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Update of the National Energy Efficiency Action Plan of the Czech Republic

pursuant to Article 24(2) of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency

Contents

1 Introduction

Developments in the energy intensity of the Czech economy

Energy intensity is one of the factors affecting the competitiveness of undertakings, as well as the economy as a whole. The period up to 1989 was characterised by high energy intensity of the economy, and in particular industry. This situation was the result of under-investing in production installations, giving priority to the development of heavy industry and state-regulated energy pricing that did not reflect global changes.

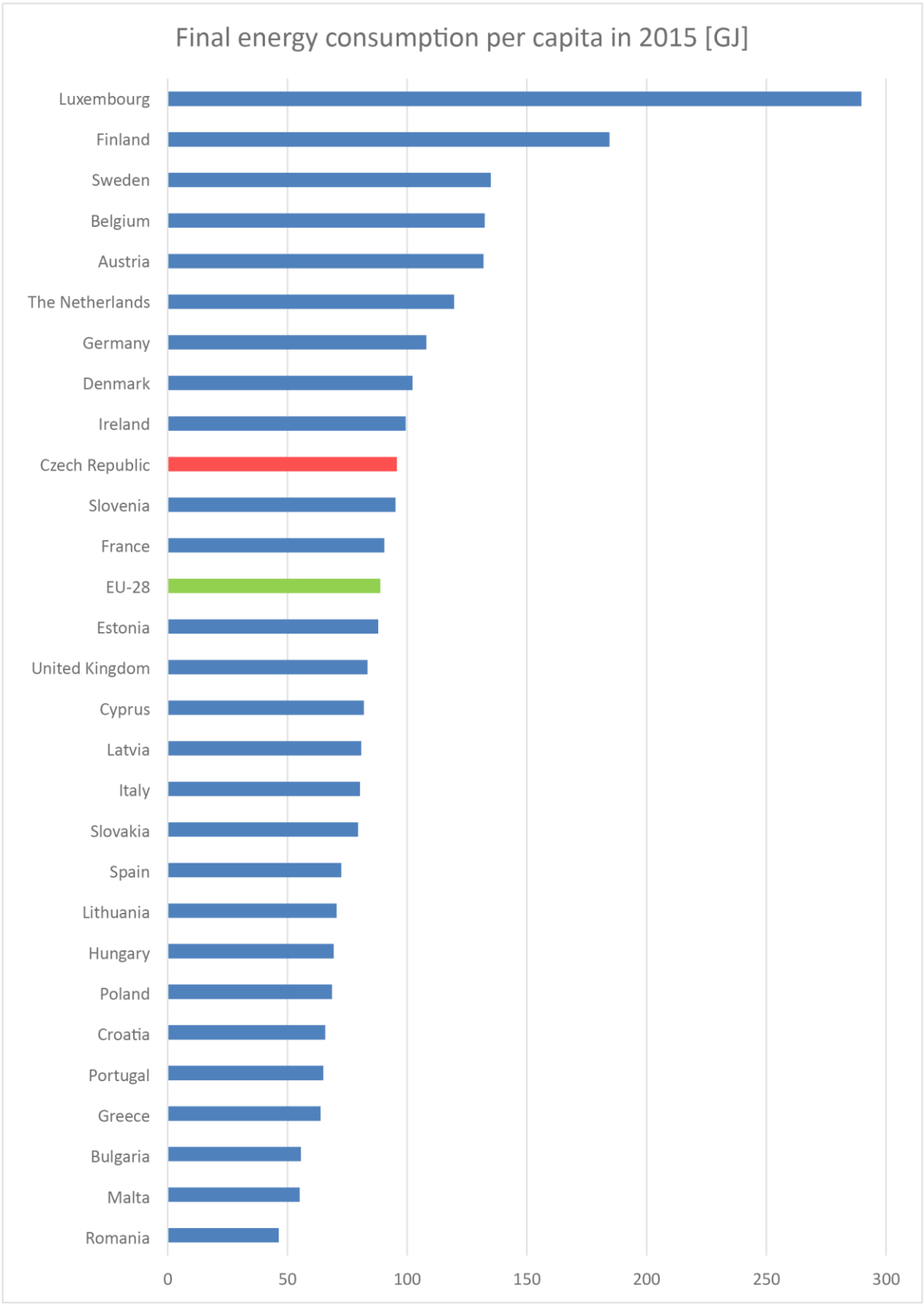
The economic transformation after 1989 included a sharp increase in energy efficiency. Due to the changes in the structure of the economy, the Czech Republic is rapidly catching up with the EU average in terms of energy efficiency. At the same time, however, it must be noted that this change is accompanied by two contradictory processes (the 'rebound effect'). Reducing the technological intensity of the economy is accompanied by an increase in the standard of living of the population, which is below the levels of developed Western European countries. As the standard of living rises, the consumption of energy by households is going up as a result of improved housing conditions.

If we compare the period during which the economy's energy intensity deteriorated (about 50 years) with the period since the transformation to a market economy began (about 25 years), we find that energy efficiency improvements have been very swift and that substantial progress has been achieved. The downward trend in energy intensity since 1990 has been uninterrupted. The energy intensity of the Czech economy has fallen by 30% since 2000. The rate at which energy intensity has fallen since 1990 (2.5% at PPP, IEA Czech Republic 2010 Review) is one of the fastest in Europe (the European average during that period was 1.5%). In 2000, the energy intensity of the economy reached 560 GJ / CZK million; in contrast, in 2015 it stood at 389 GJ / CZK million.

Despite the increasing energy efficiency, the Czech Republic has the third most energy intensive economy among the EU member states. The energy intensity of the Czech economy is more than twice the EU average. Broken down by sector, industry accounts for the largest share of the economy's energy intensity. This is followed by the transport and housing sectors. The energy intensity of industry has been consistently decreasing, the energy consumption in this sector having fallen by 17% compared to 2004. On the other hand, consumption in the housing and services sectors was relatively stable; in contrast, energy intensity in transport varied considerably.

The energy consumption in transport increased year-on-year in 2013-2015. This increase was due to an increase in industrial production over the period, the consequent increase in exports of manufactured goods and the resulting increase in freight and rail transport demand. In addition to the impact of industry on energy consumption in the transport sector, account must also be taken of the fact that the transport sector itself has recently increased its contribution to gross domestic product creation, which explains the increased energy consumption.

The relatively higher energy intensity of the Czech economy is due to the fact that despite the transformation of the economy, the share of industry (including the energy sector) in gross value added remains at about 30%. The share of heavy industry (e.g. metallurgy and mechanical engineering) is large in the Czech Republic.



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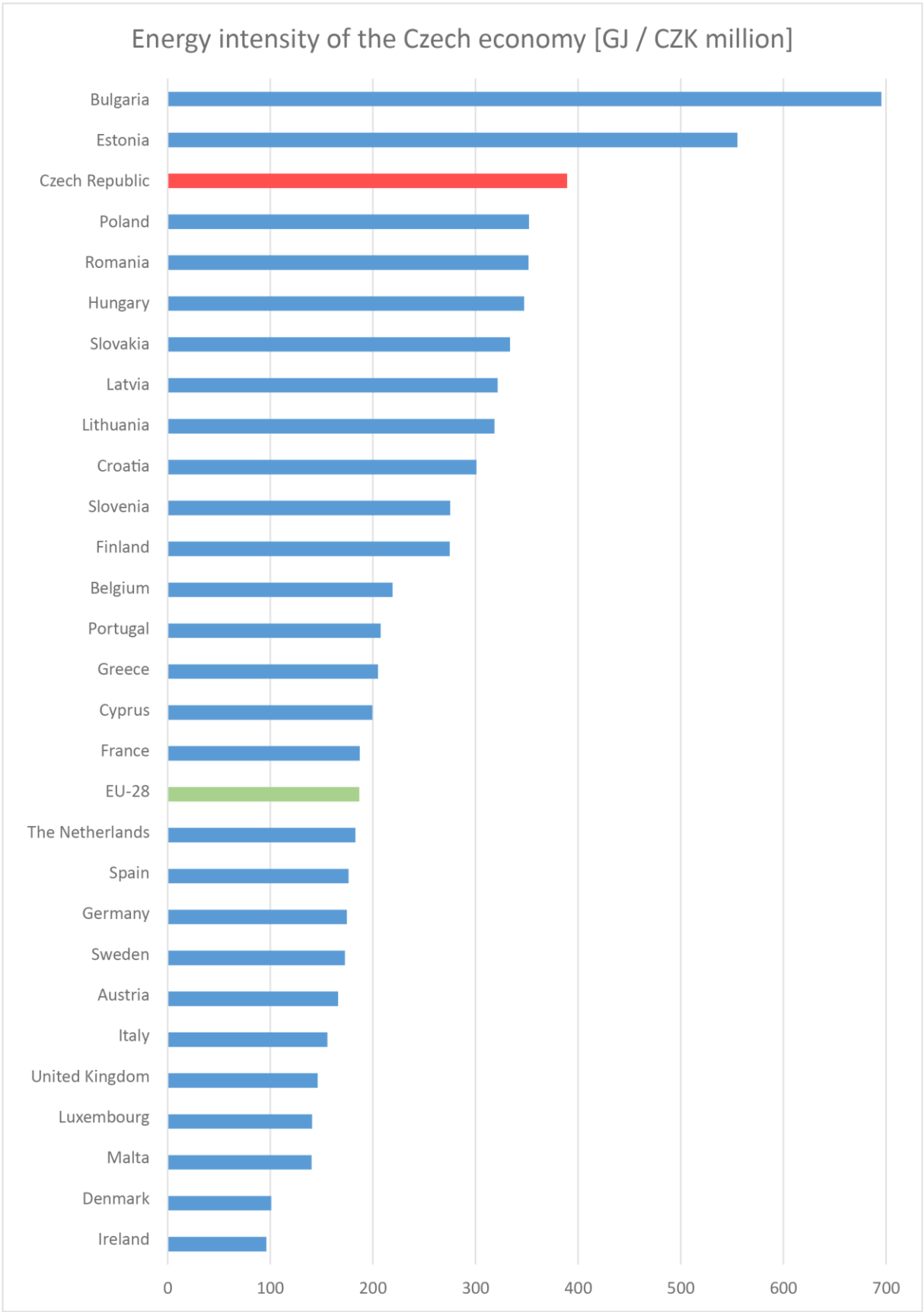

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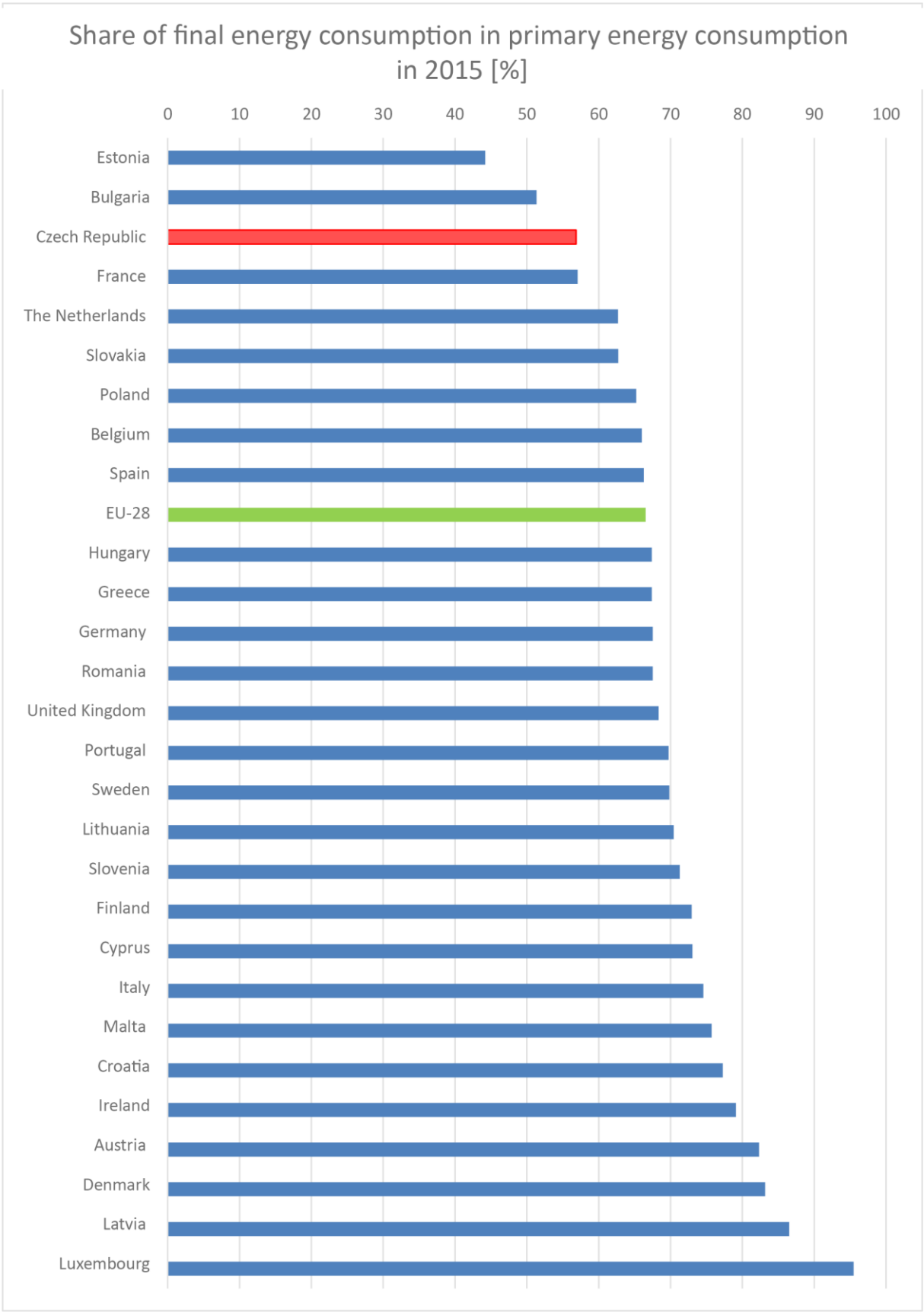

