trade unions, as well as the Länder and regions affected, to address the question of structural change through gradual reduction of coal-based electricity production. Based on the Action Programme on Climate Protection 2020 and the Climate Action Plan 2050, by February 2019 the commission is to formulate an action programme with the following elements:

- a plan for step-by-step reduction and phasing-out of coal-based electricity production, including a date of termination and the necessary accompanying measures, of a legislative, economic, social and structural-policy nature,
- financially securing the necessary structural change in the affected regions and a fund for structural change, financed by the Federal Government,
- measures for closing the gap, as far as possible, between current status and attainment of the 40-per-cent reduction target for greenhouse-gas emissions by 2020, and
- measures that reliably reach the year-2030 target on emissions reduction for the energy sector, including a comprehensive assessment of the consequences.

Step-by-step, coal-based electricity capacity is to be substituted by renewable-energy installations and, as an interim technology, by low-CO₂, natural-gas-fuelled power stations, which usually operate on combined heat and power generation (CHP). On enhancing the flexibility of CHP facilities, see 'Flexible CHP facilities as an interim technology' – Point 3.4.3.ii. Strategies and measures for increasing flexibility.

National Action Plan for Reducing Grid Bottlenecks

The latest status is that the European Electricity Market Regulation plans for Member States to either draw up their offer zones anew or present an action plan in order to address their internal, structural grid bottlenecks. The action plan is to contain specific measures and a schedule. To limit, at a level that can be dealt with, the redispatch quantities and the associated costs for the electricity consumers, Germany is producing an action plan on reduction of grid bottlenecks, as a precaution, according to the European Electricity Market Regulation, Article 13. On the one hand, this is

to contain grid-related measures: They aim at raising transport capacity through the expansion; they also strive at achieving better capacity-use of the existing grid. On the other hand, power-generation-related measures are planned: Their approach-point is the production resources from conventional and renewable energies respectively, and they counteract the geographical separation of production and use of the energy-load. Lastly, redispatch-related measures are also to be taken: These can capitalise on unused elements of potential for redispatch and cost-savings, thereby lowering the redispatch costs (cf. Section 3.4.3.). The aim of these measures is to reduce costs to the economy and to raise the electricity grids' capacity-use, even prior to completion of the large interconnectors for high-voltage, direct-current transmission. Because the redispatch quantity is a fundamental driver of grid-bottleneck costs, from 2019 Germany will check annually how the grid bottlenecks are developing and will deduce the necessary action requirements ('stress-test').

Cross-border action plan to reduce grid bottlenecks

Alongside national measures, the action plan is also to contain cross-border measures. Many measures that have a positive impact regarding grid bottlenecks can only be put into place jointly with the neighbouring countries, for instance because they require coordinated activity. An example of this is an optimisation of cross-border redispatching; this can only be done together with Germany's neighbours.

The Federal Government is also planning a cross-border action plan with Belgium. The Belgian exit from nuclear energy, to be concluded by 2025, will change the relevant region's situation in terms of power generation. Simultaneously, based on the EU Electricity Market Regulation, the borders in the region are being opened step-by-step. Both factors will have an impact on electricity trading and the grid situation.

Measures to promote better market coupling

Creation of a Capacity Calculation Region for Central and Eastern Europe ('CORE')

Various initiatives aim to improve the integration of the German bidding zone into the European markets. To this end, the 'flow-based market coupling' (FBMC), was initially set up in May 2015, between the Pentalateral Energy Forum countries (except Switzerland; see Chapter 3.4.1.ii.). This flow-based capacity calculation is intended to create better capacity use of the existing grid infrastructure. Here the market coupling initially relates to the previous day's electricity trading ('Day Ahead'). By now, flow-based market coupling is also established as the target model for almost all EU Member States in the Network Code Capacity Allocation and Congestion Management (CACM). So flow-based market coupling is now to be extended, in a second stage, to a joint Central European and Eastern European Capacity Calculation Region (CORE). This is due to a resolution in November 2016, passed by the Agency for the Cooperation of Energy Regulators (ACER). Likewise, work is in progress in relation to Denmark and Sweden, to establish uniformity in capacity calculation, albeit still without a flow-based market coupling.

Coupling the intra-day electricity trading

Alongside the cross-border day-ahead market, the significance of the cross-border intra-day trading is also growing. This is supported by two parallel processes, directed at optimisation of trading capacities during a given day: firstly, the so-called XBID project (Cross-Border Intra-Day), linking up the intra-day markets in northern, western and southern Europe since June 2018, initially on the basis of conventional award of capacity. Work is already under way to extend this market coupling to eastern Europe. Secondly there is the expansion of flow-based market coupling to include the intra-day trade. Both measures help in enabling the cross-border electricity markets to exchange elements of flexibility, also at short notice, i.e. the system is just short of operating in real-time; in this way, the markets can jointly respond at short-notice to changes in production 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

Ensuring an adequate energy systems

The Federal Government's goal is to keep the Electricity Market 2.0 able to function and to jointly safeguard security of supply in Europe. The electricity market then brings about the correct investments in production and flexibility, by itself. This free price formation was anchored in the Energy Business Act. Simultaneously, market participants have received stronger incentives to secure their electricity supplies. These measures have strengthened the existing market mechanisms. Thus the electricity market can refinance the necessary capacities, from within itself.

Further measures for a flexible and efficient electricity supply

For instance, this includes new fields of cooperation for the European electricity markets, the further development of balancing-energy markets, and discussions about the future structuring of grid remuneration. Various national measures secure the Electricity Market 2.0. Integration of the European wholesale electricity market must be promptly completed, to define security of supply on a European basis, to have sufficient capacity available in the joint internal market in situations of scarcity, and to be able to actually transport the electricity across the borders. Regional cooperation initiatives advance the process of integrating the European electricity markets.

Safeguarding the energy system's flexibility

The Federal Government's goal is to decrease obstacles to flexibility, giving all technologies the same market access. For the first time, in an arduous process, the Federal Ministry for Economic Affairs' papers – 'An Electricity Market for the Energy Transition' (Green Paper on Electricity) from October 2014, and the White Paper on Electricity, from July 2015 – have stated all obstacles to flexibility and discussed measures for eliminating them. Some of these measures were already implemented in the Electricity Market Act of July 2016. The Results Paper 'Electricity 2030' by the Federal Ministry for Economic Affairs built upon these insights and looked at which obstacles to flexibility are still present and could emerge by 2030, in addition to which measure can eliminate them.

Measures to ensure flexibility

Expanding grids according to demand and modernising them

Extensive electricity grids rank among the most cost-effective ways of creating flexibility. So it is especially important to reduce obstacles in order to expand and modernise grids promptly, thus creating more flexibility in the electricity market.

Further integrating European electricity markets and making them more flexible

The European electricity system helps in the response to flexible production and consumption, thus reducing the total costs of electricity production and the demand for capacity. In particular, wind and solar energy are to be integrated by means of intra-day trading in Europe, so as to be just short of operating in real-time. In addition, the lead markets for intra-day and day-ahead trading are to be strengthened (for details, see measures for better market coupling in Section 3.4.3.i).

Fair grid financing, serving the system's interests

The goal is for the grid remuneration system to support the grid users by helping them to contribute, through their market behaviour, to secure and favourably-priced electricity supply. For this, the systemic approach to grid remuneration must be adapted to a modern electricity system. A check is being made on how best to reduce obstacles to market-driven flexibility of producers and consumers, without thereby incentivising the grids to acquire inefficient dimensions.

Implement the 'using instead of curtailing' measure

In the context of the 'using instead of curtailing' measure (Energy Business Act, Art. 13, Para. 6a), CHP installations take on an obligation, in relation to the transmission-grid operators; they commit themselves both to curtail their CHP-electricity input in the grid-extension areas particularly at risk of bottlenecks, if the transmission grid has a bottleneck, and to generate the necessary heating through a power-to-Heat (PtH) facility. This eases the load on the grid bottleneck and avoids a curtailment of electricity from renewables, matching the extent of the CHP-input reduction and of the additional consumption from the PtH installation. The system's overall flexibility is increased: CHP facilities equipped with electrical-heat generators can now operate flexibly on the electricity market, as sources of supply and demand, and the transmission-grid operators can deploy this flexibility potential in running the grid.

Flexible CHP facilities as an interim technology

From today's perspective, modernised CHP facilities can make an important contribution to GHG reduction until approx. 2030 and also play a role beyond then. To do this they must save emissions on the electricity and heating markets and react flexibly to the fluctuating input of renewable energies. The Federal Ministry for Economic Affairs wants to create pilot projects for modernised CHP facilities; it is therefore initiating tender processes for projects that set up innovative CHP systems. The aim is that the innovative CHP systems show how CHP facilities in general can integrate renewable heating and renewable electricity by responding with double flexibility. At time of high feed-in levels of heating from renewable energies, the CHP facility's heat production is reduced, thus saving fuels and emissions. At times of high feed-in of electricity from renewable energies, the CHP facility reduces its electricity generation, once again saving fuels and emissions. Additionally, if there is a very strong supply of electricity from renewables, and thus low or declining power-exchange prices, the electric heat-generator can ease the burden on the electricity market. The technology converts rigid minimum production, conditioned by heating factors, into flexible demand for electricity. To resolve acute grid bottlenecks, CHP is also deployed in the context of the 'using rather than curtailing' rule. In the future, CHP is to be further developed and comprehensively modernised, to give it a future in the energy-transition context. On this topic, representatives of the Federal Ministry for Economic Affairs, the Federal Ministry for the Environment, the parliamentary parties, the trade associations and the Länder are currently discussing various options for action. Yet even before the outcome, adaptations to funding support are needed, due to the EU law on state aid, so as to avoid giving too much funding support to individual segments in terms of installation type. So the relevant ruling is being adapted in the so-called Omnibus Energy Act (draft legislation by the Federal Government, dated 05 November 2018).

Optimisation measures on redispatch

The objective is that renewable energies will account for a growing share of electricity generation, and that sector-coupling will make advances; thus it is becoming increasingly important to consider how the interplay between the electricity market and the electricity grid can be arranged so that the whole system can be operated securely, in a cost-favourable way. The measures currently envisaged include the following:

- Higher capacity-use on the existing grid, to raise the grids' transport capacity.
- Organising redispatch more efficiently, to make the step-by-step switchover of current feed-in management into a plannable process with a balancing-out, both in energy-use terms and in commercial transaction terms. To this end, the Federal Ministry for Economic Affairs is taking care of the research project 'Development of measures to advance efficient safeguarding of system security in the German electricity grid'.
- Cross-border redispatch. This is why the Federal Ministry for Economic Affairs began the research project called 'Study into purchasing of redispatch'. This is about quantifying the reduction potential that cross-border redispatch has. The project also includes studies into a (European) framework of arrangements, ensuring that foreign capacities are sufficiently securely available, and that the issue of cost reimbursement/cost distribution is clarified. Independently of this research project, as part of Code Capacity Allocation and Congestion Management (CACM, Arts. 35 and 74), transmission-grid operators and regulators are developing a method for coordinated, cross-border redispatch and for a cross-border division of the costs.

Flexibility check

At present there are still rulings that make it harder for market participants to act flexibly – so-called barriers to flexibility. If all technologies are to get the same market access, this means eliminating these obstacles. It is especially cost-favourable if the various options for flexibility – expanded electricity grids, flexible power plants and consumers, storage facilities, trading electricity with the European neighbours – enter into competition against one another (Electricity Market 2.0). No particular technology should gain preference because it gets unilateral funding support and is granted exceptions. The market can decide the question better. Thus the decision was adopted, jointly with the EU neighbours in electricity use, that Germany and those neighbours are to conduct a so-called flexibility check. The purpose is to identify and strive to eliminate obstacles to further increases in flexibility in the electricity market. Based on this survey's results, areas of flexibility potential in Germany and in other countries can also be ascertained and integrated into the market.

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

In Germany, competition is high among the suppliers in the retail energy sector. Today there are already as many players operating on the German electricity market as hardly anywhere else in the EU. According to the Monitoring Report 2017, by the Federal Network Agency and the Federal Cartel Office, no supplier of electricity or gas has a market-dominating position. Recent years have brought a constant increase in the number of electricity and gas providers in Germany. In 2016 more than 1,400 electricity suppliers and over 1,000 gas suppliers were operating on Germany's final-consumer market. In addition, the final-customer prices for electricity and gas are not under state regulation. They are formed freely, based on competition. On average, in one distribution-grid area more than 50 providers are offering to supply household customers – in some areas, over 100 suppliers. Competition-based price formation and market liberalisation are to continue to serve as the basis for attaining strong competitiveness on the final-consumer market for electricity and gas respectively.

Protection of energy consumers and competitiveness/market integration, nationally and in Europe

In Germany various consumer-protection measures are established. As an example, there are the existing transparency rulings. It is also appropriate to mention the opportunity that consumers have to call the Arbitration Centre for Energy, to get out-of-court settlements, where applicable, in disputes about connection to the supply grid, energy supply, and energy metering. The arbitration process, usually free-of-charge for consumers, in which the energy-supply companies are obliged to take part (subject to charges), should not last longer than three months and should end with a recommendation by the arbitrator. Even if the arbitrator's recommendation is not binding, many suppliers adhere to it. In addition, since July 2017 funding support is being provided to the build-up of a nationwide market monitor for energy, by the Federal Ministry of Justice and Consumer Protection. With the market monitor for energy, the energy market is observed in a targeted way from the consumers' perspective, by the Federation of German Consumer Organisations and the consumer-affairs' offices. Thus an overall picture can emerge from individual complaints. This helps those protecting consumers to recognise misguided developments early on, and draw attention to them, to avert harm to consumers. So the market monitor also contributes to an energy transition that is cost-efficient and socially just for consumers. The European Commission proposal on the Internal Electricity Market Directive provides for a whole group of measures to protect consumers and to strengthen their rights. Above all, the measures aim to raise transparency for consumers; among other things, they include additional invoice information, free of charge, during the current year (not only at year-end); minimum requirements for calculation of consumption and for invoice information; or introduction of standards for electricity-comparison portals. After the regulation comes into force, Germany will transpose the measures into national law, to the degree that they are not already part of the law.

Concept of basic supply and replacement supply

The existing concept of basic supply and replacement supply also serves to protect household customers. This ensures that, in principle, each household customer has a statutory entitlement to be supplied with electricity or natural gas by the respective basic supplier, according to the latter's publicised general terms and conditions, and at generally-valid prices. This is the case due to a ruling that places a unilateral obligation to contract on the respective energy-supply company, required to provide the basic supply within the limits of what is economically reasonable. For instance, the law restricts the basic supplier's right to interrupt supply immediately in the event of delayed payment or to immediately terminate the customer/supplier relationship. Neither does the basic supply provide for any contractual minimum duration; the customer can give notice of termination at short notice and at any time, without being required to state a reason.

3.4.3.v. Description of measures to enable and develop demand response, including those addressing tariffs to support dynamic pricing

Management and system stabilisation through strengthened cooperation between transmission-grid operators and distributor-grid operators, and (other) market players

Based on cost-benefit analyses, grid operators decide the grid level on which system services are rendered. Grid operators' and other market players' responsibility must be clearly defined and data must be exchanged efficiently and securely. The Federal Government is further developing intelligent management concepts, so that decentralised producers, storers of energy and energy loads can increasingly take on system responsibility. In this regard, system stability is increasingly being coordinated at European level.

Dynamic electricity-price contracts and smart meters

According to the European Commission's proposed directive for the internal electricity market, electricity suppliers are to be able to offer dynamic electricity-price contracts. Final-users who have installed a smart meter obtain a legal entitlement to such contracts. Electricity suppliers are then to be obliged to inform final-users about the opportunities, costs and risks of such a dynamic electricity-price contract. The national regulatory authority is to monitor the market development of dynamic electricity-price contracts. A Member State or its national regulatory authority are to publish an annual report – for a period of at least ten years – about these contracts' most important developments. In Germany, the Energy Business Act, Art. 40 (5), obliges suppliers to offer a price-rate for the final consumption of electricity that provides an incentive to save energy or that steers energy consumption, provided that doing so is technically feasible and economically reasonable.

Establishing a register of core market data

It is expected that, from the start of 2019, the Federal Network Agency's register of core market data will bring together the core-data of all electricity-supply facilities connected with a power-grid, in Germany's market for electricity and gas, in addition to all (other) market players, in the form of a uniform online database.

Metering Point Operation Act

In Germany, since 2016, the Metering Point Operation Act is the act forming the legal framework for the rollout of smart meters. It requires the roll-out of certified equipment units, with a seal of quality from the Federal Office for Information Security (BSI); this guarantees IT security and privacy by design. To maximise the benefit, the Metering Point Operation Act uses comprehensive protection profiles and technical guidelines to standardise the smart-meter gateway, as a communication platform for numerous application cases (Smart Metering, Smart Grid, Smart Mobility, Smart Home, Smart Services). The efficient roll-out is the only option permitted: statutory upper-limits to prices secure acceptance and economic viability. It is now up to the companies to begin the roll-out (particularly manufacturers of equipment units and operators/system administrators). They must guarantee that reliable technology is operated, and by reliable companies. Only then can the Federal Office for Information Security launch the roll-out.

3.4.3.vi. Regional cooperation***Pentalateral Energy Forum – Internal market for energy***

The Pentalateral Energy Forum's goal is to reach a closer coupling of the electricity markets in the participating countries, to test and to implement new forms of cooperation, and thus to gather experience in cross-border cooperation. Germany takes part in producing the regional report on security of supply (see also Chapter 3.3.i.).

Electricity neighbours

This cooperation among the Federal Republic's 'electricity neighbours' is in place since 2014, concerning itself primarily with increasing the flexibility of electricity markets. It also serves the purpose of integrating the electricity neighbours into the national debate on the energy transition.

Cooperation in regional groups in the context of the trans-European energy networks (Trans-European Networks Agency – TEN-E regional groups) – internal market for electricity

In the realm of electricity infrastructure, the framework of the TEN-E regional groups provides four priority-level corridors for energy infrastructure; in these, Germany is listed as a Member State affected and thereby as a member of the corresponding regional group. This includes the North Sea 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/Electricity (BEMIP Electricity; note that this is not the BEMIP Cooperation Forum, referred to in Chapter 1.4.).

Franco-German showcase project on cross-border optimisation of the energy system (Smart Border Initiative)

As part of the Franco-German Energy Platform, the energy agencies – dena on the German side and ADEME on the French side – are working on implementation of a showcase system-integration project, in the form of a cross-border Smart Grid. In particular, the so-called Smart Border Initiative aims to optimise management of the distribution grids in the Saarland-Lorraine region, using a virtual management tool and also via a new physical link at distribution-grid level. The planned Smart Grid ('Module 1') is also to have interface points and additional modules with regard both to electromobility ('Module 2') and also to heating/energy efficiency ('Module 3'). The project execution is being coordinated by dena on the German side and harmonised with the participant project partners (primarily corporate entities that represent particular geographical districts, and also energy-sector companies). In 2017 the project successfully completed the application procedure, to reach Project of Common Interest (PCI) status. In addition, it is envisaged to apply for funding support from 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 point 2.4.4.

The Federal Government is pursuing a comprehensive approach to combating poverty, one that does not only concentrate on energy, as one element of demand (see Chapter 2.4.4.).

Energy consultancy for low-income households (electricity-saving check)

On 01 April 2016 the project launching the new municipal electricity-saving check was started, as part of the National Climate Initiative. The project builds upon the previously-established offer of consultation to low-income households.

3.5. Dimension research, innovation and competitiveness

3.5.i. Policies and measures related to the elements set out in point 2.5.

To create suitable regulatory framework conditions, allowing innovative energy technologies to take their place on the market successfully, the Federal Government is continually reworking the regulatory law. Alongside this, it supports research transfer and market preparation by means of targeted funding-support measures.

Research

The Federal Government's Energy Research Programme

The Federal Government's 7th Energy Research Programme was adopted by the Federal Cabinet in September 2018. It acts as the framework for the energy research activities of the Federal Ministry for Economic Affairs and Energy, the Federal Ministry of Education and Research and the Federal Ministry of Food and Agriculture. The 7th Energy Research Programme is the result of a comprehensive consultation process, at an early stage, with stakeholders from science, business and civil society.

The 7th Energy Research Programme has five essential topic-areas:

1. Energy transition in the consumption sectors: buildings and neighbourhoods, industry, commerce, trade, and services, in addition to mobility and transport. In line with the 'Efficiency First' theme, funding-support for the project focuses on using energy efficiently and on reducing consumption.
2. Power generation: alongside the main topics – wind and solar energy respectively – other regenerative technologies of energy production play an important role, as do thermal power plants.
3. System integration: here the focus is on grids, storage facilities, and sector coupling as a new research area.
4. Cross-system research topics: this includes energy-system analysis, energy-relevant aspects of digitisation, resource efficiency, CO₂ technologies and materials research, in addition to societal aspects.
5. Research into nuclear safety is conducted against the background of the withdrawal from nuclear-energy use.

Particular emphasis is placed on the improvement and speeding-up of technology transfer and innovation transfer. For this, 'living labs for the energy transition' are to be set up, as a new programme pillar. These will be designed on a larger scale and encompass a broader thematic range than demonstration projects to date, but they can also afford a means of 'regulatory learning'. Start-ups play a decisive role in the process of innovation transfer, so for the future they are to be enabled to better participate in the 7th Energy Research Programme. In addition, the transfer also receives support via networking activities (especially the Energy Research Networks), as well as via research communication.

To strengthen European and international network integration, the 7th Energy Research Programme is directing its attention to the following: bilateral initiatives (especially Science & Technology Cooperation (STC) Agreements cooperation), established European cooperation (SET Plan, EU research-framework programmes), cooperation in the context of the IEA's Technology Collaboration Programmes and with other international organisations, as well as the international initiative 'Mission Innovation'. Likewise, there is continued international cooperation in nuclear-safety research.

Innovation and Competitiveness

Further development of opportunities to use CO₂ within the framework of CCU/CCS

Further development of opportunities to use CO₂ on the basis of renewable energy – so-called ‘CCU’ – , already receives comprehensive support in Germany and is the subject of numerous research and development projects. With ‘CO₂-Plus’ and ‘CO₂-WIN’, the Federal Government has set up its own funding-support programmes for CO₂ valorisation, mostly directed at extending the raw-materials base. Germany is also taking part in ERA-Net Cofund ACT (Accelerating CCS Technologies); this provides funding-support to larger projects and also to the whole bandwidth of the process chain involved in CCS and CCU technologies, i.e. separating, transporting, storing and using CO₂. In Germany CO₂ storage for research purposes is not taking place at present. Germany is a founding member and a leading player in the PHOENIX initiative, aimed at strengthening CCU within the European context.

‘Showcasing intelligent energy – digital agenda for the energy transition’ (SINTEG programme)

In parallel with the Energy Research Programme, solutions are developed and demonstrated for technical, economic and regulatory challenges presented by the energy transition; they are developed with the SINTEG programme, in five large model regions – so-called showcases – with over 300 companies and other market players. The focus in this is on secure and efficient procedures, suitable for mass-market use, as well as on innovative technologies, in addition to market mechanisms for flexible, intelligent grids and markets. The emphasis is on digitalisation of the energy sector. The programme’s objective is also to gather experience, tested in actual practice, for further developing the legislative framework. For this purpose, on 21 June 2017 the Federal Government adopted the SINTEG Regulation, with ‘experimentation options’ of limited duration. The regulation gives the SINTEG participants the opportunity to test out new technologies, procedures and business models, on topics such as digitalisation and sector-coupling, without incurring economic disadvantages. This makes SINTEG the ‘real-life laboratory’ for future energy supply.

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

Strategic Energy Technology Plan (EU SET Plan)

In the EU SET Plan’s framework, Germany is actively involved in the further shaping of European energy research. Representatives from Germany take part in the subject-specific working groups and formulate strategies for future cooperation on a variety of technologies. The results of the various working groups are channelled into the elaboration and further development of the national points of emphasis in funding support; they were also taken into account in producing the 7th Energy Research Programme. The SET Plan’s central objective is to strengthen cooperation with other Member States. In the Energy Research Programme context, European cooperation is to be driven forward under the auspices of the SET Plan. The research topics of the SET Plan are elaborated in European cooperation, by using the ‘Berlin Model’, among other approaches - namely separate applications for funding support, submitted to respective national organisational units for funding support and, where applicable, via joint notifications of funding support. In recent years such cooperation projects were primarily with Finland, Austria, Switzerland, the Netherlands, and Austria.

European Research Area (ERA-NET) Co-Fund

The Federal Government is pursuing several cooperation projects within the framework of the ERA-NET Co-Fund, a funding-support instrument forming part of ‘Horizon 2020’, assisting partnerships between research institutions. Specifically, the goal is strategic coordination of national programmes with the implementation of a joint tender for providing funding support to transnational research projects or innovation projects respectively. In the energy sector, cooperation projects are currently in progress in the following: geothermal energy; carbon capture, utilisation and storage (CCUS); grids; and renewable energies (wind energy, photovoltaics, bio-energy).

Regional/bilateral cooperation projects

Alongside the ‘Berlin Model’ cooperation projects there are the following individual initiatives:

North Sea cooperation on energy research

Within the North Sea energy cooperation framework, the Federal Government contributes to development of internationally accepted standards and norms for operating test benches in the research and development context; among other things, the objective in doing this is for field measures to be replaced, at least in part, by test-bench measurements over the medium-term.

Cooperation on CCUS with other countries bordering the North Sea

As part of the North Sea Basin Task Force (NSBTF), Germany, with other countries that flank the North Sea, is devoting itself to the natural-science-related, technical, legal, economic and political issues raised by storage of CO₂ beneath the North Sea, or respectively questions relating to CO₂ use.

Greco-German research cooperation and funding-support to upcoming researchers

Energy research is one of several supporting pillars that underpin research cooperation between Germany and Greece; this topic was/is addressed within the framework of two consecutive bilateral notifications on funding support. The support goes to projects pursuing sustainable and efficient supply of electricity and heating, in addition to storage of renewable energy.

Franco-German Fellowship Programme

With the fellowship programme ‘Make Our Planet Great Again – German Research Initiative’ (MOPGA–GRI), the Federal Government has established a funding-support programme, in parallel with the French initiative of the same name. The measure’s objective is to give the opportunity to renowned researchers, and also to highly-promising upcoming researchers from abroad, to research at German higher-education institutions and research institutions. In addition to climate research and geosystem research, energy research is a priority area in this initiative. Funding support is given to five fellows.

Franco-German funding-support to research on electricity grids/Smart Grids

In line with the resolution passed by the 19th Franco-German Council of Ministers, in October 2018 notification of bilateral funding support was published, targeting energy-storage units and grids. Through joint research projects, innovations are to be developed for an efficient, affordable and environment-friendly energy supply, based on renewable energy, for France, Germany and (more broadly) Europe. Paralleling technical aspects, economic and social challenges presented by the energy transition in Europe are to be taken into account, using a systemic approach.

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

Research

The 7th Energy Research Programme was adopted by the Federal Cabinet in 2018. Within this programme, in the years 2018–2022, the Federal Government plans to provide around EUR 6.4 billion in total, for research, development, demonstration and testing-out of technologies and concepts viable for the future. Compared to the period 2013–2017, this amounts to an increase of around 45 per cent.

‘Horizon 2020’ – EU Framework Programme for Research and Innovation

No country is as much involved in the societal challenge presented by ‘safe, clean and efficient energy’ in Horizon 2020 as is Germany. Via the National Contact Point on Energy, the Federal Government renders support to German researchers’ participation in consortia and their application for EU funds. The National Contact Point’s activities, providing information and consultation, help involved parties from research and industry to make appropriate use of the comprehensive and complex opportunities that Horizon 2020 presents on energy topics. To secure achievement of the ambitious European targets on energy and climate matters, the spectrum of topics ranges from research

options close to basic research, via technology-orientated development topics, right through to supporting measures with regard to introduction and dissemination in the market. Other factors gaining in importance in this are the involvement of members of the public, as consumers, and relevant socio-economic aspects.

Innovation and Competitiveness

Strengthening Germany as a research location for energy-storing technology

The Federal Government plans to make research resources and funds available to energy storage technologies, in order to make Germany a location for battery-cell production. There is also to be a new Fraunhofer Institute specialised in storage technologies.

Expansion of 'living labs for the energy transition' as a new programme pillar

The Federal Government plans to render support to the switchover from research to demonstration and market introduction. With the 7th Energy Research Programme, it has established 'living labs for the energy transition' (especially on sector-coupling technologies), as a new programme pillar. This addresses the challenges presented by cross-system, cross-sector optimisation through innovation. These will be designed on a larger scale and encompass a broader thematic range than demonstration projects to date, but they can also afford a means of 'regulatory learning'. This way, technological and regulatory findings can interact in practice and point to potentials for systemic optimisation.