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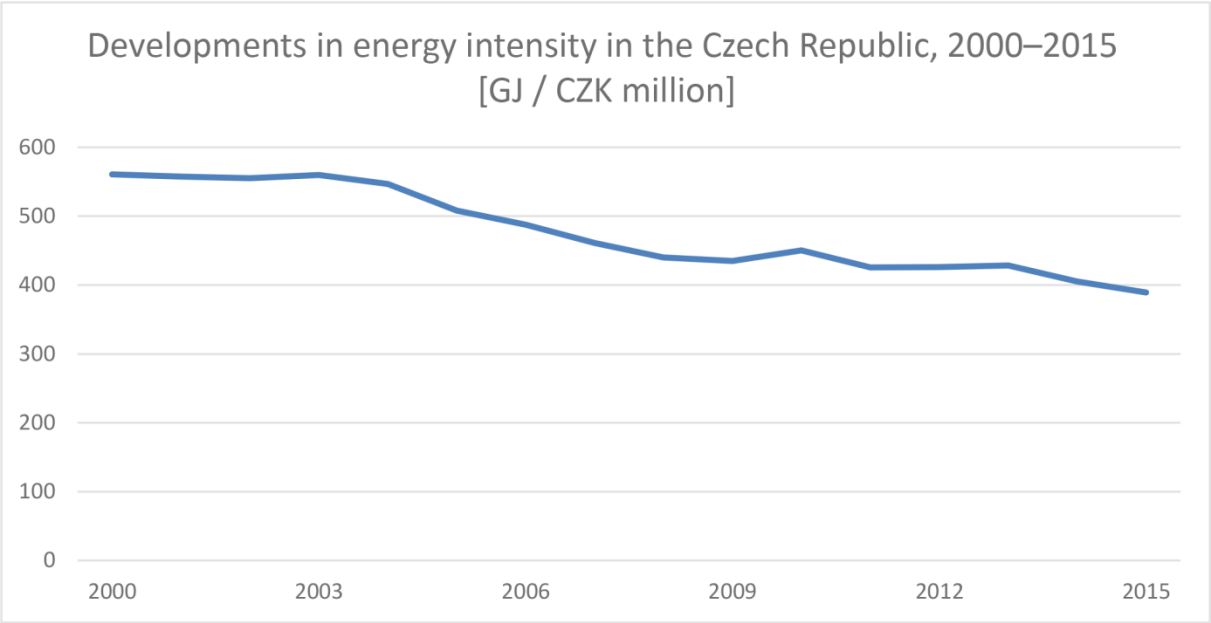

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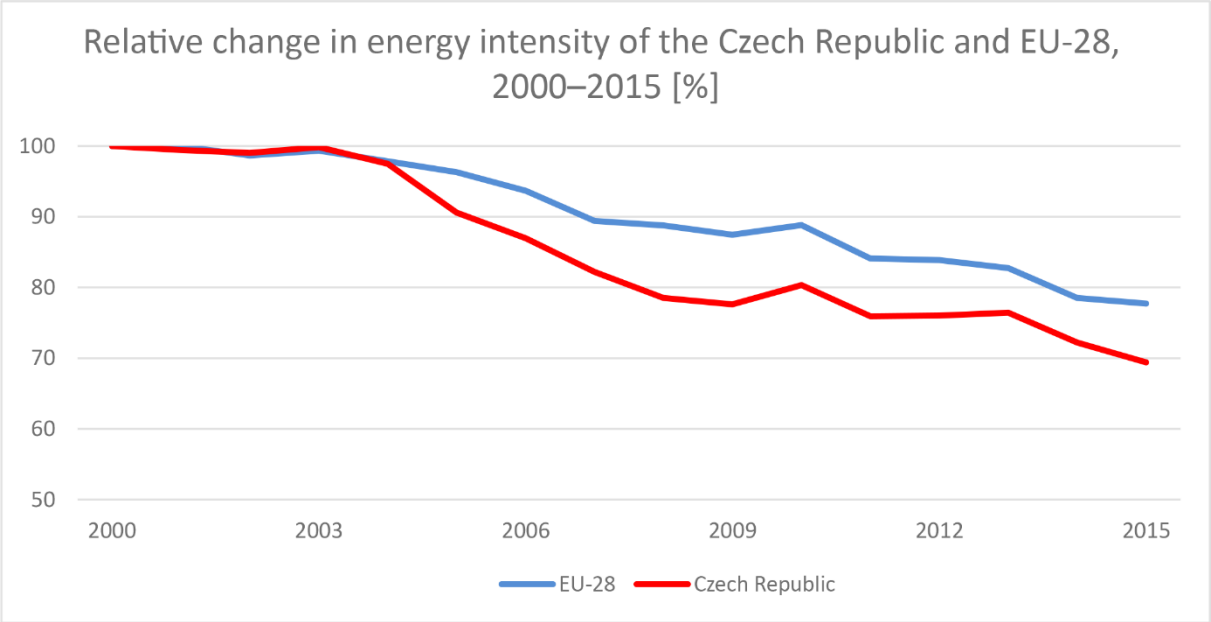


Source: Eurostat

State of play and the situation of the Czech energy sector

The national energy sector has undergone long-term development. The Czech Republic has made considerable progress in the energy sector in recent years. The OECD particularly appreciates the efforts of the Czech government to improve its energy and climate policies, progress in providing for oil and gas security, a significant shift in the liberalisation of the electricity market, and its contribution to the development of the electricity market in the Central European region. At present, however, the Czech Republic is obliged to implement policies addressing, in particular, energy efficiency. The Czech transmission system is strongly interconnected with all neighbouring countries. The total disposable transmission capacity in relation to the maximum load of the Czech Republic is more than 35% in the export and 30% in the import direction; in addition, an increasing amount of electricity in the north–south direction transits over the transmission system, equivalent to up to 30% of the maximum load of the Czech Republic.

Domestic primary energy sources cover more than 50 % of the Czech Republic's current energy consumption. The Czech Republic's energy import dependency level (including nuclear fuel) is therefore under 50% and thus one of the lowest in the EU. The current EU average is approximately 60%. In terms of sources, the Czech Republic is fully self-sufficient in the production of electricity and heat. The Czech energy sector is dominated by coal, which as a base-load source supplies almost 60% of electricity and a large proportion of heat via district heating systems. Renewable sources other than hydropower plants are better represented as a result of the promotion of renewables in the past few years, but despite substantial subsidies they have not been able to wrest a sizeable share from fossil sources. Domestic fuels account for about 60% of heat production, and more than 80% in the case of heat supply systems. Cogeneration of heat and electricity is well established in the Czech Republic. The share of heat from cogeneration accounts for almost 70% of the total centrally produced heat.

Tools to improve energy efficiency in the Czech Republic

To increase energy efficiency in the Czech Republic, regulatory or economic instruments and education have been actively used for a long time. The economic instruments used include both national resources and resources from the Structural Funds. These support tools are aimed at households (e.g. the programmes Green Savings, Panel – regeneration of prefabricated concrete buildings, etc.), industry (e.g. OP EI, OP EIC) and the services sector (e.g. OP E, EFEKT). Regulatory instruments include about 34 pieces of legislation.

In the following chapters, these tools are described in more detail and their impact on primary energy consumption by 2020 / the final energy consumption by 2020 is assessed.

2. Overview of national energy efficiency targets and savings

2.1 National 2020 energy efficiency targets

National energy efficiency targets are set in accordance with Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (hereinafter referred to as 'Directive 2012/27/EU'). Further to the passing of Directive 2012/27/EU, the Czech Republic has launched a process to transpose it into national legislation and implement it.

The Czech Republic was obliged to transpose the Directive by 5 June 2014. **Due to the time-consuming legislative process in the Czech Republic, the Directive was fully transposed on 1 July 2015.**

With a view the due fulfilment the Czech Republic's EU obligations, implementation involved the following steps:

- the setting of an indicative national energy efficiency target, based on either primary or final energy consumption, primary or final energy savings, or energy intensity, in accordance with Article 3 of Directive 2012/27/EU;
- in its Resolution No 923 of 4 December 2013, the Czech Government approved the means of implementation of Articles 5 and 7 of Directive 2012/27/EU (both cases involved an alternative approach to implementation in accordance with the relevant provisions of Directive 2012/27/EU, see below);
- in its Resolution No 1085 of 22 December 2014, the Czech Government approved the National Energy Efficiency Action Plan (and subsequently, in its Resolution No 215 of 16 March 2016, its updating based on the Commission's requirements specified during the pilot proceedings);
- in its Resolution No 609 of 21 June 2014, the Czech Government acknowledged an analysis establishing the scope of obligations, financial costs and recommended procedure for renovating the buildings under Article 5 of Directive 2012/27/EU and subsequently, in its Resolution No 1035 of 14 December 2015, it approved the Plan for Reconstructing Buildings Under Article 5 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency.

The national indicative energy efficiency target, the 'national contribution' to achievement of the Union's 2020 main 20% headline target on energy efficiency, was set in line with the requirements of Article 3 of Directive 2012/27/EU. Under the provisions of this Article, each Member State shall set a national indicative energy efficiency target based on primary energy consumption or final energy consumption.

The indicative energy efficiency target of the Czech Republic was set in accordance with the 'Czech Republic's State Energy Policy' (hereinafter referred to as the 'SEP'), a document approved by the Czech Government in its Resolution No 362 of 18 May 2015. The SEP is a strategic document outlining the State's objectives in energy management in line with economic and social development needs, including environmental protection, and serving for the development of territorial energy policies. It is a key document by which the Czech Government formulates the political, legislative and administrative framework for reliable, affordable and sustainable energy supply. To bring about the long-term vision, the SEP lays down strategic energy targets for the Czech Republic and defines strategic priorities within statutory deadlines, as well as within the period where there is usually an economic return on investments in resources and grids of all types, and within which the basic characteristics of future development can be reasonably foreseen.

The Czech Republic views the indicative national target defined in Article 3 of Directive 2012/27/EU as a framework, non-binding target which does not establish any specific and legally enforceable obligation either on the Czech Republic or on other entities. In particular, the setting of the 2020 targets is influenced by a number of factors and assumptions which may evolve over time due to externalities or for other reasons beyond our control. In the future, any significant change in these input parameters could necessitate a review of the indicative national targets by the Czech Republic.

The Czech Republic's approach to setting the national energy efficiency target is based on the Common European Framework for the Promotion of Energy Efficiency, which specifies achievement of the EU's 2020 20% headline target on energy efficiency. With this target, the EU has committed itself to a 20% decrease in energy consumption by 2020, compared to the reference scenario for the development of energy consumption in 2007[1]. Under this scenario, the final energy consumption of the Czech Republic in 2020 would be 1324.87 PJ, i.e. 31 644 Mtoe, leaving out the savings from implementation of the Directive.

The national indicative target, i.e. the maximum level of final energy consumption that should be achieved by Czech Republic, reflects a reduction to 20%, in line with the EU target. **The national indicative energy efficiency target of the Czech Republic is set at 1,060 PJ, i.e. 25,315 Mtoe of final energy consumption. The estimated national target expressed in primary energy consumption was established at 1,855 PJ, i.e. 44,305 Mtoe, based on primary energy coefficient of 1.75[2].**

[1] The reference scenario is based on the PRIMES 2007 model, which created projections of the development of final energy consumption up to 2020 for the European Commission.

[2] The coefficient was determined on the basis of developments in the primary energy coefficient in 2010-2015 with an assumption of increasing energy conversion efficiency.