The living labs for the energy transition will develop, try out and propagate integral solutions. They must be cross-cutting projects whose objectives are understood and endorsed by the local population to arrive at the necessary basic consensus for the successful transfer from research to application.

Expanding the CO₂ cycle

Within the framework of the 7th Energy Research Programme, the Federal Government plans to support the development of low-CO₂ industrial processes and sustainable technologies for closing the carbon cycle.

Section B: Analytical Basis

4. Current situation and projections with existing policies and measures

The scenario shown here, using current policies and measures, is hereafter called the ‘reference scenario’. In this context, current policies and measures are those policies and measures that were implemented or were adopted by of 31 December 2017.

4.1. Projected evolution of main exogenous factors influencing energy-system and GHG emission developments

4.1.i. Macroeconomic forecasts (GDP and population growth)

The population development, used as the basis in the projections, comes from the updated information in the 13th Coordinated Population Projection, produced by the Federal Office of Statistics (StBA, 2017) – the ‘high level of immigration’ scenario. This updated population scenario takes into account strong growth, at the outer edge of current performance levels. After 2020 the population number will decrease. Nonetheless the figure in 2030 is to be 3.2 per cent higher than in 2010. By the year 2040 the population figure will go down to 81.3 million. Because of the change in the household structure – the average household size is on the decline – the number of households up to the year 2040 will go up (+3.6 per cent in relation to 2010).

Overall economic development

As regards economic development, what is taken as the basis is a higher growth level than is stated in the EU Guidance.³ Similarly, by now the Federal Government’s current projections deviate from the development level that was noted at the start of the analytical activities. The reference scenario states the annual growth rate up to 2020 at 1.7 per cent; after that, 1.3 per cent up to 2025, and 1 per cent between 2025 and 2030. Over the period 2010-2030, Gross Domestic Product (GDP) rises by 32 per cent. In the period 2030–2040 the average growth rate taken as the basis is 0.9 per cent. The GDP increases to EUR 3,744 billion by the year 2040 (+45 per cent in relation to 2010).

4.1.ii. Sectoral changes expected to impact the energy system and GHG emissions

Table B1: Assumptions on economic development and population development, GDP, prices in real-terms

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
GDP in EUR bn.₂₀₁₀	3,088	3,127	3,166	3,207	3,250	3,283	3,316	3,350	3,383	3,416	3,744
GDP in EUR bn.₂₀₁₆	3,371	3,415	3,457	3,501	3,548	3,584	3,621	3,658	3,694	3,729	4,088
Population (k)	83,453	83,434	83,402	83,364	83,316	83,241	83,169	83,080	82,971	82,868	81,293

Source: GDP figure based on the ‘Öko-Institut’, Prognos, ISI (2017; extrapolation); population figures based on data from the Federal Office of Statistics (13th Coordinated Population Projection – Base year: 2016, Variant 2-A, ‘higher level of immigration’)

In the scenario up to 2030 and 2040, value-added in the non-energy-intensive industry sectors grows significantly more strongly than in the energy-intensive business areas (Table B2). Thus, the energy-intensive sectors’ share of gross German value-added continually decreases. Yet this does not permit direct deductions to be made about the absolute volume of energy consumption and of GHG emissions. Value-added is also on the increase in the energy-intensive sectors, and the production quantities are not going down, or only doing so slightly – therefore efficiency increases are needed to reduce the absolute quantity of energy consumption.

3 This calculation does not correspond to the Federal Government’s latest projection. The figure taken for the development trend is slightly below the values stated in the Federal Government’s 2018 Autumn Projection. At the start of the analytical work in the autumn of 2017, it became clear that a slightly higher growth level was attained in Germany than was assumed in the EU Guidance (2016). Thus, up to 2019 the Deutsche Bundesbank projection was followed (2017, Gesamtwirtschaftliche Vorausschätzungen 2017/18 mit Ausblick 2019) and then, with a time lag, the growth rates stated in the EU Guidance were used. The assumed growth rates have also been integrated, as a proposal, into the national process for the Climate Action Plan 2050.

Table B2: Structural development – gross value-added in manufacturing industry, according to sector, EUR bn., prices in real-terms, 2010

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Energy-intensive sectors*	108	108	108	109	109	110	110	110	110	110	112
Non-energy-intensive sectors	527	534	541	548	556	562	568	574	579	585	649
Total	635	642	650	657	666	672	678	683	689	695	761

* Mining; wood, paper, printing; chemicals; glass, ceramics, stones and soils; metal production

Source: Extrapolation by the 'Öko-Institut', Prognos, ISI (2017), based on information from the Federal Office of Statistics

4.1.iii. Global energy trends, international prices for fossil-based fuels, CO₂ price in the EU emissions-trading system

In the scenarios, the CO₂ price in the emissions-trading system develops in accordance with the EU reference scenario from the year 2016. Up to the year 2030, the certificate-price goes up to EUR 35 per t of CO₂; up to the year 2040 the price climbs to EUR 52 (prices in real-terms, base year: 2016). The world-market energy prices, used as the basis, are likewise taken from the EU reference scenario (Table B3). In recent years, it has been observable that the coal price and gas price are decoupling themselves from the oil price. Simultaneously the energy prices have risen a great deal less strongly than was expected. It is assumed for the scenarios that the prices for coal and gas remain constant after 2020, whereas the oil price once again increases slightly.

Table B3: Development of world-market energy prices in the period and CO₂ price, 2021 – 2030, prices in real terms: 2016

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Crude oil, Brent, in Euro 2016/MWh Hi	49	51	52	53	54	56	57	58	59	60
Coal in Euro 2016/MWh Hi	9	10	10	11	11	11	12	12	13	13
Natural gas in Euro 2016/MWh Hi	29	29	29	30	30	31	31	32	33	33
ETS certificates in Euro 2016/EUA	17	19	20	22	23	26	28	30	33	35

Source: Extrapolation by 'Öko-Institut', Prognos, ISI 2017

4.1.iv. Technology cost developments

The assumed cost developments of technologies for electricity generation and for distributed heating generation are described in Table 4 (costs at the time of the facility's entry into operation). The costs of the electrolysis units decrease only slightly in the period under consideration, because they are not put to substantial use due to their lack of economic viability.

In comparison, the costs of the SOEC (solid oxide electrolysis cell) and PEM (proton exchange membrane) electrolysis units respectively go down somewhat more steeply because, unlike the alkaline-based electrolysis units, they have not yet reached full technical maturity. As regards fossil-based electricity-generation technologies, it is taken as the basis that there will be no further downward progression of costs after 2020. By contrast, as regards renewable energies, the investment costs continue to go down. In the period 2020-2030, the cost decreases are largest for offshore wind energy (-24 per cent) and roof-based photovoltaics (-23 per cent). The costs for storage technologies are also

decreasing; the costs for batteries used by household customers are projected to decline by around one third in the period 2020–2030. In the reference scenario – beyond the phase out path – nuclear energy is not an available option; the costs are not indicated.

For heat production in buildings, the basis taken for the renewable-energy-based technologies is a cost decrease of 0.35 per cent annually. As regards fossil-fuelled installations, the assumption is that there will be no further decrease in the costs. With the installations generating an increased heat output, the costs per kW go down; therefore for larger buildings the outcome is lower specific costs.

Table B4: Development of technology costs for generation of electricity and heating, Euro/kW, prices in real terms

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 – combined cycle gas turbine (CCGT)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Natural gas – open cycle gas turbine (OCGT)	550	550	550	550	550	550	550	550	550	550
Onshore wind	1,190	1,180	1,170	1,160	1,150	1,140	1,130	1,120	1,110	1,100
Offshore wind	2,830	2,760	2,690	2,620	2,550	2,480	2,410	2,340	2,270	2,200
Photovoltaics – ground-mounted	640	630	620	610	600	590	580	570	560	550
Photovoltaics – rooftop	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 electrolysis unit	998	995	993	990	988	985	983	980	978	975
SOEC electrolysis unit ¹	2,090	2,079	2,069	2,058	2,048	2,037	2,027	2,016	2,006	1,995
PEM electrolysis unit ²	1,741	1,733	1,724	1,715	1,706	1,698	1,689	1,680	1,671	1,663
Heat generation										
a) Small buildings (12–15 kW)										
Gas – calorific value	815	815	815	815	815	815	815	815	815	815
Heating oil – calorific value	955	955	955	955	955	955	955	955	955	955
Biomass	1,600	1,593	1,588	1,582	1,577	1,571	1,566	1,560	1,555	1,549
Heating pumps – air	1,555	1,548	1,543	1,538	1,532	1,527	1,522	1,516	1,511	1,506
Heating pumps – brine	2,500	2,491	2,482	2,474	2,465	2,456	2,448	2,439	2,431	2,422
b) Large buildings (35–40 kW)										
Gas – calorific value	400	400	400	400	400	400	400	400	400	400
Heating oil – calorific value	350	350	350	350	350	350	350	350	350	350
Biomass	804	801	799	796	793	790	788	785	782	779
Heating pumps – air	974	970	967	963	960	957	953	950	947	943
Heating pumps – brine	1,663	1,657	1,651	1,645	1,640	1,634	1,628	1,623	1,617	1,611

1 SOEC: solid oxide electrolysis cell

2 PEM: proton exchange membrane

Source: Prognos, ISI, GWS, iinas 2018 (the right is reserved to update the figures with regard to small buildings)

The costs per vehicle, used in the reference development, are stated in Table B5. As is the case for the producers of indoor-area heating, costs that remain the same are also taken as the basis for fossil fuels used in cars. For electrical drives and hybrid drives, the technology costs are decreasing, mainly caused by developments regarding batteries. The costs for electrical and hybrid vehicles will remain above the costs for vehicles with drives based on liquid or gas-based fuels, also in the long term.

Table B5: Development of technology costs in the car sector, vehicle costs in EUR k., prices in real terms – 2016

Technologies	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Petroleum	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Diesel	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
Hybrid	29.4	28.8	28.7	28.6	28.4	28.3	28.2	28.1	28.0	27.8
Natural gas/bivalent	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
Electrical	31.6	29.8	29.6	29.4	29.2	29.0	28.8	28.6	28.4	28.2
Plug-in hybrid	31.8	30.0	29.9	29.8	29.6	29.5	29.4	29.3	29.2	29.0

Source: Prognos, ISI, GWS, iinas 2018

The costs expended by heat-generators and cars are higher than the costs which the European Commission uses, for instance, in the reference scenario 2016 (PRIMES model). Especially in the case of the heat-generators, significant deviations emerge. Among other reasons, the difference could be attributable to the following: inclusion of tax in the calculation (here: heat-generators, incl. valued-added tax); the performance class considered (as output increases, the costs per kW go down); or how the construction costs are dealt with; yet the (partial) reason could also be country-specific price differences.

4.2. Dimension decarbonisation

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

The annual greenhouse-gas emissions in the period 2010-2016 are shown in Table B6. The values and classification of sectors are taken from the GHG inventory (German Environment Agency, 2017). Consistent with international conventions, the LULUCF emissions and the emissions of international transport are not included in the total figure. In the year 2016 a total of 909 million t CO_{2eq} was emitted. Against the base year of 1990 this amounts to a 27 per cent reduction.

Table B6: Greenhouse-gas emissions by sector, for the years 2010-2016, in m. t of CO_{2eq}

	2010	2011	2012	2013	2014	2015	2016
Emissions attributable to energy use	802	779	785	802	762	768	772
Energy sector	357	354	364	367	349	337	332
Industry	125	123	118	119	118	127	126
Transport	154	156	155	159	160	163	166
Private households	107	91	95	101	83	88	91
Commerce, retail, tertiary sector, other*	46	42	41	44	41	42	44
Miscellaneous emissions	11	11	12	12	10	11	10
Emissions not attributable to energy use	141	142	139	140	140	139	138
Ind. processes	63	63	62	62	62	61	62
Agriculture	63	64	64	65	66	67	72
Waste	15	14	13	12	12	11	10
Total	943	920	925	942	903	907	909
For information only: LULUCF	-16	-16	-14	-14	-15	-14	-14
For information only: International air and marine transport	33	31	33	32	31	32	35

* primarily construction and military uses

Source: GHG Inventory, German Environment Agency – 2017

The annual greenhouse-gas emissions for the period 2010–2016 can be split, into emissions in the sectors subject to the emissions-trading system (ETS) and the remaining, non-ETS sectors (see Table B7). Both areas currently have an emissions level of about the same size. European air travel's emissions are likewise subject to emissions-trading. They are stated separately because they are not relevant for the country's achievement of the stated objective. It is solely domestic air travel that is taken into account regarding the climate targets.

Table B7: Greenhouse-gas emissions, split into ETS and non-ETS, 2010-2016, in m. of t CO_{2eq}

	2010	2011	2012	2013	2014	2015	2016
ETS emissions, excluding international aviation	452	450	455	483	463	457	456
Non-ETS emissions	491	470	470	459	440	450	454
Total	943	920	925	942	903	907	909
For information only: Emissions caused by international aviation*	-	-	13	7	7	7	7

* not relevant for achievement of national objective

Source: German Emissions Trading Authority (DEHST) (2011–2017; VET Reports)

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 that follow, with regard to the projections in relation to the reference development, are provisional.

Table B8: Greenhouse-gas emissions by sector, 2021 – 2040, in m. t CO_{2eq}

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Emissions attributable to energy use	693	698	702	700	693	676	663	651	635	623	510
Energy sector	284	294	303	306	304	292	286	280	270	263	205
Industry	114	113	112	111	110	109	109	108	107	106	100
Transport	163	163	162	161	159	157	155	152	150	147	118
Private households	79	77	75	73	71	69	67	66	64	63	52
Commerce, retail, tertiary sector, other	43	42	41	40	39	38	37	37	36	35	28
Miscellaneous emissions	9	9	9	9	9	9	9	9	9	8	7
Emissions not attributable to energy use	130	129	128	127	126	124	124	123	122	120	114
Industrial processes	59	58	57	57	56	55	55	55	54	53	49
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	823	827	830	828	819	800	787	774	757	743	624
For info only: LULUCF	30	29	28	27	26	25	24	23	22	21	13
For info only: International air and marine transport	41	42	43	44	45	46	47	47	48	49	50

Quelle: Prognos, ISI, GWS, iinas (2018)

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

Renewable energies' shares of energy consumption are presented in Table B9. From 2010–2017 these energies' share of gross-final energy consumption rose by around 4 percentage points, to reach 15.2 per cent. Yet between the sectors and the application areas, striking differences are evident over the period under consideration. The electricity sector acts as the main driver of renewable energy's increasing share of total gross final-energy consumption. Renewables' share in the electricity sector is climbing much more strongly than it is in heating or cooling. In the transport sector, renewable fuels' share of total fuel consumption is decreasing. Amid slightly-increasing fuel consumption, the use of biogenic fuels is declining since 2012. The amount of renewable electricity used in transport continues to be of little significance.

Table B9: Renewable energies' share up to 2017, in per cent

Renewable energies' share	2010	2011	2012	2013	2014	2015	2016	2017
Electricity (Directive 2009/28/EC)	18.2	20.9	23.6	25.3	28.1	30.8	32.2	34.4
Electricity (national statistics)¹	17.0	20.4	23.5	25.1	27.4	31.5	31.6	36.0
Onshore wind	6.2	8.1	8.4	8.5	9.6	12.1	11.3	14.6
Offshore wind	0.0	0.1	0.1	0.2	0.2	1.4	2.0	2.9
Photovoltaics	1.9	3.2	4.3	5.1	6.1	6.5	6.4	6.6
Water power	3.4	2.9	3.6	3.8	3.3	3.2	3.4	3.4
Biomass	4.7	5.3	6.3	6.6	7.1	7.4	7.5	7.5
Biogenic share of waste	0.8	0.8	0.8	0.9	1.0	1.0	1.0	1.0
Transport (Directive 2009/28/EC)	6.4	6.5	7.4	7.3	6.9	6.6	7.0	7.0
Transport (national statistics)²	5.8	5.7	6.0	5.5	5.6	5.2	5.2	5.2
Biodiesel (incl. HVO and plant oil)	4.1	3.8	4.0	3.5	3.6	3.3	3.2	3.2
Biogenic petroleum	1.4	1.5	1.5	1.4	1.4	1.4	1.3	1.3
Biomethane	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Electricity sourced from renewable energy	0.3	0.4	0.5	0.5	0.5	0.6	0.6	0.7
Heating and cooling (Directive 2009/28/EC)	12.1	12.6	13.5	13.5	13.5	13.5	13.1	13.4
Heating and cooling (national statistics)³	12.5	13.0	14.3	14.3	14.2	14.0	13.6	13.9
Biomass and renewable waste	11.6	11.8	13.0	13.0	12.7	12.4	11.9	12.1
Other renewable energies (Solar-thermal, geothermal, ambient heat)	0.9	1.1	1.2	1.3	1.6	1.6	1.7	1.7
Total gross final-energy consumption (Directive 2009/28/EC)	11.7	12.5	13.6	13.8	14.4	14.9	14.9	15.5
Total gross final-energy consumption (national statistics)	11.5	12.4	13.6	13.9	14.3	15.2	14.9	15.9

1 Deviating from Directive 2009/28/EC (*inter alia*) without normalisation water power and wind power and with total electricity generation sourced from biomass

2 Deviating from Directive 2009/28/EC (*inter alia*) without double-counts/multiple-counts; biofuels and electricity

3 Deviating from Directive 2009/28/EC (*inter alia*) without grid losses; district heating and with total Renewables Energies Directive consumption; biomass for heating and cooling. Slight deviations result from rounding differences.

4.2.2.ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

The various developments in the individual sectors, in the period from 2020, result from the existing instruments used in the reference figures; these point to impacts on renewable energies' use that are of differing levels of intensity. For instance, in the reference scenario it is assumed that the Renewable Energy Sources Act and the Energy Conservation Regulation will be continued in their current form. Continuation of the Renewable Energy Sources Act has a strong impact on renewable energies' share of the electricity sector. The assumed additional build of renewable technologies in the future is developing, in the reference scenario, based on the expansion corridors stated in the Renewable Energy Sources Act 2017. For onshore wind, according to the expansion corridor, what is assumed is an annual gross additional build of 2,800 Megawatt (MW) up to 2020; after 2020, the figure is 2,900 MW. For offshore wind, an annual additional build of 500 MW is provided for in 2021 and 2022; the figure is 700 MW for the period 2023-2025. From 2026 the additional build is raised to 840 MW per year. The annual gross additional build for photovoltaics is assumed to be 2,500 MW, in accordance with the Renewable Energy Sources Act 2017.

It is also the objective that renewable energies' share of gross electricity consumption will rise to around 65 per cent by 2030. The challenge is to better synchronise renewable energies and grid capacities. In the context of the Grid Development Plan for 2019–2030, a review is being made on which measures must be implemented in the transmission grid, to safeguard the electricity grids' take-up capacity for this purpose. By the autumn of 2019, the coalition parties will decide regarding the technology-specific deployment trajectory needed for this, up to the year 2030; where applicable, adaptations may need to be made to quantities in tenders, to reach the objective of around 65 per cent set in the coalition agreement.

The decisive factor for the actual installed output of renewable energies, alongside the gross expansion figure described, as referred to, is also the scaling-down of existing facilities. For existing onshore wind facilities, a product life-span of 15 years is taken as the basis, up to construction year 1999. For newer onshore wind-power facilities, and offshore wind, the figure assumed is a 20-year lifespan. It is taken as the basis in the reference scenario that installations are no longer operated after the guaranteed-remuneration period ends. For photovoltaics the basis applied is an average operational period of 25 years; the installations are retired from operation in a period evenly spread over ten years after their 20-year remuneration period expires. Specifically, this means that all installed facilities of one given construction year are out of operation after 30 years, with the average being 25 years and the first facilities ceasing to operate after 20 years.

In the transport sector, renewable energies' share increases step-by-step up to 2030 in the reference scenario. Primarily what is responsible for this is renewables' increasing share of electricity; this is used for electromobility and will double in comparison to the 2020 figure. Beyond 2030, renewable energies' share in transport will rise to 8.9 per cent in 2040 (without any double-counts / multiple-counts). Likewise, the primary reason for this is the increase in electricity from renewable energy; this will roughly double over the period 2030-2040, driven by the widespread use of electromobility. By contrast, consumption of biogenic fuels will not substantially change over this period. Yet due to the decreasing energy consumption for transport, the biogenic fuels do slightly gain in significance in proportional terms.

The following uses are allocated to heating and cooling as an application area: indoor-space heating; hot water; process heating; process cooling; generation of district heating. For these applications, in the reference scenario, renewable energies' share of consumption increases moderately, from 14.2 per cent in 2021 to 17.3 per cent in 2030. Up to 2040, these energies' share of the reference development will climb to 20.1 per cent.

Developments in the individual sub-areas take a variety of paths. Renewable energies' use for district-heating generation changes only slightly over the period in question. The most important renewable fuel for generating heat that is transported via the grid remains biomass (including biogenic waste); this is the case even though, in the reference development, the district heating generated by biomass is decreasing. The declining use of biomass is balanced out by increasing heat generation from waste heat and geothermal energy. A slight increase is also evident for production sourced from solar thermal energy.

In the generation of distributed indoor heat and hot water, renewable energies' consumption level increases by 20 per cent over the period 2020–2030. This increase is mainly due to biomass and ambient heat (as well as geothermal); these energy sources are used with electric heating pumps. As regards process heating, in the reference scenario biomass is used as the sole renewable fuel. In the period 2021–2030, use of biomass rises only slightly, by around 4 per cent. To generate process cooling, it is exclusively electricity that is used.

The following results regarding projections for renewable energies' share are provisional.

Table B10: Renewable energies' share, 2021–2040, in per cent

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Electricity (national statistics)	43.3	44.0	44.9	46.0	47.3	48.6	49.8	51.2	52.5	54.0	55.2
Onshore wind	17.1	17.0	17.2	17.5	17.9	18.3	18.8	19.3	19.7	20.4	22.6
Offshore wind	5.7	6.1	6.6	7.1	7.6	8.2	8.8	9.5	10.1	10.8	11.2
Photovoltaics	8.6	9.0	9.4	9.7	10.1	10.5	10.9	11.2	11.5	11.9	13.6
Water power	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Biomass	7.5	7.5	7.3	7.3	7.3	7.2	6.9	6.8	6.7	6.4	3.5
Biogenic share of Waste	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7
Transport (RED II)	5.8	6.1	6.5	6.8	7.2	7.7	8.3	8.9	9.5	10.2	17.5
Transport (national statistics)	4.8	4.9	5.0	5.1	5.2	5.4	5.5	5.7	5.9	6.1	8.9
Biodiesel (incl. HVO and plant oil)	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.9
Biogenic petroleum	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.3
Biogases	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.6
Renewable sources – electricity	0.8	0.9	1.0	1.0	1.2	1.3	1.4	1.6	1.7	1.9	4.0
Hydrogen	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2
Heating and cooling* (national statistics)	14.2	14.5	14.9	15.2	15.6	15.9	16.3	16.6	16.9	17.3	20.1
Biomass and renewable waste	11.8	11.9	12.1	12.2	12.4	12.5	12.7	12.7	12.9	13.0	13.7
Other renewable energies	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.9	4.1	4.3	6.5

* Indoor-area heating and hot water; cooling and ventilating; process heating and process cooling

Note: Deviations in the totals are due to rounding differences

Source: *Prognos*, ISI, GWS, iinas (2018)

4.3. Dimension energy efficiency

4.3.1.i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

Over the period 2008-2017, primary energy consumption decreased by around 5.5 per cent. Between 2010 and 2017 the decrease was 5 per cent. In the period 2008 – 2017, final-energy consumption rose by almost two per cent; in the period 2010 – 2017 the level remained almost constant. The individual final-consumption sectors reveal different developments. In industry (what remains of mining; also manufacturing), the increasing quantity effects (production, personnel) balanced out the effects of increasing energy efficiency; consumption rose by 4 per cent between 2010 and 2017. In commerce, retail and services there was a slight decline (-3 per cent). The transport sector's consumption rose by 8 per cent, while consumption went down by 9 per cent in the private-households sector. This steep decrease is closely related to weather developments. The year 2010 was very cold and consumption of indoor-space-heating was high. The years 2011 – 2016 were a lot warmer; as a result, consumption of indoor-space-heat was considerably lower. Since 2011 the household sector's energy consumption has not undergone any substantial change.

Table B11: Primary energy consumption, final-energy consumption, total and by sectors, 2008 – 2017, in PJ

	2008	2010	2011	2012	2013	2014	2015	2016	2017*
Primary-energy consumption	14,380	14,217	13,599	13,447	13,822	13,180	13,262	13,491	13,594
Final-energy consum.	9,159	9,310	8,881	8,919	9,179	8,699	8,898	9,060	9,329
Industry ¹	2,587	2,592	2,634	2,587	2,551	2,545	2,548	2,598	2,700
Transport	2,571	2,559	2,568	2,559	2,612	2,616	2,621	2,690	2,755
Households	2,558	2,676	2,333	2,427	2,556	2,188	2,302	2,376	2,430
Commerce, retail, services	1,443	1,483	1,346	1,345	1,460	1,350	1,428	1,396	1,443

* Provisional figures for 2017, according to the Working Group on Energy Balances

1 Remaining mining activity; manufacturing

Source: Federal Ministry for Economic Affairs and Energy – Energy Data, 2018

4.3.ii. Current potential for the application of high-efficiency CHP and efficient district heating and cooling

According to the latest estimates for the year 2014⁴, and depending on how the matter is considered, the potential for electricity generation by CHP facilities comprises 173 TWh (business-operation potential) or respectively 244 TWh (national-economy potential). Taking into account CHP-compatible electricity generation, which is decreasing over time (due to expansion of wind and photovoltaics), over the long term the CHP potential to be tapped into will decrease, the result being that the figure will be below the values stated here. It must be noted that the figure for possible CHP-sourced electricity generation is lower than the figure for CHP-compatible electricity generation. The exact amount was not estimated within the framework of the study commissioned for this. Also, from today's perspective it must be noted that current energy-system studies forecast a faster rise in wind-power and photovoltaic-power than did the study of CHP potential referred-to here. The CHP potential able to be utilised can thus be expected to prove to be even lower still over the long term. The development of CHP-based electricity generation in the reference scenario is shown in Table B12.

4 The study „Potenzial- und Kosten-Nutzen-Analyse zu den Einsatzmöglichkeiten von Kraft-Wärme-Kopplung sowie Evaluierung des KWKG im Jahr 2014“ investigated CHP's potential in Germany, consistent with the requirement stated in the EU Energy Efficiency Directive <https://ec.europa.eu/energy/sites/ener/files/documents/151221%20Mitteilung%20an%20KOM%20EED%20KWKG%20Anlage%20Analyse.pdf>

Table B12: Development of cogeneration-based electricity generation in the reference scenario up to 2050, cogeneration-based net electricity generation (TWh)*

Renewable energies' share	2016	2020	2030	2040
Total	118	124	126	126
General supply (a)	51	53	56	61
Industry (b)	35	35	35	35
Fossil-fuelled engine-based cogeneration <1 MW	8	8	8	8
Biogenic (not incl. in (a) and (b) above)	23	28	27	22

* in accordance with broad-based definition of installations (taking into account heating use for e.g. fermenter-heating, pre-drying of wood, etc.)

Source: Prognos, ISI, GWS, iinas, 2018

4.3.iii. Projections considering existing energy-efficiency policies, measures and programmes, as described in point 1.2.ii., for primary and final energy consumption for each sector, at least until 2040 (including for the year 2030)

The results that follow regarding projections for primary-energy consumption are provisional. In the reference scenario, primary-energy consumption decreases, in relation to 2010, by 20 per cent up to the year 2030 and by more than 29 per cent up to the year 2040. Over the same period, final-energy consumption decreases by 7 per cent/by 14 per cent respectively.