2.2 Other energy efficiency targets

Targets established on a general or secondary basis for energy savings / energy efficiency are included in the following national documents:

- **State Energy Policy of the Czech Republic** - creates general pressure for the reduction of emissions produced by the energy sector, along with pressure on producers and consumers to increase efficiency and savings. Priority II is to increase energy efficiency and energy savings throughout the economy and in households. Increasing energy efficiency and energy savings are a common denominator for all three components of the energy strategy, i.e. security, competitiveness and sustainability. Higher efficiency has been prompted by needs associated with the decreasing availability of disposable national energy resources and the industrial focus of the Czech Republic. It follows that the Czech Republic must maintain and, where appropriate, accelerate the trend for declining energy intensity in the generation of GDP and strive to ensure that, after 2020, energy intensity in the various sectors is on a par with comparable economies in the EU.

- **National Reform Programme (NRP) -** an annually updated conceptual document of the Czech Government that sets out a plan for key measures to promote economic growth and employment. The measures contained in the NRP aim to achieve the national targets laid down in the Europe 2020 Strategy, which includes the target of improving energy efficiency. In the area of energy efficiency, the NRP refers to the measures set out in the NEEAP and gives an overview of the main programmes funding measures to increase energy efficiency. In addition to the programmes financed from the European Structural and Investment Funds, these are the EFEKT 2 Programme and the ENERG Programme.

- **Partnership Agreement for the 2014-2020 programming period** - the basic umbrella document for drawing from the European Structural and Investment Funds (ESI Funds) in the 2014-2020 programming period. The Partnership Agreement was approved by the European Commission on 26 August 2014, and its second revision (update) on 14 December 2016. Energy efficiency and the effective use of resources are among the main priority areas of support. Energy efficiency projects are funded under the OP EIC, OP E, IROP and OP PGP.

- **National Environmental Policy** - specifies the effective environmental protection plan of the Czech Republic. In this context, cross-cutting measures are included to increase energy efficiency, where the main objective is to fulfil the commitment of increasing energy efficiency by 2020. The main measures include improving the energy performance of buildings, achieving energy savings on heating, expanding the energy labelling system and increasing the share of energy-efficient appliances, promoting an increase in the share of high-efficiency cogeneration and efficient

heat supply systems, using the best available techniques (BAT) to improve energy performance, and increasing the share of energy-efficient public lighting.

- **Climate protection policy in the Czech Republic** - a Czech Government policy that introduces basic objectives and indicative targets of the Czech Republic in climate protection up to 2050, and is therefore a long-term strategy for low-carbon development in the Czech Republic. The policy also lays down strategies leading to the cost-effective achievement of the chosen targets. The policy is designed to be proactive, and it therefore defines specific measures and tools in the areas concerned - i.e. energy, final energy consumption, industry, transport, agriculture and forestry, waste management, science and research and voluntary tools in particular - to bring about a progressive reduction of greenhouse gas emissions with respect to the economically viable potential. The purpose of the policy is to design efficient and effective measures, including their contribution to reducing greenhouse gas emissions by 2030, and to describe the trajectory that would lead to a transition to a low-carbon economy by 2050. Energy savings are one of the tools for a transition to a low-carbon economy.
- Role of the **Strategic Framework for Sustainable Development of the Czech Republic** (hereinafter also referred to as the 'SSD') - is to create a consensual framework for drawing up other conceptual documents (sectoral policies and action programmes), and in this way to be an important basis for strategic decision-making within individual departments, as well as for interdepartmental collaboration and collaboration with stakeholders. One of the aims and priorities is to improve the quality and efficiency of transport and to enhance its safety. The objective stems from the need to ensure transport sustainability, to reduce hazardous emissions including noise, and to improve energy efficiency in transport. The aims in energy savings are in particular:
  - to increase energy efficiency in transforming primary energy sources while optimally using RES;
  - to increase energy savings in the individual sectors of the national economy and for the final consumer, and
  - to support the use of efficient and eco-friendly technologies (e.g. BAT).
- **Regional Development Strategy of the Czech Republic for the 2014-2020 period** (hereinafter also referred to as the 'RDS') - the basic conceptual document in the area of regional development. The RDS is a tool for the implementation of regional policy and coordination of the work of other public policies on regional development. The RDS links sectoral perspectives (themes and priorities) with territorial aspects From the time perspective, it is a medium-term document with a long-term view of regional development of the Czech Republic (long-term vision) and short-term implementation steps. One of the priorities of regional policy is the environmental

aspect. In particular, this involves the effective use of local and renewable resources, energy conservation and improved energy efficiency. The measure aims to encourage energy savings and the use of renewable energy sources in relation to local conditions and the regional potential, with a focus on increasing energy efficiency and reducing emissions of pollutants generated by households, and on energy savings and the application of innovative techniques in industrial sectors, including the housing sector etc.

- **Transport policy of the Czech Republic for 2014-2020, with a look ahead to 2050.** The transport sector an important area of the national economy that affects virtually all areas of public and private life and the business community. It is a sector that is necessary for improving the competitiveness of the Czech Republic. The document identifies the main problems in the sector and proposes solutions. Energy consumption in transport is increasing in all major regions of the world. Road transport has the greatest share of energy consumption in the transport sector. Moreover, its share is continuing to grow. The fastest growing mode of transport is air transport, which is growing faster than road transport but from a much lower base, and it therefore lags far behind road transport in terms of output. The reason for reducing dependence on fossil fuels is not only the expected scarcity of resources (even though sources of fossil fuels will probably still be accessible at an economic price until 2030) but, in particular, national and European targets for the reduction of greenhouse gas emissions from transport and the diversification of energy sources for transport in terms of the priorities of their forms of use.

  There are essentially three routes to reducing dependence on oil products. The first is to develop new transport fuels from domestic sources or from areas that are relatively politically stable (coal, natural gas) and renewable energy sources. The second route is to increase energy efficiency (technical modifications to engines, hybrid engines etc.), and the third route is the increased use of energy-efficient modes of transport. Fuel consumption savings achieved by reducing the number of journeys and making shorter passenger journeys by non-motorised modes of transport should bring a positive contribution to the reduction of energy dependency and emissions from transport.

  Some measures:

  - Reduction of losses in the operation of power systems and equipment in electric traction by transitioning to a uniform 25 kV system.
  - Increasing the efficiency of conversion for rail traction units when renewing rolling stock - preference is to be given to the purchase of new electric-traction vehicles.
  - Ensuring the use of energy recuperation on electrified lines of SŽDC (Railway Infrastructure Administration).
  - Continuation of the electrification of rail and municipal transport.

- Shifting transport away from highly energy-intensive modes to less energy-intensive modes, with a reduction of the share of goods and passenger transport using oil energy and a gradual transition to transport systems based on a greater share of energy from renewables.
- Launching of the construction of a high-speed railway.

- **'Industry 4.0' national initiative** – this aims to spur the key ministries and industry representatives to develop detailed action plans in the political, economic and social areas. Reduced energy and material intensity of production, increased productivity in production, optimisation of logistics routes, technological solutions for decentralised energy production and distribution systems and intelligent urban infrastructures are the main benefits of Industry 4.0. The initiative supports the introduction of Smart Cities/regions/buildings, which would include monitoring of the energy intensity of buildings, intelligent street lighting, smart grids, building of a network of electric charging stations, sustainable intelligent urban mobility etc. At present, the first pilot project is the town of Písek.
- **National Emission Reduction Programme -** this is a basic conceptual document in improving air quality and reducing emissions from air pollution sources that was drawn upon the basis of Section 8 of Act No 201/2012 on air protection, as amended. It was approved in Resolution No 978 of 2 December 2015 of the Czech Government. The NERP contains an analysis of state and development of air in the Czech Republic, the causes of pollution, the emission of pollutants from individual sectors of the economy, scenarios for the development of air pollution, and the international commitments of the Czech Republic and their observance. The NERP lays down procedures and measures to remedy the existing unsatisfactory state of the air, targets for reducing air pollution levels, and deadlines for achieving them. It works with various future development scenarios and, in the proposal section, it sets out the maximum quantity of emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds, ammonia and PM2.5 fine dust particles by 2020, as well as emission ceilings for individual sectors of the economy. These emission values are to be achieved using 23 priority measures at the national level to reduce emissions and improve air quality, which are to be fulfilled by the individual central public authorities, and which are described in detail in the lists of measures in the annex to the NERP. Fifteen of these measures are aimed at the transport sector, three at industry, two at agriculture and three at households. Implementation of the measures should also fulfil the objective of the NERP, which is the swiftest possible reduction in the risks posed to human health by air pollution, in particular the effects of exposure to suspended PM10 and PM2.5 particulate matter and ground-level ozone, the reduction of the negative impact of air pollution on ecosystems and vegetation (acidification, eutrophication, the effect of ground-level ozone) and on materials, and compliance with national emission reduction obligations and with the applicable pollution limits.

2.3 Savings in primary energy consumption and final energy consumption

The Czech Republic has historically compiled its energy balance in accordance with the methodology of the International Energy Agency (IEA), which is also the basis for the SEP. However, on the basis of the requirement arising from the EU Pilot proceedings No 7553/15/ENER, data was retrospectively updated according to the Eurostat methodology. However, some methodological differences exist between energy consumption information published according to IEA methodology and according to Eurostat methodology. For this reason, the Czech Statistical Office carried out in 2016 a detailed review of the methodology used. Analysis of trends in energy consumption shows a long-term decline in final energy consumption and primary energy consumption. There has been a long-term decrease in energy consumption in industry and services in spite of a growth in their economic performance and of the overall and gross domestic product of the country.

Table: Statistical data of the Czech Republic – Eurostat data

	unit	2011	2012	2013	2014	2015
Consumption of primary energy sources	TJ	1,833,224	1,821,390	1,822,045	1,768,524	1,776,965
Total final energy consumption	TJ	1,023,686	1,021,906	1,017,008	983,664	1,010,197
Final energy consumption by sector: – Ministry of Industry and Trade						
industry	TJ	328,057	325,326	314,616	310,381	315,639
transport	TJ	261,499	254,664	252,131	261,311	271,674
households	TJ	280,865	291,686	300,750	266,179	275,194
Services	TJ	126,817	122,820	120,764	117,035	119,279
Gross value added by sector: Ministry of Industry and Trade[3]						
Industry	mil. CZK	1,347,606	1,346,426	1,346,252	1,477,294	1,546,848
Services	mil. CZK	2,206,097	2,206,690	2,223,576	2,314,585	2,444,995
Disposable household income	mil. CZK	2,184,176	2,205,828	2,207,679	2,284,609	2,362,047
Gross domestic product (GDP)	mil. CZK	4,033,755	4,059,912	4,098,128	4,313,789	4,554,615
Electricity generation from thermal power generation	GWh	82,157	81,925	80,692	80,514	77,912
Electricity generation from combined heat and power	GWh	43,540	42,234	41,981	42,605	42,349
Heat generation from thermal power generation	TJ	134,971	134,926	136,074	118,429	119,876
Heat generation from combined heat and power plants, including industrial waste heat	TJ	104,012	106,180	106,985	94,327	95,704
Fuel input for thermal power generation	TJ	979,417	980,243	970,058	933,577	898,486
Number of passenger-km – Ministry of Transport	pkm million	108,353	107,794	107,172	110,114	113,814
Number of tonne-km – Ministry of Transport	tkm million	71,817	68,087	71,509	71,421	76,613
Population (mean) – CSO	person	10,496,672	10,509,286	10,510,719	10,524,783	10,542,942

[3] Values are in current prices.

One of the main tools for achieving savings in final energy consumption is Article 7 of the Directive. According to Article 7, each Member State is required to achieve annual savings of 1.5% by the volume of annual sales of energy to final customers. Over the period 2014-2016, the Czech Republic achieved 17,045 TJ of new savings, which corresponds to cumulative savings of 20,800 TJ. It is expected that 30,526 TJ of additional savings will be achieved during 2017-2020, corresponding to cumulative savings of 76,315 TJ.

Table: Achieved and expected energy savings according to Article 7 of the Directive.

		Final energy savings (TJ)
Annual savings	2014-2016 - achieved	17,045
	2017-2020 - expected	30,526
	Total	47,571
Cumulative savings	2014-2016 - achieved	20,800
	2017-2020 - expected	76,315

2.4 Final energy savings pursuant to Article 4 of Directive 2996/32/EC of the European Parliament and of the Council

According to Article 27(1) of the EED, Member States must comply with the requirements of Article 4(1) to (4) of the ESD on the general end-use energy savings target of 9% by 2016. To this end, a top-down method has been employed, making maximum possible use of information from the ODYSSEE database of internationally comparable energy efficiency indicators (http://www.indicators.odyssee-mure.eu/energy-efficiency-database.html). Indicators up to 2010 were available when the evaluation was being prepared.

The evaluation employing the top-down methodology was derived directly from Standard EN 16212 – Energy Efficiency and Savings Calculation, Top-down and Bottom-up Methods. The savings in each area were evaluated. Cross-cutting measures were not quantified using the top-down method because the indicators or, more precisely, the values of the indicators for cross-cutting measures, are already included in the sectoral measures, and their benefits would therefore be included twice. The agriculture sector was not assessed separately because of the paucity of statistics.