Table B13: Reference scenario – primary energy consumption, final-energy consumption, total and by sectors, 2021 – 2040, in PJ

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Primary-energy consumption	12,670	12,446	12,213	12,166	12,092	11,933	11,796	11,670	11,525	11,391	10,182
Final-energy consumption	9,041	9,005	8,957	8,908	8,861	8,794	8,727	8,658	8,590	8,521	7,856
Industry ¹	2,460	2,440	2,425	2,410	2,397	2,378	2,360	2,341	2,322	2,303	2,187
Transport	2,905	2,922	2,922	2,921	2,919	2,905	2,890	2,872	2,853	2,833	2,505
Households	2,246	2,223	2,198	2,174	2,152	2,130	2,109	2,089	2,070	2,052	1,921
Commerce, retail, services	1,429	1,420	1,411	1,402	1,393	1,381	1,369	1,357	1,345	1,333	1,243

¹ Remaining mining activity; manufacturing

Source: Prognos, ISI, GWS, iinas, 2018

The strongest decrease in final-energy consumption is in the private-households sector - 23 per cent up to the year 2030. The average annual decline in consumption is almost 1 per cent, up to 2030; after 2030 this decrease slows down. In transport, energy consumption continues to rise; it only decreases from 2024 onwards. Thus transport's energy consumption in 2030 is slightly above the 2010 level. Longer-term, with electromobility's increasing market penetration, annual consumption is reduced considerably; the rate of change then comprises -1.5 per cent each year.

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

The studies on the cost-optimum level of minimum requirements for overall energy efficiency in buildings were last updated in the „Kurzgutachten zur Aktualisierung und Fortschreibung der vorliegenden Wirtschaftlichkeitsuntersuchungen sowie zu Flexibilisierungsoptionen“ (IbH, ITG, Ifeu, ecofys). From the microeconomic viewpoint, the optimum level is calculated separately for residential and non-residential buildings respectively; alongside the scenario for energy price development that the Federal Government uses, the short report also directs attention to an alternative scenario regarding the study of factor-sensitivity. The study follows the European criteria for calculating the cost-optimum position; taking this yardstick of measurement, it states the current standard according to regulatory law (Energy Conservation Regulation 2016) as the current cost-optimum level. The result was passed on to the European Commission.

4.4. Dimension energy security

4.4.i. Current energy mix, domestic energy resources, import dependency, including relevant risks

The current energy supply in Germany is decisively shaped by fossil-fuel consumption. Thus, in 2016 (as base-year) around 80 per cent of primary-energy consumption is due to coal, petroleum and gas (Table B14, based on the Federal Ministry for Economic Affairs and Energy – ‘Energy Data 2018’).⁵ The remaining share is largely attributable to renewable energies: 13 per cent; nuclear energy: 7 per cent; and other fuels (< 1 per cent). The net electricity exports are shown with minus-signs.

The energy mix’s import dependency is mainly a result of the high consumption of fossil fuels; these are mostly imported (Table B15). An exception to this is lignite, which is sourced entirely domestically and is even exported in small quantities. Since the start of the period under consideration, 2010, the expiry of hard coal subsidies is leading to a decline in domestic hard coal production and thus an increasing import share. Up to the end of 2018 the subsidies for hard coal sales will fully expire and domestic production will end. From 2019 onwards, the import share of coal will be 100 per cent. Between 2010 and 2016, gas consumption decreased by around 150 PJ, yet over the same period domestic production was almost halved. As a result, the import share of gas rose significantly. Petroleum is almost entirely imported. Renewable energies and nuclear energy are sourced almost entirely domestically.⁶

Table B14: Primary-energy consumption by fuel, 2010–2016, in PJ

	2010	2011	2012	2013	2014	2015	2016
Hard coal	1,714	1,715	1,725	1,840	1,759	1,729	1,693
Lignite	1,512	1,564	1,645	1,629	1,574	1,565	1,511
Petroleum	4,684	4,525	4,527	4,628	4,493	4,491	4,566
Gas	3,171	2,911	2,920	3,059	2,660	2,770	3,056
Nuclear	1,533	1,178	1,085	1,061	1,060	1,001	923
Renewable energies	1,413	1,463	1,385	1,499	1,519	1,644	1,676
Other fuels	254	267	244	222	237	234	247
External-trade balance: electrical energy*	-64	-23	-83	-116	-122	-174	-182
Total	14,217	13,599	13,447	13,822	13,180	13,262	13,491

* includes small proportions of district heating

Source: Federal Ministry for Economic Affairs and Energy, 2018 (the right is reserved to update this information)

5 Only fossil gases. Biogases are stated among renewable energies.

6 According to the EU-Stat definition, nuclear energy is considered as a domestic primary energy. Thus use of nuclear energy for electricity generation does not increase import dependency. As regards electricity, only the external-trade balance is indicated (net quantity). No distinction is made here between the individual production technologies.

Table B15: Import dependency, 2010–2016, net imports* in per cent

	2010	2011	2012	2013	2014	2015	2016
Hard Coal	77.0	81.6	80.3	86.8	87	88	94.8
Lignite	-1.6	-1.7	-1.9	-1.9	-3	-3	-1.9
Petroleum	98.6	97.0	98.8	98.0	98	99	97.9
Gas	80.7	86.0	85.0	86.1	88	89	90.1
Nuclear	0	0	0	0	0	0	0
Renewable energies	-0.6	0.0	0.5	-0.8	-2	-1	-1.4
Total	59.0	60.5	60.9	62.0	61.2	61.7	63.8

* (Import minus export and stockpiled resources) in relation to primary-energy consumption

Source: based on Federal Ministry for Economic Affairs and Energy, 2018 (the right is reserved to update this information).

4.4.ii. Projections of development with existing policies and measures, at least until 2040 (including for 2030)

The results that follow regarding projections for primary-energy consumption are provisional. They state that primary-energy consumption is to decline between 2020 and 2030 by around 1,400 PJ. With the exception of gas, all fossil-fuels will record a decrease, mainly driven by the increased use of renewable energies in transport, buildings and electricity. In electricity production, it is primarily lignite's share that declines significantly, while use of natural gas goes up. The driver for this development is the long-term increases in CO₂ prices in the emissions-trading system. Use of domestic nuclear power will end completely from 2023 onwards, with the nuclear power phase-out.⁷ Consumption of renewable energies will climb significantly, up 12 per cent in 2030 (compared to 2020). After 2030, consumption of renewable energies will only slightly increase. This is due to the development in the energy sector; existing installations that cease to operate are replaced by new ones in all instances (especially in the case of photovoltaic and biomass installations).

Table B16: Primary-energy consumption by fuel, 2021–2040, in PJ

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hard Coal	1,433	1,473	1,514	1,526	1,513	1,463	1,444	1,409	1,331	1,326	1,173
Lignite	1,212	1,241	1,262	1,263	1,256	1,181	1,131	1,116	1,090	1,041	650
Petroleum	4,496	4,450	4,400	4,351	4,299	4,238	4,175	4,111	4,046	3,983	3,305
Gas	2,873	2,897	2,919	2,928	2,915	2,914	2,908	2,868	2,855	2,820	2,691
Nuclear	678	339	0	0	0	0	0	0	0	0	-
Renewable energies	1,938	1,956	1,976	2,007	2,042	2,072	2,087	2,118	2,145	2,168	2,205
Other fuels	229	231	233	232	234	234	236	238	238	237	231
External trade balance: electrical energy*	-189	-140	-91	-142	-168	-169	-185	-190	-180	-185	-72
Total	12,670	12,446	12,213	12,166	12,092	11,933	11,796	11,670	11,525	11,391	10,182

* includes small proportions of district heating

Source: *Prognos*, ISI, GWS, iinas, 2018

⁷ According to Eurostat, nuclear energy is considered as a domestic energy source; among other factors, imported electricity sourced from nuclear energy is not explicitly indicated; it is also not stated separately under the fuel category 'nuclear energy'.

Due to the exit from nuclear energy⁸ and the decrease in use of lignite, domestic energy sources' share is declining. Simultaneously gas consumption in the reference scenario remains relatively constant, primarily due to the increased use of electricity obtained from natural gas. Because more than 90 per cent of natural gas is imported, the overall import share rises to around 65 per cent by 2030, and almost 66 per cent by 2040.

Table B17: Import-dependency, 2021–2040, net imports* in per cent

Fuel	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	-2.1	-2.0	-2.0	-2.0	-2.1	-2.1	-2.1	-2.1	-2.1	-2.2
Petroleum	95.7	95.7	95.7	95.7	95.7	95.7	95.7	95.7	95.7	95.6	95.7
Gas	93.6	94.1	94.6	95.0	95.4	95.7	96.1	96.3	96.6	96.8	93.6
Nuclear	0	0	-	-	-	-	-	-	-	-	-
Renewable energies	-0.8	-0.8	-0.8	-0.8	-0.8	-0.7	-0.7	-0.7	-0.7	-0.7	-0.6
Total	63.0	64.9	66.8	66.5	66.2	66.2	66.2	65.8	65.5	65.4	65.6

* (Import minus export and stockpiled resources) in relation to primary-energy consumption

Source: *Prognos*, ISI, GWS, iinas, (2018) (the right is reserved to update the information)

In the period 2010–2016 the countries of the former Soviet Union acquired ever greater significance as a source of coal imported to Germany; in 2016 these countries accounted for more than a third of the total. Together with three other countries, the USA (19 per cent), Colombia (22 per cent) and Australia (13 per cent), the countries/group of countries named account for around 90 per cent of coal imports to Germany.

At almost 40 per cent in 2016, Germany sourced the largest share of its petroleum imports from Russia; that country's share has continued to rise since 2010. Since the start of the 2000s, the market share accounted for by Norway (12 per cent) and by the United Kingdom (19 per cent) is on a downward trend. Germany sourced additional larger quantities from countries in Africa (14 per cent) and the Near East (5 per cent). Gas imports to Germany in 2015 were sourced almost exclusively from three countries, with Russia and Norway being of greatest significance, each having a share of around 34 per cent respectively. Almost all the rest (29 per cent) was imported from the Netherlands (29 per cent).

8 In Eurostat nuclear energy is considered as a domestic energy source.

4.5. Dimension internal energy market

4.5.1. Electricity interconnectivity

4.5.1.i. Current interconnection level and main interconnectors

The development of electricity-trading capacities, taken as the basis for quantitative analyses, uses as its long-term orientation the Grid Development Plans of 2015 and 2017, and the Ten-Year Network Development Plan (TYNDP 2018).

Table B18: Reference scenario – average available traded capacity for Germany and its electricity-use neighbours – 2020 – 2040, in GW

Export (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	34
2040	8	1	4	2	5	5	5	1	5	2	37

Import (from ... to DE)	AT	BE	CH	CZ	DK	FR	NL	NO	PL	SE	Total
2020	5	0	4	1	1	4	2	0	1	1	19
2025	8	1	4	3	2	4	4	1	2	1	30
2030	8	1	6	3	3	5	4	1	3	1	34
2035	8	1	6	3	4	5	5	1	3	2	37
2040	8	1	7	3	4	5	5	1	3	2	37

Source: Prognos 2018

4.5.1.ii. Projections of interconnector expansion requirements (including for the year 2030)

In the Grid Development Plan, requirements for expansion of the transmission-grids are checked at two-year intervals; the requirements emerge from the development of domestic power-generation and consumption structure and also from the European internal market for energy. The Grid Development Plan's results are published on www.netzentwicklungsplan.de; their most recent version serves as the basis for the quantitative analyses used in the National Energy and Climate Plan.

4.5.2. Energy transmission infrastructure

Information on this must be submitted at a later date.

4.5.3. Electricity and gas markets, energy prices

4.5.3.i. Current situation of electricity and gas markets, energy prices

Developments in the cross-border price and in the consumer prices for natural gas are closely linked with the development of the world market price. Following a steep rise in the period 2010-2012, after 2015 the cross-border price fell below the 2010 level; in 2016 it was at 1.5 Cent/kWh (Table B19). The consumer groups took various paths of development. In the household sector, the price between 2010 and 2016 did not substantially change. Large-scale customers benefited from a downturn in prices. This was strongest in evidence among the high-energy-intensity users.

The consumer prices for electricity rose for most consumer groups during the period 2010–2016, on average by around 4 Cent/kWh. The energy-intensive, privileged consumers in industry constitute an exception. Their prices were almost constant over the period 2010–2016, at 5 Cent/kWh. This consumer group is exempted from the Renewable Energy Sources Act surcharge.

4.5.3.ii. Projections of development with existing policies and measures, at least until 2040 (including for the year 2030)

Fees, surcharges and remunerations are levied on the final-consumer prices for natural gas and electricity. These price components refinance the grid infrastructure (for instance) and the expansion of renewable energies. Yet for climate-protection reasons, for reasons of energy policy and – not least – resource-distribution policy, other paths of refinancing are conceivable. Against this background, the long-term development of final-consumer prices for fuels and also electricity is not dependent solely on the (global) price and cost developments. For these reasons a projection up to 2030 or respectively 2040 is not possible.

Table B19: Gas prices by consumer group and also prices for PtX by sector, 2021–2040, in Cent/kWh

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Natural gas											
Cross-border price	2.9	2.9	2.9	3.0	3.0	3.1	3.1	3.2	3.3	3.3	3.6
Households	8.0	8.1	8.2	8.3	8.5	8.6	8.7	8.8	9.0	9.1	9.8
IND Band I2	5.4	5.5	5.6	5.6	5.7	6.1	5.4	5.5	5.6	5.6	6.6
IND Band I4	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4
IND Band I6	3.4	3.5	3.5	3.6	3.6	3.9	3.4	3.5	3.5	3.6	4.2
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	37	36	36	36	36	36	37	36	36	36	35

* Information given on PtX excludes tax [Figures on PtGas are subject to reservation of the right to update the information]

IND-Band I2: 1 000 GJ < consumption < 10 000 GJ

IND-Band I4: 100 000 GJ < consumption < 1 000 000 GJ

IND-Band I6: Consumption > 4 000 000 GJ

Source: Natural gas: Öko-Institut, Prognos, ISI 2017; electricity prices: Prognos 2018

4.6. Dimension research, innovation and competitiveness

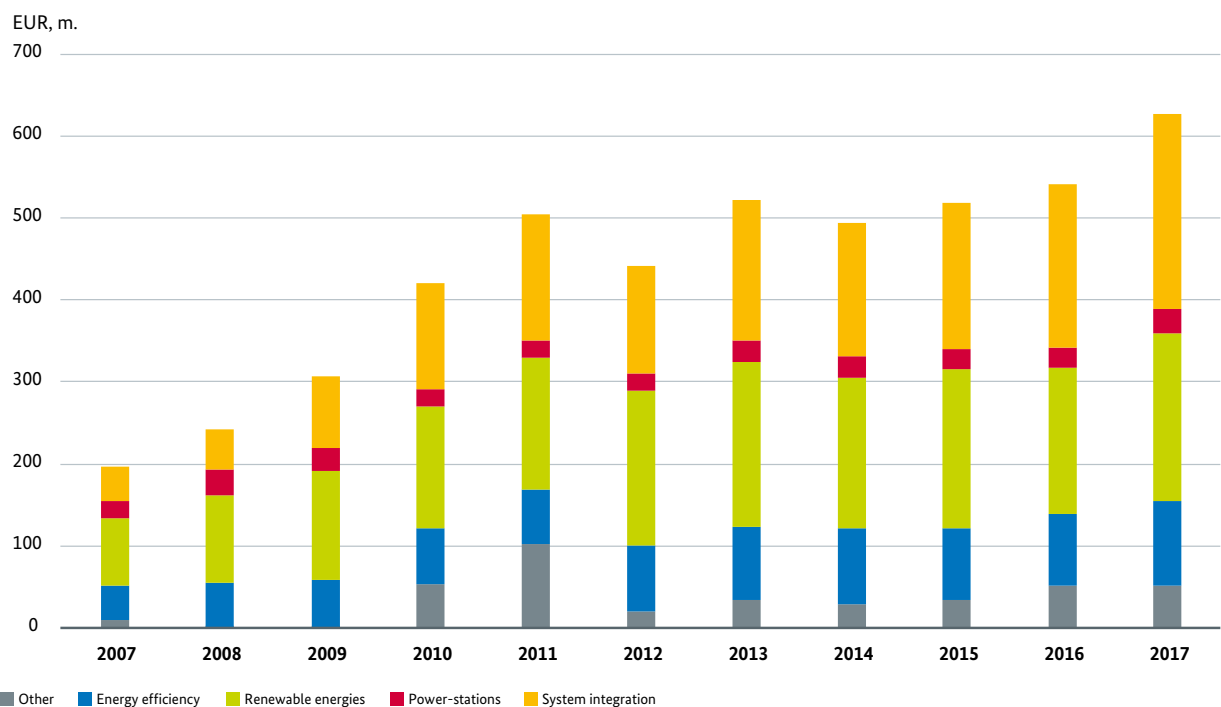
4.6.i. Current status of the low-carbon-technologies' sector and, to the extent possible, its position on the world market (that analysis is to be carried out at Union or global level)

The energy transition is part of a modernisation strategy for the overall economy, which gives rise to substantial investments in Germany as an economic location. As part of this, innovative business models also offer major opportunities. The energy transition helps in tapping into areas of potential for innovation and new markets. The digitalisation of the energy-transition also contributes to this. Many German companies benefit from this trade with new and innovative energy technologies. A current research project is to examine German companies' position more precisely, regarding international trade in energy technologies. Results on this will be presented in the course of 2019 and will form part of Germany's final NECP.

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 last ten years; its share of German GDP is now at around 0.03 per cent. In 2017, within the framework of the Federal Government's Energy Research Programme, EUR 1.013 billion were disbursed. These resources are distributed to direct funding-support for projects. and to institutional funding support provided to the Helmholtz Community. In addition, the Länder indicated their own energy-research expenditure in 2016, amounting to around EUR 250 million. The prospect is that, especially with regard to energy-efficiency and renewable energies, energy research's significance will continue to grow as the energy transition progresses. The Federal Government's medium-term finance planning provides for a volume of EUR 1.301 billion for funding support to energy research, within the framework of the 7th Energy Research Programme for the year 2020.

Figure B1: Overview of topics involved in promoting non-nuclear projects in the Energy Research Programme undertaken by the Federal Government (adjusted for inflation; base year: 2010)



Source: Project Management Jülich, 'profil' database

For research and development expenditure by private business, there are only estimates. In 2016, solely in the energy-research projects that received public support-funding, companies invested around EUR 155 million in the development of innovative energy technologies. To this, one can add third-party payments to higher-education institutions and research institutions in the context of collaborative projects. According to the Foundation Owners' Association on Scientific Statistics (Stifterverband Wissenschaftsstatistik), the private sector's total spend on internal R&D in 2015 comprised around EUR 61 billion. Of this, around EUR 7 billion are accounted for by companies who, *inter alia*, are active in 'energy research and energy technologies.' Using this order of magnitude on a proportional basis, the Foundation Owners' Association estimates the research and development workforce, active in energy research in 2015, to be around 52,000 people (equivalent of full-time posts).

Table B20: Registrations and issue of patents with effect for the Federal Republic of Germany, and with the registering party's/owner's headquarters in Germany, in selected activity areas of the WIPO IPC Green Inventory, for 2017, as an assessment by the German Patent and Trade Mark Office (DPMA) (status: June 2018)

Technology area	Patent registrations, published in 2017	Issue of patents, published in 2017
Alternative Energy Production	820	567
Energy Conservation	961	507
Total	1,770	1,062

Source: DPMA 2018

4.6.iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

Industry's electricity prices

The average electricity prices charged to industrial companies, outside the scope of compensation rulings, went down in 2016 but in 2017 they rose again. According to Federal Network Agency figures, on cut-off date 01 April 2016 the electricity prices for industrial consumers (annual consumption quantity: 24 GWh), outside the scope of the statutory exceptional provisions, essentially ranged from 12.91 to 15.69 ct/kWh (value-added tax excluded). In 2016, as of the cut-off date, the average prices went down by 4.0 per cent compared with the previous year, from 14.80 to 14.21 ct/kWh (see Table B21). This is primarily due to a price downturn in purchasing, sales and margin as a price constituent. This reduction can be expected to be mainly attributable to the wholesale prices; these once again decreased significantly at the start of 2016, and thus before the cut-off date for the Federal Network Agency's electricity-prices survey. Another contributor to the electricity-price decrease was the reduced grid charges for industrial customers not covered by compensation rulings; these went down by 0.06 ct/kWh to 2.06 ct/kWh. Here it should be noted that some large industrial customers, with high annual consumption and a constant ordering level, conclude a separate grid-use contract with their grid operator and thereby pay individual grid charges. In 2017, as of the cut-off date 01 April, the electricity prices have risen by 4.9 per cent, taking them to 14.90 ct/kWh.

Table B21: Electricity price constituents for industrial customers

Electricity price constituents for industrial customers, ct/kWh	01 April 2016	01 April 2017
Energy purchasing and sales (incl. margin)	3.48	3.41
Grid charge	2.06	2.23
Renewable Energy Sources Act surcharge	6.35	6.88
Surcharge: CHP Act (<i>KWKG</i>)	0.06	0.09
Issue of a concession	0.11	0.1
Surcharge acc. to Electricity Grid Remuneration Regulation, (<i>StromNEV</i>), Art. 19	0.06	0.06
Offshore liability surcharge	0.03	0.04
Surcharge: electricity loads able to be switched off	0	0.01
Electricity taxes	2.05	2.05
Total price	14.21	14.9

In individual cases, electricity prices differ significantly from company to company. For instance, individual quantities used and user profiles play a part in determining the price. There are also regional differences – on the grid charges, for instance. The result of various cost-relief rulings – among others, regarding the Renewable Energy Sources Act surcharge and the electricity tax – is that, in particular, companies whose production is especially electricity-cost-intensive, and which face strong international competition, have their payment obligations reduced subject to certain conditions. These cost-relief rulings make an important contribution to maintaining Germany as an industrial location and serve the overall economy's interest. For the Federal Government it is an established principle that the international competitiveness of German industry must be safeguarded. The objective remains to avoid the outward migration of companies into countries with lower environmental standards or respectively lower energy charges ('carbon leakage') and also to secure, on a lasting basis, closed value-creation chains and industrial employment in Germany.

4.6.iv. Description of energy subsidies, including for fossil fuels

The fossil fuels coal and gas still play an important role in the Federal Government's current energy mix – despite successful expansion of renewable energies. 22 per cent of primary-energy consumption is based on coal and lignite (10.9 per cent coal; 11.1 per cent lignite), 23.8 per cent on natural gas, and 6.1 per cent on nuclear fuels. Coal remains the most important fuel used to generate electricity. Likewise, fossil fuels will also retain their significance in the future, as a back-up technology. At present the Commission on 'Growth, Structural Change and Employment' (see also Chapters 1.2. and Chapter 2.4.), appointed by the Federal Government, is examining how, and by what date, coal-powered electricity is to be ended.

State aid for coal turnover, and for measures to retire the relevant coal-mining resources, comprises EUR 1,020.3 million. Adaptation payments for coal-mining employees account for EUR 102.5 million in 2018. The assistance funding promised to coal mining has been reduced in recent years. From 1998 to 2005 the Federal assistance payments were more than halved; from 2006 to 2016 they underwent another decrease, by around 20 per cent. Over the years, what has gained significance is primarily the outgoings for retirement of coalmines and the costs of eliminating inherited financial burdens; thanks to these investments, negative environmental effects of coal mining have been able to be reduced. The subsidies have also enabled the adaptation process in German coal mining to be shaped in a socially harmonious way.

In Germany, alongside subsidies for hard coal-mining, there are, in particular, the following measures of support for fossil fuels.

1. Privileges on energy tax and electricity tax

The energy-tax exemption for use of energy products to generate electricity (e.g. use of coal to produce electricity) is predetermined on an obligatory basis by the EU Energy Tax Directive; this is in order to avoid double taxation of the energy products used, and thus of the electricity produced as a result. The tax relief for certain processes and procedures, and the so-called 'peak shave' in energy-tax law and in electricity-tax law, serve the aim of maintaining German industries' competitiveness on international markets, and of preventing the companies' migration to countries with lower environmental standards (carbon leakage). Beyond this, there are elements of tax relief for local public transport, for agriculture and forestry enterprises, and for inland waterway transport. In instances where the energy-tax law and electricity-tax law benefits are state-aid payments, they are in line with EU state aid rules.

2. Electricity-price compensation

The electricity-price compensation provides state aid to balance out the costs, passed on into the electricity price, from European emissions trading (indirect CO₂ costs). This electricity-price compensation can be claimed solely by companies that, due to significant indirect costs, are exposed to an actual risk of a shifting-over of CO₂ emissions. The purpose of the electricity-price compensation is to keep the jobs in Europe, to maintain European industry's competitiveness internationally, and to prevent the firms and the greenhouse-gas emissions from migrating to countries that have lower environmental standards (carbon leakage). It is the expectation that the Member States implement this electricity-price compensation.

5. Impact assessment of planned policies and measures

5.1. Impacts of planned policies and measures described in Section 3 on energy system and GHG emissions and removals, including 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 ten 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

Using suitable strategies and measures, the greenhouse-gas emissions are to decrease by at least 55 per cent by 2030 (cf. Point 2.1.1.). Consistent with this, primary-energy consumption is to be further reduced by 2030 in relation to the reference development, and with renewable energies' market share further increasing in relation to the reference development. It is possible to analyse the socio-economic and environmental impacts of planned strategies and measures in the context of an assessment of consequences, as soon as the specific structure of the future strategies and measures is known. These strategies and measures are being worked out in the programme of measures for the Climate Action Plan 2050 and in the further process of shaping the National Energy and Climate Plan.

Because of the relevant effects for Germany's 'electricity neighbours', and for the cross-border trade in electricity, a preview is being prepared, stating renewable energies' expansion in the electricity sector up to 2030.

It was decided, in the coalition agreement between the CDU, CSU and SPD, that renewable energies' share of gross electricity consumption is to be raised to around 65 per cent by 2030, in view of the challenges presented by better synchronisation of renewable energies and grid capacity. As part of the Grid Development Plan 2019–2030, transmission-grid operators and the Federal Network Agency are checking which measures are essential for this, from the perspective of the grid.

On 15 June 2018 the Federal Network Agency endorsed the scenario framework which forms the basis for the Grid Development Plan 2019–2030. The scenario framework contains three scenarios: these illustrate, as examples, how the 65-per-cent target could be reached, as was established in the coalition agreement between the CDU, CSU and SPD; these three scenarios are to be adopted in the autumn of 2019, in the light of the results from two sources: a working group on raising acceptance for the additional growth of wind energy, and the Commission on 'Growth, Structural Change and Employment' (see 2.1.2.). The bandwidth of the resulting installed-capacity levels, based on the three scenarios, demonstrates that the future development is uncertain (see Table B22).

For Scenario A 2030, net electricity consumption of 512.3 TWh is assumed; Scenario B 2030 envisages 543.9 TWh, while Scenario C predicts 576.5 TWh. Accordingly, the renewable energies' installed capacity differs in the three scenarios: It is lowest in Scenario A and highest in Scenario C. Accordingly the focus of future additional construction is on the following fuels: onshore wind, offshore wind, and photovoltaics. The installed capacity of hydrogen and of other renewable energies is stagnating, while that of biomass is declining.

Table B22: Installed capacity of renewable energies in the approved scenario framework for the Grid-Development Plan 2019 – 2030 (in GW)

Installed output in GW	Reference 2017	Scenario A 2030	Scenario B 2030	Scenario C 2030
Onshore wind	50.5	74.3	81.5	85.5
Offshore wind	5.4	20.0	17.0	17.0
Photovoltaics	42.4	72.9	91.3	104.5
Biomass	7.6	6.0	6.0	6.0
Water power	5.6	5.6	5.6	5.6
Other renewables	1.3	1.3	1.3	1.3
Total	112.8	180.1	202.7	219.9

Source: Federal Network Agency, 2018, https://www.netzentwicklungsplan.de/sites/default/files/paragraphs-files/Szenariorahmen_2019-2030_Genehmigung.pdf

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

Supplementary information on this is to follow decisions on the specific structure of future policies and measures.

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

Supplementary information on this is to follow decisions on the specific structure of future policies and measures.

5.2. Macroeconomic and, to the extent feasible, the 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 comparison to projections with existing policies and measures

It is to be expected that future strategies and measures will entail additional investments in the respective sectors. In view of the results from the comparable analyses that are available, it is to be assumed that these additional investments will lead to (moderate) value-creation impetus and employment creation. Distribution effects can have a highly differentiated impact; they depend on the specific shape that the future strategies and measures take.

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List of the parameters and variables to be stated in Section B of the National Plan

The following projection data for the 2020-2040 period relates to the reference development (cf. Section B.4.). In part, the information given consists of provisional results from Prognos AG. For individual indicators there remains a need to make additions and update the inputs.