Savings calculated using the top-down method for the period 2008-2010 compared to the savings planned in NEEAP II are presented in the following table.

Table: Summary of energy savings proposed in NEEAP II and evaluation using the top-down method

Measures in sectors	NEEAP II plan, TJ, 2008-2010	Analysis of implementation using the top-down method, TJ, 2008-2010	NEEAP II plan, TJ, 2011-2013	Analysis of implementation using the top-down method, TJ, 2011-2013	Analysis-plan difference
Households	4,903.2	17,857.8	7,545.6	1,623.4	7,032.4
Tertiary sector/services	1,947.6	12,295.3	2,642.4	11,688.9	19,394.2
Industry	1,796.4	21,425.2	2,350.8	-6,735.9	10,542.1
Transport	3,715.2	-3,194.3	4,222.8	6,165.5	-4,966.8
Agriculture	230.4	not assessed	374.4	not assessed	-604.8
Cross-cutting measures	7,131.6	not assessed	8,096.4	not assessed	-15,228.0
Total	19,724.4	48,384.0	25,232.4	12,742.0	16,169.2

Table: Summary of energy savings proposed in NEEAP II and evaluation using the top-down method (2008-2014)

Measures in sectors	NEEAP II plan, 2008-2016 (TJ)	Analysis of implementation using the top-down method, 2008-2014 (TJ)
Households	21,146.4	27,015.4
Tertiary sector/services	7,066.8	7,414.5
Industry	8,456.4	36,234.1
Transport	13,615.2	4,378.3
Agriculture	1,137.6	not assessed
Cross-cutting measures	24,876.0	not assessed
Total	**76,298.4**	**75,042.4**

Applying the top-down method using the best indicators available and the available statistics, the NEEAP II plan for 2008-2016 was 98% fulfilled in 2014. Fulfilment in the period 2015-2016 was evaluated by the bottom-up method based on the measurement of the

savings achieved through the implementation of specific measures to increase energy efficiency. During 2015-2016, policy measures resulted in 16,351 TJ of new energy savings. **A total of 91,393.4 TJ of energy savings was achieved in 2008-2016**. **Based on these results, it can be stated that the general objective of final energy savings of 76,298.4 TJ by 2016 was fulfilled pursuant to Article 4 of Directive 2006/32/EC of the European Parliament and of the Council.**

3. Policy measures to implement the Directive

3.1 Horizontal measures

3.1.1 Energy efficiency obligation schemes and alternative measures

Binding target for new energy savings

Article 7 of Directive 2012/27/EU establishes a binding end-use energy savings target equivalent to achieving new annual savings of 1.5% of the annual energy sales, by volume, to final customers by 2020.

The Czech Republic has historically compiled its energy balance according to the IEA methodology, which is also the basis for the SEP. Based on complaints from the European Commission regarding the update of the Czech National Action Plan for Energy Efficiency 2014, the method for calculating this target was changed. The target of the Czech Republic for 2020 is now calculated on the basis of the Eurostat methodology. As a result of this change, the target increased in 2015 due to a difference of 2.89 PJ between the value calculated according to the IEA methodology (47.78 PJ) and the value according to the Eurostat methodology (50.67 PJ). In January 2017, Eurostat published revised data on energy consumption in the Czech Republic on the basis of the revision made by the Czech Statistical Office. This revision led to an increase in the final energy consumption values in the reference period for the calculation of the new energy savings target, and the target therefore increased. **The target of the Czech Republic is, pursuant to Article 7 of Directive 2012/27/EU and based on the current analyses performed on 28 February 2017, set at 51.10 PJ of new energy savings, i.e. a total cumulative energy saving of 204.39 PJ by 2020.**

Calculation methodology

Under Article 7(1) of Directive 2012/27/EU, sales of energy used in transport (liquid/gas fuels, electricity consumed for traction; coal for steam locomotives) was excluded from the final energy consumption of each year (2010, 2011, 2012). Compared to the calculation of the target in NEEAP II, the non-energy use of fuels already included in the Eurostat database is not deducted. This operation produces the 'base', which is the basis for calculating the target value of the savings, and from which the own final energy consumption is subtracted.

Own consumption includes:

- BIOMASS
  - ✓ Households
  - ✓ Final consumption of own biomass in industry (heat)
  - ✓ Final consumption of own biomass in industry (electricity)

- SOLAR COLLECTORS
  - ✓ Solar collectors
- BIOGAS
  - ✓ Final consumption of own biogas (heat)
  - ✓ Final consumption of own biogas (electricity)
- MUNICIPAL SOLID WASTE
  - ✓ Final consumption of MSW in incinerators (heat)
  - ✓ Final consumption of MSW in incinerators (electricity)
- INDUSTRIAL WASTE
  - ✓ Final consumption of INW in incinerators (heat)
- COKE
  - ✓ Final consumption of own coke (technology)
- COKE OVEN GAS
  - ✓ Final consumption of own coke oven gas
- BLAST FURNACE GAS
  - ✓ Final consumption of own blast furnace gas
- CONVERTER GAS
  - ✓ Final consumption of own converter gas
- OTHER FUELS
  - ✓ Final consumption of own other fuels (electricity)
  - ✓ Final consumption of own other fuels (heat)

This procedure results in the adjusted final consumption of the fuels and energy sold in 2010-2012. The adjusted final consumption is used to calculate the three-year average for final energy consumption, which is used to calculate savings for the individual years 2014-2020, i.e. achieving annual savings of 1.5% of final consumption by volume.

Table: Calculation of the three-year average as the basis for the calculation of the target

Year	**2010**	**2011**	**2012**
Unit	*PJ*	*PJ*	*PJ*
Final consumption 1132.82 1087.24 1074.26	1,058.06	1,023.69	1,021.91
Transport	260.81	261.50	254.67
Final energy consumption not sold, Own consumption	119.11	129.16	131.85
Adjusted final consumption of fuels and energy sold	678.13	633.03	635.38
Three-year average	**648.847**		

Table: Calculation of binding savings target – without the use of the exemptions under Article 7(2) of Directive 2012/27/EU

Three-year average	**648.85**

Year	Saving
Unit	*PJ*
2014	9.73
2015	19.47
2016	29.20
2017	38.93
2018	48.66
2019	58.40
2020	68.13
Cumulatively	272.52

Without using the exemptions under Article 7(2) of Directive 2012/27/EU (deduction of an amount of savings not exceeding 25% of the total calculated savings), the above table shows that the annual amount of new energy savings will be 68.13 PJ by 2020.

Use of exemptions

Directive 2012/27/EU allows the savings commitment to be reduced by up to 25% of the original target in four ways. The Czech Republic made use of the option provided for in Article 7(2)(a) and (d) of the Directive, i.e. the commitment was calculated applying a gradual increase in savings in individual years (1% in 2014 and 2015; 1.25% in 2016 and 2017; 1.5% in 2018, 2019 and 2020). In accordance with Article 7(2)(a) and Article 7(2)(d) of the Directive, the energy savings achieved through the Green Savings Programme and the third call under the Eco-energy Programme of the Operational Programme Enterprise and Innovation (calls in the period 2009-2010) were deducted from that amount. The Green Savings Programme was announced in April 2009, and the third call of the Eco-energy Programme of the Operational Programme Enterprise and Innovation was announced on 1 February 2010. These programmes thus meet the Directive's requirement that individual measures be introduced from 31 December 2008. (Note: the reference dates for support to implement energy saving measures under the Green Savings Programme were from 1 April 2009). Under the programmes, a monitoring, processing and reporting system was put in place, and the results were regularly evaluated. The savings achieved are therefore metered, reported and verifiable, thanks to the individual measures. As the programmes focus on long-term savings and promote installation of heating sources using renewable energy and investment in energy savings when buildings are retrofitted or newly built, as well as savings in plant and buildings in the business sector, they are expected to have an impact even beyond 2020.

The use of these exemptions results in an overall reduction of 17.03 PJ in the target of 68.13 PJ calculated under Article 7(1) of the Directive, which corresponds to an overall reduction of 68.13 PJ in the cumulative target of 272.52 PJ. This deduction fulfils the requirement of the Directive, i.e. the use of these exemptions must not lead to a reduction of more than 25 % in the cumulative target. The Czech Republic has made full use of the exemption.

Table: Calculation of the use of exemptions

Exemption	**Potential target reduction**	**Reduction in the cumulative target**
Article 7(2)(a) – Slower introduction of savings	Potential reduction 9.73 PJ	38.93 PJ
Article 7(2)(b) – Exclusion of the energy consumption of customers covered by the EU emissions trading system	N/A	
Article 7(2)(c) – Inclusion of savings achieved in the energy transformation, distribution and transmission sector	N/A	
Article 7(2)(d) – Inclusion of part of the savings under the Green Savings Programme and the Eco-energy Programme under the OP EI 2007-2014	Potential reduction 7.30 PJ	29.20 PJ
Total	**approx. 17.03 PJ**	**approx. 68.13 PJ**

The amount of 9.73 PJ was deducted from the annual energy savings (1.5 % annually in 2014-2020) using the values specified in Article 7(2)(a) of the Directive (use of the exemption of savings achieved thanks to a slower increase), which corresponds to cumulative energy savings of 38.93 PJ. Using the second exemption under Article 7(2)(d), a deduction was made of the savings generated by the Green Savings Programme (a total of 5.9 PJ) and the third call under the Eco-energy Programme of the Operational Programme Enterprise and Innovation (a total of 5.569 PJ). With regard to the provisions of Article 7(3) of the Directive, it is impossible to deduct the entire volume of savings (11,469 PJ) achieved under the above grant programmes. As the permissible deduction is no more than 25%, 7.30 PJ was deducted under this exemption, which corresponds to cumulative energy savings of 29.20 PJ **This was used to calculate a binding target for the Czech Republic of 51.10 PJ of new energy savings, i.e. 204.39 PJ of accumulated energy savings by 2020.**

Table: Comparison of savings with constant and gradual increase

Year	The amount of annual savings subject to a constant introduction of annual savings without applying exemptions under Article 7(2)(a) and (d).		The amount of cumulative savings subject to a gradual increase in annual savings (exemption under Article 7(2)(a)).	
	Annual savings percentage	Amount of annual savings	Annual savings percentage	Amount of annual savings
2014	1.5%	9.73	1.0%	6.49
2015	1.5%	19.47	1.0%	12.98
2016	1.5%	29.20	1.25 %	21.09
2017	1.5%	38.93	1.25 %	29.20
2018	1.5%	48.66	1.5%	38.93
2019	1.5%	58.40	1.5%	48.66
2020	1.5%	68.13	1.5%	58.40
Cumulatively		272.52		

Table: Reduction of savings commitment based on exemptions

Exemption	Reduction of energy savings commitment 2014-2020	Corresponding reduction in annual energy savings	Reduction in cumulative energy savings 2014-2020
Slower introduction of savings	9.73	1.39	38.93
Inclusion of part of the savings under the Green Savings Programme and the Eco-energy Programme under the OP EI 2007-2014	7.3	1.043	29.20
Total	**17.03**	2.43	**68.13**

Alternative policy measures and the national energy efficiency obligation scheme

To comply with Article 7, the Czech Republic has opted to implement a set of other policy measures in accordance with Article 7(9) of the Directive. For implementation purposes, we call this method an 'alternative scheme'.

In terms of other policy measures offered and described by the Directive, the Czech Republic will make use of financing schemes and instruments, as well as training and education, including energy advisory programmes, that lead to the application of energy-efficient technology or methods and lead to the reduction of end-use energy consumption:

- Financial engineering instruments
- Investment subsidies
- Non-investment subsidies (analyses of the appropriateness of the Energy Performance Contracting method, energy management, awareness-raising: advice centres, seminars, publications)

These methods enjoy a long-standing tradition in the Czech Republic. Appropriate processes are established here for the approval of individual projects, and all stakeholders (public authorities, entrusted parties and beneficiaries from among natural and legal persons – public administration, businesses, housing cooperatives and unit owner associations) have experience with them.

These are methods under which reporting on savings, including cost effectiveness, can be carried out transparently.

The Czech Republic will further examine additional measures to be used in the context of alternative policy measures. If financial resources for the above forms of support are insufficient for achieving the savings target set by the Directive, the Czech Republic will take additional measures in the form of appropriate tools for achieving the relevant target. In this context, a certain savings potential can be seen in the involvement of private companies, regions and municipalities in the system on a voluntary basis, based on the experience from other countries.

Setting intermediate periods

The Czech Republic applies two periods, namely:

Period I: 5 years (1 January 2014 – 31 December 2018)

Period II: 2 years (1 January 2019 – 31 December 2020)

This method of division makes more time available in Period I for approval of the conditions, introduction and implementation of the alternative scheme. An important aspect in the setting of this deadline was the launch of the operational programmes for the programming period 2014-2020, whose approval was marked by delays beyond the control of the Ministry responsible for setting the energy efficiency obligation schemes, which led to delays in the announcement of specific calls that form the core of the alternative scheme. This division

also provides enough time in Period II for potential adjustments to the support and incentive mechanisms that will lead to progress towards the overall target by 2020.

Implementing public authorities and entrusted parties

Choosing an alternative scheme means that implementation will be in the hands of public authorities or their delegated bodies, and therefore there will be no obligated parties in this system. As financial engineering instruments and investment subsidies financed from public funds are expected to be the primary mechanisms, their administration will be entrusted to entities with previous experience of these mechanisms. In the Czech Republic, these entities are: the Ministry of Industry and Trade, the Ministry of the Environment, the Ministry of Regional Development and regions involved in the Joint Boiler Replacement Scheme of the Czech-Moravian Guarantee and Development Bank.

The alternative scheme will emphasise the comprehensiveness and sustainability of the measures supported. To implement the alternative scheme, the focus of the interventions, **form and amount of support and other parameters, conditions and procedure for obtaining support** are set so as to fulfil the principles of synergy and complementarity, i.e. the intervention of the various entities are coordinated and not mutually competitive. Conversely, they will also complement **the related policy measures aimed primarily at extending the sustainability of completed projects** so that the system is effective. A detailed breakdown of policy measures, including the sectoral breakdown of the various implementing public authorities or entrusted parties, is described on a separate page in Annex 2 to this document.

All activities of the entities concerned aiming to meet the energy savings objective for 2020 through an alternate scheme are coordinated by the Committee appointed by the Minister of Industry and Trade in the second half of 2015. The Coordination Committee is an advisory body to the Minister of Industry and Trade responsible in particular for monitoring progress towards the objectives, tasks and measures arising from the NEEAP prepared under Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency; coordinating the implementation of policy measures and their complementarity, in particular measures under an alternative scheme relating to support for programmes aimed at reducing energy consumption, making recommendations on the implementation of tasks and, if necessary, designing and recommending corrective action.

List of alternative policy measures by sector

Households

- New Green Savings, 2013
- New Green Savings, 2014-2020
- Operational Programme Environment 2014-2020 (PA 2 – SO 2.1)
- Integrated Regional Operational Programme

- JESSICA Programme
- Panel Programme
- Joint Boiler Replacement Scheme
- The Reasonable Energy Savings Programme

Services

- Operational Programme Enterprise and Innovation (business entities)
- Operational Programme Enterprise and Innovation for Competitiveness (business entities)
- EFEKT Programme – investment part (public service sector, lighting)
- Operational Programme Environment, 2007-2013 (public service sector)
- Operational Programme Environment, 2014-2020 (public service sector)
- Operational Programme Prague – Growth Pole 2014-2020
- Operational Programme Transport
- The Reasonable Energy Savings Programme
- Alternative measures for increasing energy efficiency in municipalities and regions (public service sector)

Industry

- Operational Programme Enterprise and Innovation
- Operational Programme Enterprise and Innovation for Competitiveness
- The ENERG Programme
- Additional alternative measures for increasing energy efficiency in Czech industry
- Strategic Framework for Sustainable Development

<u>Further alternative measures for the 2017-2020 period</u>

Although a basic framework of policy measures has been established, the Ministry of Industry and Trade is looking for other options that would directly or indirectly help increase energy efficiency, not only in relation to the fulfilment of the obligations of the Czech Republic under Article 7 of Directive 2012/27/EU, but also at the general level. With regard to this, further measures were proposed that may be introduced and evaluated during the 2017-2020 period:

- Promoting ecodriving of cars – support for economic driving by car drivers through the introduction of regular free training and the creation of an ecodriving manual.

- Organisation of ecodriving training for lorry and bus drivers – the measure consists of extending the regular training pursuant to Act No 247/2000 to include training in economic driving with the principles of training and practical instruction in economic driving.
- Measures to increase the energy efficiency of agricultural establishments
- Support for the construction sector in the Czech Republic is improving energy efficiency and environmental protection in line with the EU 2020 environmental strategy
- Energy Savings Fund
- Support for the installation of cogeneration units
- Tax incentives, carbon tax and other instruments to promote investment in increasing energy efficiency.
- Programmes supporting research and development

Methodology for reporting energy savings achieved by implementing policy measures

The method of data collection for the evaluation of realised energy savings and the method their appraisal are described in a document entitled *Methodology for reporting energy savings from alternative policy measures referred to in Article 7(9) of the Energy Efficiency Directive (2012/27/EU).* This document was approved in 2015 by the Coordination Committee of the Minister for Industry and Trade, and focuses on setting basic rules for the calculation of energy savings in accordance with points 1 and 2 of Annex V to the Directive. The aim of the methodology is to focus on all of the following aspects: calculation, control and verification of the energy savings achieved.

The basic issue when setting the methodology for calculating energy savings is the eligibility of the reported savings pursuant to Article 7 of and Annex V to the Directive.

Under Article 7 of the Directive, energy savings can be reported if there exist alternative policies (such as financial and tax incentives and voluntary agreements) that speed up the introduction of, say, more efficient products, buildings, vehicles or services. In this case, full account can be taken of energy savings from individual measures in all policy measures other than those set out in Annex V, points 2(a) and 3 (a). For these specified exceptions, only energy savings exceeding the level defined on the basis of EU law can be included.

With regard to this fact, alternative scheme policy measures were proposed (see previous chapters) such that the included measures have 100% additionality, that is, that they will lead to energy savings that can be reported in full if their implementation is accelerated by means of financial and tax incentives or voluntary agreements.

The basic rules for being able to report alternative scheme energy savings are:

- the energy-saving measures are implemented as a result of policy measures,

- the reported energy savings are in accordance with the requirements of European legislation (according to Annex V to the Directive),
- the specific project was implemented between **1 January 2014 and 31 December 2020**.

The **saving of 'purchased energy'** is reported, that is, the difference between the final energy consumption before and after the implementation of the measure. These rules are described in greater detail in this methodology, which forms and annex to this document.

Fulfilment of an alternative scheme for the obligatory reduction of energy consumption

According to the NEEAP measures from 2014, the fulfilment of commitments under the energy efficiency obligation was dependent on the effective use of resources from investment and structural funds and proceeds from the sale of emission allowances. Continuous evaluation of the fulfilment of the commitment pursuant to Article 7 of the Directive according to the approved scheme has proved to be inadequate, even despite political pressure to make more efficient use of the funds allocated to energy efficiency support programmes financed by the structural funds.

The data collected in 2016 confirmed this fact. The conclusions of this continuous evaluation presented in the Report on the achievement of national energy efficiency targets show that if there is no extension of the implemented or planned policy measures, the target of obligatory new savings will not be met during the 2014-2016 or 2017-2020 periods. For this reason, the working group Coordination Committee of the Minister for Industry and Trade reviewed the activities of the Czech Republic in relation to increasing energy efficiency. The identification of additional measures in industry was updated during the continuous evaluation.

As a result of a shortfall in new energy savings during 2014-2016 of 4.86 PJ compared to the plan specified in the calculation of the commitment pursuant to the methodology set out in the Energy Efficiency Directive, a shortfall has arisen in the fulfilment of cumulative savings accrued for 2014-2016 period of 23 PJ[4]. This deficit must be made good by accelerating progress towards the commitment in the forthcoming 2017-2020 period.

Measures to ensure the fulfilment of the commitment pursuant to Article 7 of Directive 2012/27/EU

An analysis of the conditions of the individual support programmes identified barriers to drawing funds that were not foreseen by energy savings predictions. Based on the document *Report on the achievement of national energy efficiency targets,* which the Government approved on 27 February 2017 in its Resolution No 158, revisions were made to the

[4] The target for cumulative energy savings for the 2014-2016 period was determined proportionally as 43.8 PJ; in that period, 20.8 PJ was fulfilled. The deficit in cumulative savings arose as a result of the low fulfilment of annual savings during 2014 and 2015. Even though greater fulfilment of the commitment in 2016 meant that the shortfall fell to 4.86 PJ during the 2014-2016 period, there remains a deficit in cumulative savings.

framework for the obligatory increase in energy efficiency and implementation of measures to remove barriers to the implementation of the existing framework. Some of these steps were also included in this update of the National Energy Efficiency Action Plan.

The following measures are involved:

- revision of policy measures to extend them to include already-implemented measures (included in the NEEAP Update, see Annexes 1 and 2);
- proposal for policy measures that should be implemented by the end of 2020 (included in the NEEAP Update, see Annexes 1 and 2);
- elimination or at least a substantial reduction in restrictions on the allocation of funds for large enterprises to increase the OP EIC absorption capacity;
- support for soft measures aiming to generate private funding in the areas of energy efficiency (included in the NEEAP Update);
- establishment of a working body for the preparation and application of financial instruments of a uniform and coordinated approach to energy efficiency involving, in particular, representatives of the Ministry of Finance, the Ministry of Regional Development, the Ministry of Industry and Trade, and the Ministry of the Environment in connection with the task of preparing a National Investment Strategy – Investment Plan of the Czech Republic with regard, inter alia, to the transformation of the Czech-Moravian Guarantee and Development Bank into a national development bank pursuant to Government Resolution No 919 of 17 October 2016;
- analysis of the possibility of setting a combination of an alternative approach and standard approach to improving energy efficiency in accordance with Government Resolution No 923 (point II-1) of 4 December 2013.

3.1.2 Energy audits and energy management systems

The obligation of drawing up an energy audit and supporting the introduction of energy audits is regulated by the Energy Management Act (Section 5 State Programme on the Promotion of Energy Savings and the Utilisation of Renewable and Secondary Energy Sources and Section 9 Energy audit). The obligation of ensuring the drawing up of an energy audit was introduced into the Energy Management Act in 2012 by Act No 318/2012 amending Act No 406/2000 on energy management, as amended, Act No 103/2015 amending Act No 406/2000 on energy management, as amended, and Act No 634/2004 on administrative fees, as amended (hereinafter referred to as 'Act No 103/2015').

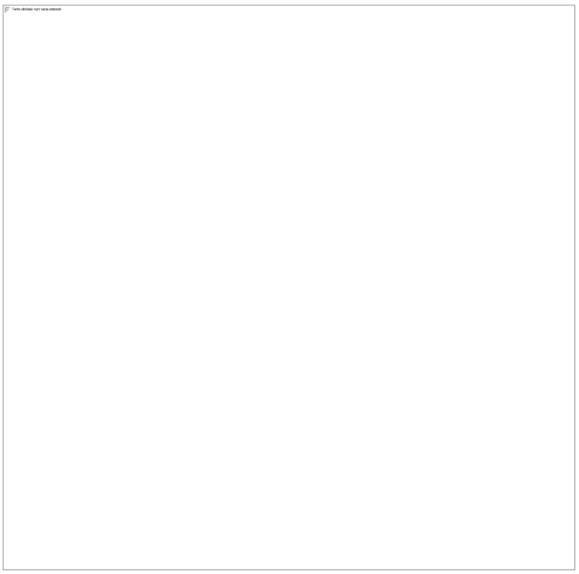
Obligation of drawing up an energy audit according to the size of the enterprise

This obligation was introduced into Czech law by Act No 103/2015. The obligation stems from the requirements set out in Article 8(4) of Directive 2012/27/EU. In this case, the obligation of drawing up an energy audit and repeating the process every four years applies to enterprises that are not a small or medium-sized enterprise according to the definition of

that term contained in Commission Recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized undertakings (hereinafter referred to as the 'Recommendation').

The staff headcount, annual turnover and annual balance sheet total are used to categorise enterprises. For classification, cumulative fulfilment of the staff headcount, annual turnover and annual balance sheet total by enterprises is sufficient. The Figure below gives an overview of the limit values for the categories of microenterprises, small enterprises and medium-sized enterprises.

Figure : Limit values for the categorisation of enterprises according to Commission Recommendation 2003/361/EC



When assessing the criteria of staff headcount and the financial values referred to above, the values of 'partner' and 'linked' enterprises are also taken into account. In other words, when determining the staff headcount and financial values, the values of other companies that are part of the same business grouping are included. This interpretation also applies to partner and linked enterprises based in another country[5]. Data (staff headcount/annual turnover or balance sheet total) on partner enterprises are included in the amount of the percentage share of capital or voting rights (whichever is greater). Before determining proportions, full data on all enterprises to which the enterprise is linked are added to the data on the direct partner enterprise. Data on the partners of the partner enterprise are not included after that.