Indicator 1.1: Population [in k.]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Population	k	81,179	80,321	82,184	83,458	83,316	82,868	82,179	81,293

Indicator 1.2: GDP [EUR, m., real-terms prices]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
GDP	EUR m. ₂₀₁₆	2,648,738	2,816,308	3,057,384	3,326,396	3,548,307	3,729,306	3,921,966	4,087,767
GDP	EUR, m. ₂₀₁₀	2,426,546	2,580,060	2,800,913	3,047,358	3,249,741	3,415,510	3,591,959	3,743,809

**Indicator 1.3: Sectoral gross value-added (including main industrial, construction, services and agriculture)
[in EUR m.₂₀₁₀]**

	2005	2010	2015	2020	2025	2030	2035	2040
Agriculture and forestry, fishery	16,109	16,700	15,244	15,103	15,199	15,175	15,276	15,342
Manufacturing industry	655,394	700,282	778,924	631,812	670,830	701,839	737,170	773,799
Manufacturing industry excluding construction sector	559,489	600,439	675,914	740,862	783,278	815,709	852,816	889,537
Mining and extraction of stones and soils	4,626	5,301	4,499	3,650	2,917	2,350	1,955	1,667
Manufacturing	485,862	515,175	590,494	647,471	687,104	717,723	752,494	787,362
Manufacture of foods and drinks, tobacco products	40,740	38,110	48,118	54,237	54,744	54,843	55,397	55,823
Manufacture of textiles, clothing, leather goods and shoes	7,643	6,958	6,531	6,375	6,085	5,773	5,548	5,367
Manufacture of wooden goods, paper and printed products	24,384	24,207	25,062	25,143	25,295	25,161	25,203	25,214
Coking plant and petroleum processing	7,129	5,503	4,688	6,012	4,542	3,499	2,794	2,288
Manufacture of chemical products	38,138	40,987	41,253	44,413	46,805	48,317	50,009	51,701
Manufacture of pharmaceutical products	19,365	20,850	21,567	25,212	27,177	28,826	30,655	32,508
Manufacture of rubber goods, plastics, glassware, ceramics, and similar products	35,915	37,702	41,740	44,888	46,894	48,201	49,783	51,298
Metal production and processing, manufacture of metal products	63,763	62,513	71,765	75,641	78,169	79,582	81,498	83,514
Manufacture of data-processing equipment, electronic and optical products	20,324	30,508	43,086	51,515	59,330	66,411	73,802	81,225
Manuf. electrical equipment	37,492	39,750	38,013	40,034	41,948	43,186	44,643	46,118
Mechanical engineering	80,949	77,102	83,247	90,031	99,201	107,014	115,392	123,900
Vehicle construction	82,168	96,645	129,379	147,495	158,373	166,943	176,267	185,489
Manuf. of furniture, other goods; repair and maintenance of machines	33,485	34,340	35,480	36,649	39,121	40,985	43,026	45,042
Construction	96,788	99,843	103,497	109,050	112,448	113,870	115,646	115,738
Services	1,506,505	1,604,713	1,728,115	1,883,750	2,014,051	2,130,047	2,256,121	2,366,734

Indicators 1.4 and 1.5: Number of households [in k.] and household size [inhabitants/household]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Household	k	39,178	40,301	40,774	41,695	41,967	42,257	42,468	42,311
Household size		2.10	2.03	2.02	2.00	1.98	1.96	1.93	1.92

Indicator 1.6: Households' disposable income [EUR], expenditure concept: nominal prices

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Disposable income	EUR bn.	1,452	1,562	1,754	2,007	2,241	2,532	2,837	3,142

Note: Disposable income is ordinarily indicated in nominal prices by, *inter alia*, the Federal Office of Statistics.

Indicator 1.7: Number of passenger km: all modes of transport, split between road (cars and buses separated if possible), rail, air, and domestic navigation (when relevant) [million pkm]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Personal transport									
Bus transport	MPkm	81,056	84,282	88,789	91,278	89,747	85,680	85,222	84,189
Motorised cycles	MPkm	18,766	17,315	17,823	17,871	18,287	18,206	18,119	17,911
Cars	MPkm	856,935	885,085	929,278	965,427	987,880	983,493	978,824	967,575
Rail	MPkm	92,130	100,172	106,763	113,406	119,464	122,362	122,522	121,849
Air transport ¹	MPkm	169,528	193,734	220,663	252,729	273,345	292,807	303,379	312,791

1 Outgoing traffic

Indicator 1.8: Freight transport tonnes-kilometres: all modes excluding international maritime, i.e. split between road, rail, aviation, domestic navigation (inland waterways and national maritime) [million tkm]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Freight transport									
Heavy trucks (3.5 t and over)	Mtkm	402,690	440,600	458,908	519,548	568,215	601,447	627,997	650,402
Rail	Mtkm	100,542	110,300	120,732	139,303	152,672	161,949	168,849	174,639
Domestic-waterway shipping	Mtkm	64,096	62,278	55,315	62,246	69,137	74,303	79,607	84,538
Air transport ¹	Mtkm	7,201	10,773	11,418	12,712	14,313	15,900	17,847	19,801

1 Outgoing traffic

Indicator 1.9: International import prices: oil, gas and coal fuel [Euro/GJ or Euro/toe, price basis: 2016]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Crude oil	Euro/GJ	9	11	8	13	15	17	17	18
Natural gas	Euro/GJ	5	6	6	8	8	9	10	10
Power-station coal	Euro/GJ	2	3	2	3	4	5	6	6
Syncrude	Euro/GJ			143	119	100	80	73	65

Indicator 1.10: EU-ETS carbon price [Euro/EUA, price basis: 2016]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
CO ₂ price	EUR/t	25	16	8	16	23	35	44	52

Indicator 1.11: Assumed EUR and USD exchange rates [Euro/currency and US dollar/currency]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
USD for 1 EUR	nominal	1.25	1.33	1.11	1.14	1.15	1.16	1.18	1.19

Indicators 1.12 and 1.13: Heating Degree Days, Cooling Degree Days (CDD)

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
HDD	HDD	3,148	3,630	2,909	3,024	3,008	2,993	2,979	2,967
Cooling-degree days	CDD	168	145	164	168	173	177	182	186

CDD with threshold-temperature deviating from EU-Stat figure/figures

Source: Extrapolation based on ODYSSEE database and E3MLab, CDD taken over from PRIMES data set

Indicator 2.1.1: Indigenous production by fuel type (all energy products: coal, crude oil, natural gas, nuclear energy, renewable energy sources) [ktoe]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	ktoe	56,484	45,906	43,004	30,964	30,756	25,505	19,084	15,956
Crude oil and petroleum products	ktoe	5,004	3,621	3,470	3,200	2,782	2,419	2,103	1,828
Gas	ktoe	14,334	11,113	6,335	4,799	3,220	2,178	1,487	1,029
Natural gas	ktoe	14,334	11,113	6,335	4,762	3,129	2,056	1,351	887
Nuclear	ktoe	42,061	36,257	23,677	15,954	0	0	0	0
Renewable energies	ktoe	16,851	27,712	38,886	44,310	46,704	49,152	48,784	49,478
of which: hydropower	ktoe	1,689	1,802	1,632	1,777	1,777	1,777	1,777	1,777
Wind energy	ktoe	2,341	3,250	6,811	10,929	12,441	14,952	15,818	16,434
Thermic solar energy	ktoe	261	484	671	894	1,149	1,411	1,717	2,022
Photovoltaics	ktoe	110	1,009	3,330	4,091	5,022	5,803	6,022	6,721
Biomass	ktoe	7,976	11,010	12,062	11,714	11,715	11,453	11,015	10,662
Biogas	ktoe	1,005	4,236	7,854	8,018	7,797	7,227	5,983	5,374
Waste	ktoe	3,690	4,667	5,988	5,913	6,038	6,032	5,834	5,742
Waste (renewable)	ktoe	1,845	2,334	2,994	3,105	3,122	2,970	2,611	2,424

Indicator 2.1.2: Net imports by fuel type (including electricity and split into intra-EU and extra-EU net imports) [ktoe]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels, total	ktoe	25,972	31,644	36,166	35,534	35,884	31,337	30,350	27,678
Intra-EU (EU28)	ktoe	6,760	4,840	1,941					
Intra-EU (EU27_new)	ktoe	6,779	4,868	1,945					
Extra-EU	ktoe	16,913	21,767	26,739					
Crude oil, petroleum products, total	ktoe	120,537	110,291	105,774	104,680	99,554	92,345	84,350	76,763
Intra-EU (EU28)	ktoe	30,031	31,674	22,767					
Intra-EU (EU27_new)	ktoe	15,385	18,324	11,130					
Extra-EU	ktoe	90,490	78,491	82,854					
Gas, total	ktoe	61,940	61,645	58,676	59,745	62,254	61,204	60,231	59,469
Intra-EU (EU28)	ktoe	16,968	18,311	28,380					
Intra-EU (EU27_new)	ktoe	16,968	18,311	28,380					
Extra-EU	ktoe	55,129	52,490	54,996					
Electricity, total	ktoe	-393	-1,286	-4,152	-4,756	-3,957	-4,219	-2,139	-1,387
Intra-EU (EU28)	ktoe	912	-298	-3,478					
Intra-EU (EU27_new)	ktoe	912	-298	-3,478					
Extra-EU	ktoe	-1,305	-988	0					
Total	ktoe	208,056	202,294	196,465	195,203	193,735	180,667	172,793	162,523

Indicator 2.1.3: Import dependency from third countries [%]

	Unit	2005	2010	2015
Solid fuels	%	21	28	34
Crude oil and petroleum products	%	73	69	76
Gas	%	71	69	84

Indicator 2.1.4: Main import sources (countries) for main fuels (including gas and electricity)

	2005	2010	2015
Solid fuels	Poland	Russia	Russia
Crude oil and petroleum products	Russia	Russia	Russia
Gas	Russia	Russia	Russia
Electricity	France	France	France

Indicator 2.1.5: Gross Inland Consumption by fuel-type (all solid fuels, all energy products: coal, crude oil and petroleum products, natural gas, nuclear energy, electricity, derived heat, renewables, waste) [ktoe]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	ktoe	81,952	78,824	79,515	66,532	66,692	57,005	49,643	43,899
of which: coal	ktoe	81,950	78,823	79,515	66,532	66,692	57,005	49,643	43,899
Crude oil and petroleum products	ktoe	121,475	111,317	107,174	108,039	102,569	95,025	86,715	78,846
Gas	ktoe	77,782	75,905	65,154	64,883	65,866	63,756	62,090	60,878
of which: natural gas	ktoe	77,782	75,905	65,154	64,883	65,866	63,756	62,090	60,878
Nuclear	ktoe	42,061	36,257	23,677	15,954	0	0	0	0
Derived heat	ktoe	-6	-6	-4	0	0	0	0	0
Renewable energy	ktoe	17,210	27,571	38,354	44,131	46,695	49,581	49,452	50,413
Electricity	ktoe	-393	-1,286	-4,152	-4,756	-3,957	-4,219	-2,139	-1,387
Waste	ktoe	1,845	3,906	4,252	4,301	4,393	4,388	4,245	4,177
Total	ktoe	341,925	332,487	313,971	299,084	282,257	265,536	250,006	236,827

Indicator 2.2.1: Gross electricity generation [GWh]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Gross electricity generation	GWh	622,579	632,983	646,888	645,260	629,031	623,915	599,658	595,602

Indicator 2.2.2: Gross electricity generation by fuel (all energy products) [GWh]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Coal	GWh	288,142	262,896	272,200	232,094	240,178	200,181	171,202	147,891
Natural gas	GWh	74,036	90,352	63,017	63,387	81,514	83,373	87,078	97,375
Petroleum products	GWh	11,997	8,741	6,209	5,956	5,516	5,651	5,367	4,127
Nuclear	GWh	163,055	140,556	91,786	67,063	0	0	0	0
Renewables	GWh	69,284	111,209	193,287	251,588	276,167	308,879	310,285	319,876
Other	GWh	16,065	19,229	20,389	25,172	25,656	25,832	25,726	26,333
Total	GWh	622,579	632,983	646,888	645,260	629,031	623,915	599,658	595,602

Indicator 2.2.3: Share of combined heat-and-power generation in total electricity generation, total [in %]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Share of electricity generation (acc. to Eurostat*)	%	12.6	13.2	12.2					
Share of electricity generation (model calculation)	%	14	17	18	20	21	21	21	20

* The values from Eurostat include the quantities of the public and industrial CHP facilities; as regards the model values, power generation from biogenic and small-scale CHP facilities is additionally taken into account (based on figures from the association); the result is a higher share for CHP.

Indicator 2.2.4: Electricity generation capacity by source, including retirements and new investments [MW] (balance, installed capacity)

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Installed net output									
Hydropower	MW	5,210	5,410	5,470	5,742	5,742	5,742	5,742	5,742
Biomass	MW	2,940	6,230	7,170	7,770	7,226	6,129	4,334	3,433
Nuclear	MW	20,340	20,430	10,800	8,107	0	0	0	0
Lignite	MW	20,680	21,340	21,420	17,900	17,028	15,173	11,001	9,132
Coal	MW	27,640	28,390	28,650	21,817	18,775	17,951	15,770	12,593
Petroleum	MW	5,500	5,900	4,200	1,230	910	836	812	630
Gas	MW	20,600	23,800	28,360	21,504	24,988	32,120	33,212	34,176
Wind – onshore	MW	18,250	26,820	41,300	53,529	54,971	60,082	61,749	64,171
Wind – offshore	MW	0	80	3,280	7,704	10,804	15,004	15,921	15,700
Solar	MW	2,060	18,010	39,220	49,836	61,102	70,514	73,133	81,562
Total	MW	123,220	156,410	189,870	195,139	201,546	223,551	221,673	227,139
Additional build/retirement of facilities: 5-year-values									
			2006 to 2010	2011 to 2015	2016 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040
Hydropower	MW		3,290	940	600	-544	-1,097	-1,795	-901
Biomass	MW		90	-9,630	-2,693	-8,107	0	0	0
Nuclear	MW		660	80	-3,520	-872	-1,855	-4,172	-1,869
Lignite	MW		750	260	-6,833	-3,042	-824	-2,181	-3,177
Coal	MW		400	-1,700	-2,970	-320	-74	-24	-182
Petroleum	MW		3,200	4,560	-6,856	3,484	7,132	1,092	964
Gas	MW		8,570	14,480	12,229	1,442	5,111	1,666	2,422
Wind – onshore	MW		80	3,200	4,424	3,100	4,200	917	-221
Wind – offshore	MW		15,950	21,210	10,616	11,266	9,411	2,619	8,429
Solar	MW		33,190	33,460	5,269	6,407	22,004	-1,877	5,465
Total	MW		33,190	33,460	5,269	6,407	22,004	-1,877	5,465

Source up to 2015: AGEE-Stat; Federal Ministry for Economic Affairs and Energy; Federal Network Agency

Indicator 2.2.5: Heat generation in thermal power stations (coupled) [ktoe]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Emissions from traditional thermal power stations	ktoe	8,719	8,673	7,823	8,259	8,399	8,683	8,524	8,343

Note: What is shown is the coupled generation of heat in thermal power stations for public-utilities supply.