As a result of the use of the definition of small and medium-sized entrepreneurs according to the Recommendation, the obligation of drawing up an energy audit applies to a significant number of entrepreneurs that, at the national scale, are considered to be small or medium-sized enterprises (around 2,000 enterprises, which approximately corresponds to the

[5] This follows from Communication dated 6 November 2013 from the Commission to the European Parliament and the Council implementing the Energy Efficiency Directive – Commission Guidance[5], which expressly provides in section 3.4 that '*applying this definition in practice requires for instance the consideration of consolidated data concerning each enterprise, including in other Member States and outside Europe, in order to ensure a harmonised definition and treatment across the EU.*'

number of active large enterprises for the year 2015 as published by the Ministry of Industry and Trade in the Report on the development of small and medium-sized enterprises and their support in 2015). However, taking into account the status of an enterprise as being a partner or linked enterprise with regard to a foreign parent company in accordance with the Recommendation leads to the entrepreneur being classified as not small or medium-sized, even though it is small or medium-sized at the national scale.

Czech Statistical Office statistics show that 13,400 enterprises were under foreign control in the Czech Republic in 2012[6]. It can be estimated (in view of the impossibility of identifying the precise relationship of a partnership and an alliance) that many of these businesses are classified, according to the Recommendation, as enterprises that are not small or medium-sized. However, the number of such enterprises does not correspond to the number of energy audits drawn up, even taking into account the fact that some companies prefer to replace the recurring obligation to draw up energy audits introducing, and having an accredited person certify, an energy management system (ČSN EN ISO 50001) or an environmental management system in accordance with the Czech harmonised standard governing environmental management systems (ČSN EN ISO 14001). Moreover, some entrepreneurs classified this way do not use or own an energy management system within the meaning of the Energy Management Act. It is therefore clear from the foregoing that it is not possible to quantify the number of affected entities precisely or, consequently, to quantify the number of energy audits drawn up in order to fulfil this obligation, or the numbers of introduced and certified energy management schemes or environmental management systems in accordance with the Czech harmonised standards governing environmental management systems (certification companies are not obliged provide data on the number of certifications performed to the Ministry in view of the sensitivity of such data).

Obligation of drawing up an energy audit according to consumption

Regardless of the definition of the size of a company, a natural or legal person (an entity that is a small or medium-sized enterprise or other entity that does not meet the requirements of an enterprise that is not small or medium-sized) is, according to the applicable legislation, required draw up an energy audit for its building or energy management system if the sum of the total annual energy consumption of all its buildings and energy management systems exceeds 35,000 GJ (9,722 MWh). However, this only applies to individual buildings or individual energy management systems that have an energy consumption greater than 700 GJ (194 MWh) per year. This obligation was introduced into law in 2001. In this case, no requirement was specified for the repeated drawing up of this energy audit.

Access to qualified elaboration of energy audits

In the Czech Republic, final customers have had access to energy audits since 2000, when Act No 406/2000 on energy management was promulgated. Today, in the wake of several

[6] The data on the number of non-financial companies under foreign control in 2012 come from the Czech Statistical Office report 'Who is pulling the strings of the Czech economy?' http://www.statistikaamy.cz/2015/03/kdo-taha-za-nitky-ceske-ekonomiky/

amendments to this law and implementing decrees, we are in a position to say that in the Czech Republic:

- energy audits are of high quality and are drawn up by energy specialist according to the authorisations referred to in Section 10 of the Energy Management Act. Energy specialists are obliged to complete continuous refresher training courses in order to ensure and support their expertise. The State Programme on the Promotion of Energy Savings and the Utilisation of Renewable and Secondary Energy Sources supports specialist courses intended, among other things, for training energy specialists;
- in order to save costs on the drawing up of energy audits, Section 9 of the Energy Management Act lists cases where it is admissible to have simpler forms of energy audits focused only on assessing specific measures ('energy assessments'); With regard to increasing energy efficiency and monitoring the fulfilment of the commitment under Article 7 of Directive 2012/27/EU, a major role is played by energy feasibility assessments for projects relating to improving building energy performance, increasing the efficiency of energy use, reduction of emissions from combustion sources of pollution or the use of renewable or secondary sources or combined heat and power financed by aid programmes from state or European funds, or funds resulting from the sale of greenhouse gas emissions allowances.
- since mid-2016, it has been obligatory for energy audits to be recorded electronically the ENEX database of the Ministry of Industry and Trade. This is an obligation on energy specialists. The database generates a unique registration number for each document, which allows the required energy audit to be identified and verified. The ENEX database allows energy audits to be evaluated, is used by the control authority, which is the SEP and, last but least, is used for verifying the collection of data on the savings achieved under the different support programmes included in the policy measures according to Article 7 of Directive 2012/27/EU.

Since the end of June 2016, when there was no obligation to record documents in the ENEX database, the Ministry of Industry and Trade has recorded 13,669 energy audits and energy assessments in the database. Since the obligation to register the documents in the ENEX database came into being and the launch of its new version in July 2016, approximately 5,600 energy audits and energy assessments have been recorded.

Pursuant to Section 13a of the Energy Management Act, compliance with the provisions of the law is monitored by the State Energy Inspection, which inspects both persons obliged to draw up energy audits and the persons drawing up energy audits.

Support for the introduction of energy audits and energy management systems

Under the State Programme on the Promotion of Energy Savings, calls are regularly published for the provision of support in carrying out 'Establishment of an energy management system' projects. Such support was published by the end of 2016, addressed in

particular to public administration. In 2017, support was extended to enterprises specified in the calls.

The object of the support is the introduction of a region's or a municipality's energy management system. All of the measures proposed must be implemented in accordance with ČSN EN ISO 50001 and it is expected that they will be aimed at certification of the entity's energy management system. The support aims to put in place a functioning energy management system in all structures owned by the applicant, meeting the requirements of the aforementioned standard. The support primarily centres on the production of basic documents required by the standard, organisation (a definition of processes, responsibilities, information flows, etc.), the preparation of systems for monitoring and evaluating energy consumption, and system certification. Upon receiving a subsidy, beneficiaries undertake to provide the Ministry of Industry and Trade, as required, with aggregated data on the results of energy management system implementation for a minimum period of the five years following completion of the project. The annual funding provided for these projects amounts to CZK 1,000,000. From the summary below of the drawdown of financial support for the introduction of energy management, it can be seen that energy management systems were introduced by eight of the total of 14 regions between 2012 and the end of 2015.

Table: Supported energy management introduction projects

Year	EFEKT STATE PROGRAMME	
	Grant beneficiary	**Project name**
2012	Liberec Region	Introduction of systematic energy management according to ČSN EN 16001 for buildings under regional ownership - Liberec Region
	PARDUBICE REGION:	Introduction of systematic energy management according to ČSN EN 16001 for buildings under regional ownership - Pardubice Region
	Central Bohemian Region	Introduction of systematic energy management according to ČSN EN 16001 for buildings under regional ownership - Central Bohemian Region
	Hradec Králové Region, Hradec Králové	Introduction of systematic energy management according to ČSN EN 16001 for buildings under regional ownership - Hradec Králové Region
2013	Moravian-Silesian Region	Introduction of systematic energy management for buildings under regional ownership
	South Moravian Region	Introduction of systematic energy management for buildings under regional ownership
	Statutory City of Opava	Introduction of systematic energy management for buildings under regional ownership
	Plzeň Region	Introduction of systematic energy management for buildings under regional ownership
2014	Statutory City of Opava	Introduction of systematic energy management under ČSN EN 50001
	Town of Frýdek-Místek	Introduction of systematic energy management under ČSN EN 50001

	Town of Tábor	Introduction of systematic energy management under ČSN EN 50001
	Town of Strakonice	Introduction of systematic energy management under ČSN EN 50001
	Town of Uherské Hradiště	Introduction of systematic energy management under ČSN EN 50001
	Town of Hodonín	Introduction of systematic energy management under ČSN EN 50001
	Town of Chrudim	Introduction of systematic energy management under ČSN EN 50001
	Town of Kopřivnice	Introduction of systematic energy management under ČSN EN 50001
	Pardubice Region	Introduction of systematic energy management under ČSN EN 50001
	Statutory City of Jablonec nad Nisou	Introduction of systematic energy management under ČSN EN 50001
2015	Statutory City of Brno	Implementation of energy management in accordance with ČSN EN ISO 50001
2016	Town of Kolín	Implementation of energy management in accordance with ČSN EN ISO 50001
	Statutory City of Kladno	Implementation of energy management in accordance with ČSN EN ISO 50001
	Statutory City of Děčín	Implementation of energy management in accordance with ČSN EN ISO 50001
	Statutory City of Česká Lípa	Implementation of energy management in accordance with ČSN EN ISO 50001

3.1.3 Metering and billing

Obligations relating to metering and billing are transposed by Act No 458/2000 on business conditions and public administration in the energy sectors and on amendments to certain acts, as amended (hereinafter referred to as the 'Energy Act'), and by the Energy Management Act, Implementing Decree No 82/2011 on electricity metering and on the means of determining compensation for damage in the case of the unauthorised offtake, unauthorised supply, unauthorised transmission or unauthorised distribution of electricity, as amended, and Implementing Decree No 108/2011

on gas metering and on the means of determining compensation for damage in the case of the unauthorised offtake, unauthorised supply, unauthorised storage, unauthorised transport or unauthorised distribution of gas, as amended.

Final customers have their electricity, gas and thermal energy supplies metered, and typically make payments in the form of monthly advances accompanied by quarterly or annual settlement. Bills provide detailed financial data and information itemising individual parts of the payment, and include a graph comparing consumption with the previous period. It is up to customers which method they use to pay their bills.

On the basis of a comprehensive study looking into the issue of smart meters (http://www.mpo.cz/assets/cz/energetika/elektroenergetika/2016/11/Ekonomicke-posouzeni-AMM-elektro.pdf), the Czech Republic has decided that such will not yet be introduced universally. Nevertheless, we do not rule out a situation in the future where customers will be able to apply for the installation of smart meters, provided that they pay for the extra costs incurred. This will give customers the opportunity to assess the costs and benefits of smart metering themselves and will help them to reach an optimal decision. The timetable for general introduction of smart metering systems is part of the Government-approved National Action Plan for Smart Grids. (http://www.mpo.cz/assets/dokumenty/52353/60358/633373/priloha003.pdf).

Where thermal energy and hot water are supplied from a central source, billing meters are used at transfer stations. As a matter of priority, transfer stations set up separately for individual customers, especially where major reconstruction projects are involved. The further breakdown of billing of consumption metered in this way is transparent, aided by various types of cost allocators for heat and hot water.

The billing of supplies of electricity, gas, and thermal energy is governed by Implementing Decree No 70/2016 on the scope, particulars, and dates for the billing of supplies of electricity, gas or thermal energy and related services. The final settlement of electricity and gas billing is carried out at least once a year, and may take place at shorter intervals. Payments are made in the form of monthly advances.

Thermal energy suppliers provide customers with free billing of thermal energy supplies at least once per calendar year, calculated as at 31 December of the calendar year, as this is the last day of the billing period. Suppliers provide customers with the billing of thermal energy supplies for the calendar year by 28 February of the following calendar year, unless otherwise agreed with the customer.

Act No 406/2000 on energy management, as amended, requires all apartments and non-residential premises in multi-family buildings and multi-purpose buildings with a supply of thermal energy from a thermal heat supply system, or with central heating or cooling or shared production of hot water to be equipped with devices registering thermal energy supply (hereinafter ‘registering devices’), such devices being prescribed meters in accordance with the Metrology Act, or devices for the distribution of heating costs, within the scope and in the manner prescribed by an implementing regulation.

The aim of the legislation in the area of metering and billing is to enhance consumer protection and to ensure that there is no inequality between consumers and suppliers. However, this protection is provided not only by the Energy Act but also be other regulations, for example Act No 634/1992 on consumer protection, as amended, and Act No 89/2012, the Civil Code. The last amendment to the Energy Act in 2015 significantly deepened protection of consumers and means by which they could terminate agreements on associated supply services. According to the regulations under Section 11a, customers

have the option of terminating an agreement up to 15 days after the start of supply of electricity/gas.

According to Section 17(4) of the Energy Act, the interests of customers and consumers in the energy sectors are protected by the Energy Regulatory Office. This competency is further specified in Section 17(7) of the Energy Act. To support consumers, the Energy Regulatory Office has set up a Customer Information Centre http://www.eru.cz/cs/informacni-centrum .

3.1.4 Consumer awareness programmes and professional training programmes

The aim of Article 12 Improvement of consumer awareness and standing programme, in connection with Article 17 Information and training, is to give the Member State tools to support the efficient use of energy by small customers, including households. For this requirement, the Czech Republic uses elements of fiscal incentives (for details, see Energy efficiency obligation schemes and alternative measures), the provision of information and model projects.

The **fiscal incentives** include in particular the New Green Savings Programme, which consists of direct investment in measures to reduce the energy intensity of buildings (stemming from Section 7 of Act No 383/2012 on the terms of trading greenhouse gas emission allowances), the Panel+ Programme, which focuses on investment in the renovation of multi-family buildings, the Integrated Regional Operational Programme, which consists of direct investment in measures to reduce the energy intensity of the buildings intended for habitation, and part of the Operational Programme Environment (Specific Objective 2.1 Reduction of emissions from local household heating), which is focused on the replacement of obsolete heating sources in the buildings for habitation.

The **provision of information** makes use of the tools of the State Programme on the Promotion of Energy Savings, which is specifically aimed at informing the general public through seminars, publications and support provided by free information centres. Information is provided to small customers on the following topics:

- ***'Awareness of energy saving in household heat consumption'*** **-** the objective is to support the organisation of thematic information campaigns and awareness-raising events on energy savings in households (media, leaflets, lectures, etc.).
- '***Energy labelling of household appliances***' - awareness campaigns are aimed at supporting the implementation of the Energy Labelling Directive. The labelling of household appliances is a compulsory measure derived from EU legislation aimed at fitting household electrical appliances with labels providing information on their energy efficiency, which can serve as a basis for households when purchasing such devices. Energy labelling and raising awareness of energy efficiency are ways to encourage consumers in achieving energy savings. The effect of this tool in improving energy efficiency will again be reflected in the annual energy balance.
- ***'Energy Star'*** - support for the sale of energy-saving office technology by labelling compliant products with the Energy Star label, and the possibility of selecting

compliant products from a publicly accessible database. Office technology manufacturers may subscribe to the Energy Star scheme and have their products certified within the scope of this programme. Certified products bear the Energy Star label and are entered in a database of energy-saving appliances. Energy Star labels and the database of energy-saving products are designed to help consumers when purchasing such products.

To **show model projects** as examples of good practice, the Ministry of Industry and Trade approved and published the **Reasonable Energy Savings Programme**. The Ministry aimed to use this programme to provide examples of good practice in energy efficiency. Activities focused on the promotion of successful energy-saving projects have the potential to create an environment that will facilitate the development of the awareness and stimulate the development and preparation of high-quality energy-saving measures, without using investment funds in the public and private sectors.

Under the programme, a website has been created of online records of implemented measures to promote energy savings and their benefits (www.usporysrozumem.cz). Registered projects must meet quality requirements and comply with the principles of good practice, that is, with the quality elements specified in the programme. After implementation, such projects can be awarded a certificate of quality, and it will be possible to use the quality mark with the programme's logo. After the registration of at least ten projects that bear the quality certification and in which the energy services provider has actively participated, it can be designated a high-quality energy services provider. This may bring the company a competitive advantage on the market, which is at present relatively opaque due to a wide variety of approaches to the provision of services of various quality levels.

The aim of the programme is to stimulate a reduction in energy consumption and improve the quality of provision of energy services with regard to the fulfilment of the adopted European framework, in particular Article 3 and Article 7 of Directive 2012/27/EU, both until 2020 and thereafter. The programme is one of the alternative scheme measures referred to in Article of Directive 2012/27/EU.

3.1.5 Availability of qualification, accreditation and certification schemes

The following qualification schemes are available in the Czech Republic:

1) Energy specialists

Energy specialists are natural persons holding an authorisation granted by the Ministry to:

(a) perform an energy audit and an energy assessment;

(b) prepare a certificate;

(c) inspect boilers and thermal energy distribution systems in operation; or

(d) inspect air-conditioning systems.

Energy specialists may hold authorisation for all the above document types. However, for each activity, the energy specialist must demonstrate relevant knowledge by passing a professional examination covering the area for which the specialist wishes to obtain authorisation. In addition to the professional examination, an applicant for authorisation must demonstrate legal capacity, be of good character and be professionally competent (as evidenced by the appropriate training and experience).

A list of energy specialists is publicly accessible on the website of the Ministry at http://www.mpo-enex.cz/experti/ .

One of the obligations for energy specialists is to complete regular refresher training courses. This training aims to consolidate, deepen and update professional knowledge of applicable legislation governing energy management, the energy performance of buildings and energy management systems, and the energy efficiency of energy production plants, including plants producing energy derived from renewable energy sources, secondary energy sources and cogeneration.

If the State Energy Inspectorate, which is the inspection body in this area, detects an error in the activities carried out by an energy specialist, the Ministry of Industry and Trade invites the specialist to retake the examination and demonstrate his knowledge before an expert panel. Authorisation to engage in professional activities is removed from those energy specialists who fail to comply with the requirements of continuing training or re-examination.

(2) Persons authorised to install selected installations generating energy from renewable sources

A person authorised to install selected installations generating energy from renewable sources (hereinafter referred to as a 'person authorised to carry out installation') means a natural or legal person holding a trade licence for the relevant area of activity. Such a person must ensure that the actual installations are performed by a person holding an applicable certificate not more than five years old demonstrating professional qualification under the Act on recognition of the results of further training.

3.1.6 Energy services

Development of energy services under the conditions of the Czech Republic

In 1999, the State began providing support to energy-saving projects under the State Programme on the Promotion of Energy Savings and the Utilisation of Renewable and Secondary Energy Sources (the EFEKT Programme). Calls concerning publications and seminars regularly focus on booklets, leaflets, recipe books for contracting authorities, and websites (the database of EPC and EC projects), training seminars are held, and grants are provided for the production of methodology aids (EPC Project Contracting Methodology, Code of Conduct, improvements in the quality of EPC contracting).

In 1999, the provision of support for energy-saving projects began from the State Programme on the Promotion of Energy Savings and the Utilisation of Renewable Energy Sources in the form of grants provided to energy service customers as contributions from the investment framework for installed energy-saving devices.

In 2006, the EPC support method strategy was changed and grant funds were provided to applicants (towns, statutory cities) for the preparation of projects designed using the EPC method in the form of support for the organisation of public tendering procedures, which did not prove to work particularly well, especially with regard to the annual periodicity of the EFEKT Programme. In 2012, support was renewed under the EFEKT Programme in the form of subsidies for drawing up analyses of the suitability of selected projects for contracting authorities from the public administration sector.

The financing of investments in installed energy-saving measures are another common element of EPC-type energy services provided. In this case, energy service providers require sufficient access to financial resources in order to carry out their activities. In the Czech Republic, it is common practice to sell debts, and they are sold almost exclusively to entities holding a Czech National Bank banking licence. The name of the specific financial institution to which a receivable is assigned is usually specified in the EPC contract prior to the signing thereof. Negotiations with the financing institution are completed after notification of the selection of the best bid and completion of the tendering procedure. The assignment of a receivable does not change the status of the customer. This liability remains a trade payable, i.e. it is supplier credit. The sale of a receivable does not change supplier credit into bank credit, which would influence the customer's debt service indicator. No contractual relationship is established between the customer and the financial institution (the bank), i.e. from an accounting and legal perspective, the assignment of a receivable has no impact on the customer or the customer's debt service indicator. The contractual obligations of energy service companies consist particularly in the provision of guarantees for achievable energy savings. Installed savings measures, upon completion, are transferred to the customer's assets without the establishment of any liens. The assignment of receivables has been used in almost all projects completed since 2005. These were EPC projects in the public sector (cities, regions, and publicly co-funded State institutions).

Since 2011, information on energy service companies has been available on the website of the Association of Energy Service Providers (www.apes.cz) along with other information and links.

A model contract has been created primarily for the purposes of public contracting for guaranteed energy services by contracting authorities. In this respect, it is publicly available at the website of the Ministry of Industry and Trade:

http://www.mpo.cz/dokument105425.html

The contents of the model EPC contract were modified in accordance with Annex XIII to the Directive by an amendment to Act No 406/2000 on energy management (Act No 103/2015), and the model was also set out in this Act.

The Ministry's website (http://www.mpo.cz/dokument105425.html) also contains other documents promoting the development of guaranteed energy services. The documents are as follows:

- Government Resolution No 109 of 22 February 2012 on finalisation of the methodology for use of the Energy Performance Contracting (EPC) method – guaranteed energy services (Czech Government Resolution).
- Model contract for contracting with guaranteed energy service providers.
- Schedules to an agreement on the provision of guaranteed-result energy services via the EPC method.
- Code of Conduct – Guaranteed energy services.
- The process of preparing public tendering procedure for the provision of guaranteed-result energy services via the EPC method.
- Methodology for the preparation and implementation of energy-saving projects handled using the EPC method.

In connection with the amendment to Act No 406/2000 on energy management in force from 1 July 2015, a list of providers of energy service, which is regularly added to, was published on the website of the Ministry of Industry and Trade: https://www.mpo.cz/cz/energetika/energeticka-ucinnost/energeticke-sluzby/seznam-poskytovatelu-energetickych-sluzeb--170967/

It is expected that the list of energy service providers will be further expanded in connection with the announced Reasonable Energy Savings Programme, in which energy service providers will be the driving force in the development of the energy services market and in the application of financial instruments in energy efficiency.

Proposed measures

In this area, proposals are put forward for the provision of energy services employing the EPC method in the tertiary sector, and the promotion thereof. This measure aims to supplement the methodology for the preparation and implementation of projects using the EPC method in the public and, in particular, State administration so that EPC becomes one of the significant methods employed in achieving energy savings in buildings.

The EPC (Energy Performance Contracting) method seeks to reduce operating costs related to energy consumption in buildings. The basis of this method is that customers do not need to invest in the replacement of obsolete technology themselves. In the conclusion of EPC service supply agreements, the service supplier undertakes to cover the cost of investments in savings measures from its own resources, and the customer repays them from the savings achieved in operating costs. The hallmark of EPC is the guarantee that a project will generate savings.

Publicly co-funded organisations may make use of this type of service. However, they are frequently concerned about making mistakes when accounting for these projects as they

view this process as the funding of investments from operating costs. The aim of the measure is to draw up and support the preparation and implementation of EPC projects in the public sector in general, and in particular by state contributory organisations and organisational units of the state.

Currently, there are approximately 15 companies on the market for the provision of energy services provided via EPC; of these, 13 have organised themselves into the Association of Energy Service Providers (AESP), which was founded in 2010. The AESP website (www.apes.cz) includes a list of member energy service companies, with their contact details and websites offering more detailed information about them. In terms of the level, quality and range of energy services, the Czech Republic is among the most developed in the European Union.

Providing energy services via EPC has a tradition in the Czech Republic of more than 20 years. Over that period, more than about 200 projects have been completed. In recent years, the annual volume of investments in the implementation of EPC projects has stood at around EUR 10 million. Between 10 and 15 new projects are completed every year. Trends over the past 10 years indicate that some further development can be expected. According to an expert estimate, in the future we can expect the implementation of projects including the provision of guaranteed-result energy services in approximately 30 to 50 structures, with average annual energy savings of between 600 and 1,000 GJ per structure. That would be tantamount to overall energy savings of at least 30 TJ per year, and this range could increase further.

Direct state support for using EPC

In the EFEKT Programme, it has been possible since 2012 to draw support for drawing up assessments of the suitability of structures for energy-saving projects using the EPC method. Support was first provided to towns and subsequently (in 2016) it was extended to other regional entities, urban districts, companies owned 100% by municipalities and urban districts, educational legal entities, state organisational units, contributory organisations, and public not-for-profit healthcare facilities. The overview given below shows that 775 structures were analysed for their suitability for the use of EPC.

Year	Grant beneficiary	Number of structures assessed
2012	Town of Klatovy	33
	Central Bohemian Region	9
	Town of Klimkovice	16
	Town of Nymburk	11
	Town of Holice	7
	Town of Kopřivnice	42
	Town of Nové Strašecí	9
	Statutory City of České Budějovice	21
	Town of Jeseník	8

	Town of Hronov	18
	Town of Písek	19
	STATUTORY CITY OF KARVINÁ	13
	TOWN OF KLÁŠTEREC NAD OHŘÍ	8
	TOWN OF OSEK	5
	Town of Krnov	12
	CITY OF PRAGUE	24
	Sportovní a rekreační zařízení města Ostravy s.r.o. [Sports and Recreational Facilities of the Town of Ostrava Ltd.], Ostrava	9
	Statutory City of Opava	12
2013	Statutory City of Pardubice	36
	Town of Chrudim	12
	Town of Český Těšín	20
	Town of Semily	11
	Municipality of Hodslavice	4
	Town of Vysoké Mýto	13
	Town of Litoměřice	16
	Statutory City of Opava	14
	Town of Litomyšl	8
	Town of Moravská Třebová	9
	Town of Roztoky	11
	Statutory City of Hradec Králové	8
	Town of Mohelnice	0
	Town of Písek	6
	Prague 9 District	23
	Town of Jaroměř	13
2014	Statutory City of Jablonec nad Nisou	12
	Municipality of Bílovec	17
	Town of Jičín	8
	Dopravní podnik hl. m. Prahy a.s. [Prague Public Transport Company j.s.c.]	16
2015	Statutory City of Olomouc,	40
	Town of Skuteč	8
	Town of Sušice	10
	Municipality of Hartvíkovice	7
	Municipality of Velký Osek	7
	Town of Mnichovo Hradiště	12
	Pardubice Region	12
2016	Town of Kolín	39

	Town of Šluknov	16
	Children's Psychiatric Hospital Opařany	16
	Town of Studénka	14
	Town of Přelouč	12
	Town of Krnov	14
	Municipality of Velký Osek	8
	Town of Jilemnice	10
	Town of Třinec	8
	Municipal social services administration	5
	Town of Velké Poříčí	2
	Town of Hronov	2

3.1.7 Other energy efficiency measures of a horizontal nature

The Czech Republic is continuously implementing educational programmes in the field of energy efficiency. At the same time, specialist documents have been drawn up in the form of interpretative communications, and these are listed in chapter 3.1.6.