Indicator 2.2.6: Heat generation from CHP plants (incl. industrial waste-heat) (coupled) [ktoe]

	Unit	2005	2010	2015
Heat generation	ktoe	15,582	16,139	15,997

Indicator 2.2.7: Cross-border interconnection capacities for gas and electricity

To be supplied at a later date.

Indicator 2.3.1: Fuel inputs to thermal power generation (solid fuels, oil, gas) [ktoe]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	ktoe	65,740	59,687	60,910	51,314	52,333	43,553	36,437	31,142
Crude oil and petroleum products	ktoe	1,427	855	542	531	487	498	473	359
Gas	ktoe	17,808	19,954	14,255	14,950	16,277	15,560	14,458	14,706
All products	ktoe	90,075	90,587	89,509	79,328	82,163	71,392	61,846	55,956

Indicator 2.3.2: Fuel inputs to other conversion processes [ktoe] (refineries, coking plants)

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Refineries	ktoe	125,047	103,074	100,078	101,007	96,115	88,761	80,305	72,454
Coking plants	ktoe	7,540	8,316	8,504	6,560	6,398	6,252	6,137	6,043

Indicator 2.4.1: Primary and final-energy consumption [ktoe]

	Einheit	2005	2010	2015	2020	2025	2030	2035	2040
Gross inland consumption	ktoe	341,925	332,487	313,971	291,280	274,614	258,074	242,895	230,152
Primary energy consumption	ktoe	317,264	309,905	292,705	270,185	254,463	238,950	224,554	212,495
End energy consumption	ktoe	218,456	219,650	212,124	211,405	206,261	198,251	190,493	183,067

Indicator 2.4.2: Final energy consumption by sector (industry, residential, tertiary, agriculture and transport [including split between passenger and freight transport, when available]) [ktoe]

	Einheit	2005	2010	2015	2020	2025	2030	2035	2040
Industry	ktoe	59,093	60,562	60,951	58,064	56,098	53,900	52,388	51,190
Households	ktoe	63,498	62,454	53,171	53,555	50,758	48,393	46,714	45,307
Commercial and public services*	ktoe	30,146	32,103	31,113	30,035	29,195	28,002	27,010	26,196
Transport	ktoe	62,321	61,101	63,168	66,669	67,261	65,176	61,743	57,842
Freight transport	ktoe	17,164	17,713	18,449	19,997	20,671	20,681	20,557	20,229
Personal transport	ktoe	45,158	43,388	44,719	46,672	46,590	44,495	41,186	37,613
Agriculture*	ktoe	3,047	3,252	3,602	3,082	2,950	2,780	2,639	2,531
Total	ktoe	218,456	219,650	212,124	211,405	206,261	198,251	190,493	183,067

* For Germany, the agriculture sector is not explicitly indicated as an item. Accordingly, the value of the sectors was calculated anew here.

Indicator 2.4.3: Final energy consumption by fuel (all energy products) [ktoe]

	Einheit	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	ktoe	8,237	9,379	10,399	8,834	8,439	8,125	7,939	7,813
Crude oil and petroleum products	ktoe	90,309	83,168	81,119	81,145	77,164	71,114	64,456	58,219
Gas	ktoe	55,136	56,431	51,764	50,889	48,749	46,364	44,353	42,219
Derived heat	ktoe	10,751	11,268	9,594	9,961	10,355	10,515	10,576	10,532
Renewable energies	ktoe	8,841	12,671	13,962	15,083	16,314	17,190	17,905	18,472
Electricity	ktoe	44,907	45,780	44,259	44,412	43,901	43,418	43,650	44,147
Waste	ktoe	276	953	1,026	1,081	1,339	1,525	1,615	1,665
Total	ktoe	218,456	219,650	212,124	211,405	206,261	198,251	190,493	183,067

Indicator 2.4.4: Final non-energy consumption [ktoe]

	Einheit	2005	2010	2015	2020	2025	2030	2035	2040
Solid fuels	ktoe	243	352	367	351	313	278	248	221
Crude oil and petroleum products	ktoe	21,947	19,838	18,527	18,070	17,182	16,245	15,530	14,910
Gas	ktoe	2,472	2,392	2,372	2,674	2,655	2,601	2,563	2,526
Total	ktoe	24,662	22,582	21,266	21,095	20,151	19,124	18,340	17,657

Indicator 2.4.5: Primary energy intensity of the overall economy (primary energy consumption per GDP [toe/Euro])

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Primary energy intensity	toe/Euro	0.131	0.120	0.105	0.089	0.078	0.070	0.062	0.057

Indicator 2.4.6: Final energy intensity by sector (industry, residential, tertiary and transport)

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Industry	toe/k€	0.090	0.086	0.078	0.092	0.084	0.077	0.071	0.066
Residential buildings	toe/m ²	0.019	0.017	0.014	0.013	0.012	0.012	0.011	0.011
Freight transport	toe/Mtkm	29.87	28.39	28.54	27.25	25.70	24.23	22.99	21.77
Personal transport	toe/Pkm	37.06	33.88	32.80	32.40	31.30	29.61	27.31	25.00
Services	toe/k€	0.024	0.022	0.017	0.016	0.015	0.013	0.012	0.011

Values – industry, commerce, services; price basis: 2010

Indicator 2.5.1: Electricity prices by type of consumption sector (residential, industry, tertiary) [Euro/kWh]

	Unit	2010	2015
Household customers*	Euro/kWh	0.24	0.29
Non-household customers			
Group IA: Consumption < 20 MWh	Euro/kWh	0.25	0.28
Group IB: 20 MWh < Consumption < 500 MWh	Euro/kWh	0.18	0.23
Group IC: 500 MWh < Consumption < 2 000 MWh	Euro/kWh	0.15	0.20
Group ID: 2 000 MWh < Consumption < 20 000 MWh	Euro/kWh	0.14	0.17
Group IE: 20 000 MWh < Consumption < 70 000 MWh	Euro/kWh	0.12	0.15

* Consumption from 2,500 kWh to 4,999 kWh

Indicator 2.5.2: National retail fuel prices (including taxes, per source and sector) [Euro/ktoe]

	Unit	2005	2010	2015
Engine petroleum ('Super')	Euro/ktoe	1,830,719	2,012,195	1,823,846
Diesel	Euro/ktoe	1,441,088	1,570,205	1,396,378

Indicator 2.6.1: Energy-related investment costs, measured against GDP

	Unit	2005	2010	2015	2020	2025	2030	2035	2040

Indicator 2.7.1: 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) and by technology¹

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Gross electricity generation	ktoe	5,493	9,547	15,703	21,657	23,773	26,588	26,710	27,535
Final-energy consumption for heating and cooling	ktoe	8,794	14,347	14,642	14,988	16,412	17,460	18,250	18,871
Final-energy consumption: transport ^{1,2}	ktoe	1,978	3,064	2,806	3,118	3,438	3,908	4,438	5,063
Gross final-energy consumption ²	ktoe	16,159	26,802	32,909	39,651	43,274	47,218	48,174	49,687
Renewables' share									
of gross electricity consumption	%	10.5	18.2	30.5	42.6	47.3	53.8	54.0	55.2
of final-energy consumption for heating and cooling	%	7.7	12.1	13.5	14.0	15.6	17.3	19.0	20.2
of final-energy consumption: transport	%	3.4	5.6	5.0	5.5	7.2	10.2	13.9	17.5

1 According to EU Directive 2009/28/EC

2 Consumption of biogenic fuels and electricity from renewable energies in the transport sector

Indicator 2.7.2: Electricity and heat generation from renewable energy in buildings (according to definition in Directive 2010/31/EU, Article 2 (1)) [ktoe]

	Unit	2005	2010	2015	2020	2025	2030	2035	2040
Heat generation	ktoe	4,913	8,512	9,671	11,130	12,382	13,336	14,036	14,584

Indicator 3.1: GHG emissions: ETS/Non-ETS and LULUCF

	Unit	2010	2015	2020	2025	2030	2035	2040
ETS	Mt CO _{2eq}	452	457	413	420	377	341	316
Non-ETS	Mt CO _{2eq}	491	450	425	399	366	335	308
LULUCF	Mt CO _{2eq}	-16	-14	30	26	21	17	13

Indicator 3.2: GHG emissions by sector and area

	Unit	2010	2015	2020	2025	2030	2035	2040
Emissions attributable to energy use	Mt CO_{2eq}	802	768	707	693	623	560	510
Energy sector	Mt CO _{2eq}	357	337	295	304	263	229	205
Industry	Mt CO _{2eq}	125	127	115	110	106	103	100
Transport	Mt CO _{2eq}	154	163	163	159	147	133	118
Private households	Mt CO _{2eq}	107	88	80	71	63	57	52
Commerce, retail, services, other	Mt CO _{2eq}	46	42	44	39	35	31	28
Miscellaneous emissions	Mt CO _{2eq}	11	11	9	9	8	7	7
Emissions not attributable to energy use	Mt CO_{2eq}	141	139	131	126	120	116	114
ind. processes	Mt CO _{2eq}	63	61	59	56	53	50	49
Agriculture	Mt CO _{2eq}	63	67	63	63	62	61	61
Waste	Mt CO _{2eq}	15	11	9	7	5	5	4
Total	Mt CO_{2eq}	943	907	838	819	743	677	624
For information only: LULUCF	Mt CO _{2eq}	-16	-14	30	26	21	17	13
For information only: International air and sea transport	Mt CO _{2eq}	33	32	40	45	49	49	50

Indicator 3.3: CO₂ intensity of overall economy, t CO_{2eq}/EUR k of GDP

	Unit	2010	2015	2020	2025	2030	2035	2040
CO ₂ intensity	t CO _{2eq} /k. Euro	0.365	0.324	0.275	0.252	0.218	0.188	0.167

Indicator: 3.4.1: GHG intensity of electricity generation and district-heating production

	Unit	2010	2015	2020	2025	2030	2035	2040
Electricity generation	t CO _{2eq} /toe	6.39	6.17	5.25	5.57	4.81	4.33	3.91
District-heating generation	t CO _{2eq} /toe	3.35	3.51	3.35	3.31	3.21	3.15	3.06

Electricity: reference point is gross electricity generation, including exports/imports, minus self-consumption quantities, pump-based electricity and grid losses. District heating: reference point is volume generated, minus grid-losses

Indicator 3.4.2: GHG intensity of final consumption, by sector

	Unit	2010	2015	2020	2025	2030	2035	2040
Industry	t CO _{2eq} /toe	2.0	2.1	1.9	1.9	1.9	1.9	1.9
Industry, including processes	t CO _{2eq} /toe	3.0	3.1	2.9	2.9	2.9	2.9	2.9
Transport	t CO _{2eq} /toe	2.5	2.6	2.5	2.4	2.3	2.2	2.0
Private households	t CO _{2eq} /toe	1.7	1.6	1.5	1.4	1.3	1.2	1.1
Commerce	t CO _{2eq} /toe	1.3	1.2	1.3	1.2	1.1	1.0	1.0

Industry: in one instance including GHG emissions of the industrial processes; in the other instance, excluding those emissions

Notification on Measures and Methods for Implementation of Directive 2012/27/EU, Article 7, by the Member States

The Member States report their planned detailed method to the Commission, for the energy-efficiency obligation systems, according to Directive 2012/27/EU, Annex V, Number 5, and alternative strategic measures pursuant to Articles 7a and 7b, and also Article 20 (6), of the stated Directive.

The Federal Government of the Federal Republic of Germany hereby provide a provisional notification to the Commission, subject to further checking, according to the Governance Directive, Annex III, No. 1, for provisional calculation of the Energy Saving Obligation, according to Directive 2012/27/EU, Article 7, Paragraph 1, Sentence 1, 1b) (new). Further political discussion is required for information pursuant to the Governance Directive, Annex III, Nos. 2 to 5, regarding further aspects of the Energy Saving Obligation, according to the Directive 2012/27/EU, Article 7 (for instance, the further calculation of this obligation, fulfilment of it, and monitoring of it); therefore that information does not form part of the subject matter of this provisional notification.

1. Calculation of the amount of the energy-saving obligations to be achieved over the whole period from 01 January 2021 to 31 December 2030, making it evident how the following aspects were taken into account:

a. The annual final-energy consumption, averaged over the last three-year period, prior to 01 January 2019 [in ktoe]

The basis for calculation used to determine the savings-objective, in accordance with Directive 2012/27/EU, Article 7, Paragraph 1, Sentence 1, Number 1b) (new), is the final-energy consumption values of the Federal Republic of Germany, in accordance with the Working Community on Energy Balances (AGEB). Up to now, only provisional data is available for the year 2017. No data is available yet for the year 2018. Therefore, for the time being, the provisional average is calculated from the two years, 2016 and 2017. The year 2018 will also be taken into account when the first data is available on this.

- Final-energy consumption 2016: 9.060 PJ
- Final-energy consumption 2017: 9.329 PJ (provisional)
- Averaged final-energy consumption per year for 2016–2017: 9.195 PJ / 220 Mtoe (provisional)

b. The total, accumulated energy savings to be achieved regarding final-energy consumption, in accordance with Directive 2012/27/EU, Article 7, Paragraph 1 (b) [in ktoe]

The savings objective is quantified provisionally as being 4.046 PH or respectively 97 Mtoe, according to Directive 2012/27/EU, Article 7, Paragraph 1, Sentence 1 (b) (new).

c. Data used in calculating the final-energy consumption and the sources of that data, including the grounds for use of alternative statistical sources and differences, where applicable, regarding the quantities that emerge (if sources other than Eurostat are used)

The figures for final-energy consumption are based upon the national energy balance produced by the Working Community on Energy Balances (AGEB). No use is made of Eurostat data; this is because the provisional annual consumption figures for the year 2017 cannot yet be called off from Eurostat (similarly the prospect is that the provisional data for 2018 will not be published by Eurostat by the time that the final NECP is completed, on or before 31 December 2019).