3.2 Energy efficiency of buildings

3.2.1 Building Renovation Strategy

In accordance with Article 4 of Directive 2012/27/EU, the Building Renovation Strategy was drawn up in 2014 and updated in December 2016 (Annex 4).

The aim of the strategy is to seek a cost-effective approach to the renovation of buildings. Energy-efficient construction can significantly contribute to the growth of the Czech economy, depending on the leverage of public funds achieved. In the long term, the reduction of energy costs is an important tool for enhancing the competitiveness of the economy. A fundamental consequence of high-quality building renovations is the saving of energy, and therefore less fossil fuels need to be used, leading to less local pollution, reduced greenhouse gas emissions, and greater energy security.

The basis for determining potential energy savings in buildings is the determination of the proportion of already renovated buildings and the cost effectiveness of further savings in them. The strategy is based on this proportion and the further potential for savings identified by Chance for Buildings research, consultancy company estimates, support programme statistics, the number of ETICSs (a contact insulation system) sold and, in the case of multi-family buildings, a PanelScan study[7]. All the same, in February 2017, the Czech

[7] Study into the condition of the prefabricated housing stock in the Czech Republic, CERPAD for the Ministry of Regional Development, 2009

Statistical Office published the results of Energo 2015, a statistical examination of the energy consumption and behaviour of households. For reasons of time, however, the results of that examination could not be incorporated into the strategy.

The strategy studies various scenarios for the renovation of the building stock, the costs and benefits thereof, and proposes policy, legislative and economic instruments to implement them. Based on the outputs of the individual parts (an overview of the building stock, the potential for savings in the building stock, investment costs of renovations, definitions of individual renovation scenarios) the energy and economic impacts of the different scenarios were evaluated.

The scenarios considered are:

Scenario 1: Business as usual, with no new policy measures

Scenario 2: Fast but shallow renovation of the building stock

Scenario 3: Slow but, for energy purposes, deep renovation of the building stock

Scenario 4: Fast and deep renovation of the building stock

Scenario 5: Ideal hypothetical (3% deeply renovated buildings from 2017)

The business-as-usual scenario (1), not counting on state intervention, will see the renovation of 94% of those buildings not yet renovated by 2070 (single-family buildings), 2058 (multi-family buildings) and 2054 (public and commercial buildings), with a cut in energy consumption by roughly 56.5 PJ by 2050 compared to the current situation. Buildings renovated since the 1990s will not be renovated again until the second half of this century. Cumulative essential investment costs up to 2050 stand at EUR 22.2 billion for the implementation of this scenario.

The hypothetical scenario (5), on the other hand, envisaging major state intervention leading to the use of the full absorption capacity of energy-saving construction, will cover the renovation of all non-renovated building stock and the high-quality renovation of buildings that in the past have only undergone shallow renovation (have only had their windows replaced, or insulation installed to the required values, etc.) by 2040. This will prevent buildings from becoming dilapidated and will ensure that much of the energy-saving potential is harnessed. By 2050, it will reduce energy consumption in multi-family buildings by roughly 163 PJ. Cumulative essential investment costs up to 2050 stand at EUR 65.5 billion for the implementation of this scenario.

Scenarios 2, 3 and 4 are situated between the two extremes above. The achievement of different levels of energy savings depends mainly on the effectiveness of regulatory measures, the volume of public funds allocated, and the ability to excite additional private investment (the ‘financial leverage’ amount).

The setting of energy criteria, such as the terms and conditions of support schemes, is equally important. A comparison of scenarios 2 (fast but shallow) and 3 (slow but deep) shows that, in

the initial stage of the scenario it is possible to obtain larger energy savings through faster, shallow renovation, but in the longer term the shallow renovation blocks part of the economically effective potential of the savings, and then deep renovation that is slower to take effect records, in absolute terms, a lower possible achievable level of energy consumption.

Scenario 1: Business as usual	**2020**	**2030**	**2050**
Final energy consumption in the given year [PJ]	346	329	292
Energy savings compared to initial situation 349 PJ [PJ]	3	20	56
Investment costs in the given year [EUR millions]	661	687	603
Cumulative investment costs [EUR millions]	2,623	9,393	22,235
Energy cost savings – no price rises or discounts [EUR millions]	656	4,326	22,571
Total induced GDP [EUR millions]	3,790	10,280	22,636
Average induced employment	12,585	12,928	12,636
Total state budget income [EUR millions]	874	3,146	7,470
Total social security insurance [EUR millions]	100	360	855
Scenario 2: Fast but shallow renovation of the building stock			
Final energy consumption in the given year [PJ]	343	292	230
Energy savings compared to initial situation 349 PJ [PJ]	6	57	118
Investment costs in the given year [EUR millions]	1273	2061	700
Cumulative investment costs [EUR millions]	4137	23,394	51,494
Energy cost savings – no price rises or discounts [EUR millions]	800	8,455	49,289
Total induced GDP [EUR millions]	5,238	23,736	50,679
Average induced employment	19,874	32,272	29,231
Total state budget income [EUR millions]	1,381	7,855	17,285
Total social security insurance [EUR millions]	158	899	1,977
Scenario 3: Slow but, for energy purposes, deep renovation of the building stock			
Final energy consumption in the given year [PJ]	344	310	240
Energy savings compared to initial situation 349 PJ [PJ]	4	38	109
Investment costs in the given year [EUR millions]	932	1273	1,122
Cumulative investment costs [EUR millions]	3,288	15,600	39,193
Energy cost savings – no price rises or discounts [EUR millions]	727	6,409	39,301
Total induced GDP [EUR millions]	4,462	16,686	40,220
Average induced employment	15,940	22,049	22,938
Total state budget income [EUR millions]	1,109	5,388	13,625
Total social security insurance [EUR millions]	127	614	1,551
Scenario 4: Fast and deep renovation of the building stock			
Final energy consumption in the given year [PJ]	341	276	194
Energy savings compared to initial situation 349 PJ [PJ]	7	72	155
Investment costs in the given year [EUR millions]	1,419	2,546	563
Cumulative investment costs [EUR millions]	4,464	27,807	61,200
Energy cost savings – no price rises or discounts [EUR millions]	838	10,038	62,779
Total induced GDP [EUR millions]	5,594	28,732	61,741
Average induced employment	21,635	39,303	35,627
Total state budget income [EUR millions]	1,506	9,604	21,157
Total social security insurance [EUR millions]	172	1,094	2,409

Scenario 5: Ideal hypothetical			
Final energy consumption in the given year [PJ]	327	253	185
Energy savings compared to initial situation 349 PJ [PJ]	22	96	163
Investment costs in the given year [EUR millions]	2,776	2,546	117
Cumulative investment costs [EUR millions]	9,879	36,355	65,524
Energy cost savings – no price rises or discounts [EUR millions]	1,521	15,070	74,454
Total induced GDP [EUR millions]	10,984	37,392	65,248
Average induced employment	48,626	51,662	37,685
Total state budget income [EUR millions]	3,392	12,635	22,385
Total social security insurance [EUR millions]	387	1,439	2,549

From modelling, scenario 4 (quick and deep) may seem the most appropriate. If its funding could be secured, this scenario would make a major contribution to overall savings on final energy consumption by 2030. Compared the scenario where renovation is just as quick but shallow (scenario 2), scenario 4 brings 26% more savings at a cost that is higher by about 19%. A shift to the implementation of scenario 4 is therefore considered cost effective and ensures a higher contribution to the fulfilment of the Czech target. This shift, however, is hindered by the investment amounts necessary and other barriers reducing the absorption capacity for implementation by property owners. To overcome them, a long-term strategy is needed, together with targeted efforts by state and the coordination of all stakeholders.

Experience shows that the implementation of scenarios 2 to 5 depends on the volume of public funds that can be earmarked for building renovation. At present, those funds can only be predicted up to 2020, or 2023 in the case of operational programmes financed by the ESIF. At present, those funds can only be predicted up to 2020, or 2023 in the case of operational programmes financed by the ESIF. In the longer term, therefore, there is considerable uncertainty about the availability of a disproportionately larger volume of public funds, which is due also to the fact that the revised EU ETS Directive has yet to be finally approved, and the fact that it has not been decided how potential funds from the Modernisation Fund and other resources available to the Czech Republic under the EU ETS will be allocated. The basic framework for using EU funds after 2020 is also not known. Furthermore, a study of potential in other sectors of the economy is being prepared, which will guide the prioritisation of measures to achieve savings.

The Czech Republic is currently evaluating the possibilities of the real fulfilment of individual scenarios in which account must be taken of the setting under discussion of the climate-energy framework up to 2030 and the European funds framework for the period after 2020. Major factors affecting how much use can be made of potential energy savings in buildings will be the outcome of analyses currently being drawn up of the potential for savings in other sectors of the Czech economy, and analyses of the latest results of a statistical examination of building-sector measures already implemented.

3.2.2 Further improvements in the energy efficiency of buildings

Regulatory and fiscal instruments are used to promote improved energy performance. The

regulatory instruments relate in particular to the implementation of the requirements of Directive 2010/31/EU. The fiscal instruments concern certain policy measures pursuant to Article 7 of Directive 2012/27/EU that are also tools for the fulfilment of the Building Renovation Strategy (see above).

Regulatory instruments

Energy performance is addressed by the Energy Management Act, specifically in Section 7 and Section 7a. These provisions contain both actual energy performance requirements, and the obligation to draw up building energy performance certificates. Further details are provided in the implementing regulation – Implementing Decree No 78/2013 on the energy performance of buildings, as amended. The Implementing Decree provides for the following:

- cost-optimal levels of energy performance requirements for buildings for new buildings and major alterations of completed buildings, alterations other than major alterations of completed buildings, and nearly-zero energy buildings;
- methodology for calculating the energy performance of buildings;
- model for assessing the technical, economic and environmental feasibility of alternative energy supply systems;
- model for determining the recommended measures to reduce a building's energy performance;
- model and contents of the certificate, the method of drafting and location thereof in the building.

Energy performance assessments depend on the calculation of selected energy performance indicators and their comparison with the reference values for these indicators. The indicators of the energy performance of buildings are:

(a) total primary energy per year;
(b) non-renewable primary energy per year;
(c) total energy supplied per year;
(d) partial energy supplied for heating, cooling, ventilation, humidity treatment, hot water and lighting technical systems per year;
(e) average thermal transmittance;
(f) thermal transmittance of each structure at system boundary;
(g) efficiency of technical systems.

In the case of the construction of a new building and nearly-zero energy building, the builder, owner or association of unit owners must concurrently meet the legislative requirements for these three energy performance indicators:

- indicators of non-renewable primary energy per year;
- total energy supplied per year;

- average thermal transmittance of building envelope (e).

In the case of alteration of a completed building and an alteration other than a major alteration of a completed building, the builder, owner or association of unit owners must meet at least one of the following three combinations of energy performance indicators:

- requirement for non-renewable primary energy per year, and thermal transmittance of building envelope;
- total energy supplied per year, and thermal transmittance of building envelope;
- thermal transmittance of each structure at the system boundary for altered elements of the building envelope, and efficiency of technical systems.

The other energy performance indicators are informative, and the requirement for their fulfilment is not laid down by legislation.

In connection with the implementation of the requirements of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (hereinafter referred to as 'Directive 2010/31/EU'), new buildings must comply with the requirement for nearly-zero energy buildings by 2020. Act No 406/2000 on energy management, as amended, establishes a time frame for the introduction of this obligation. Nearly-zero energy building means a 'building that has a very high energy performance, whose energy required is covered to a very significant extent by energy from renewable sources'.

Fiscal instruments

List of measures, by sector, contributing to improvements in the energy efficiency of buildings[8]

Households

- New Green Savings, 2013
- New Green Savings, 2014-2020
- Operational Programme Environment 2014-2020 (PA 2 – SO 2.1)
- Integrated Regional Operational Programme
- JESSICA Programme
- Panel Programme
- Joint Boiler Replacement Scheme

Services

- Operational Programme Enterprise and Innovation (business entities)

[8] Measures under New Green Savings 2013, the JESSICA Programme and the Joint Boiler Replacement Scheme are terminated measures that will not generate new energy savings in the 2017-2020 period.

- Operational Programme Enterprise and Innovation for Competitiveness (business entities)
- Operational Programme Environment, 2007-2013 (public service sector)
- Operational Programme Environment, 2014-2020 (public service sector)
- Operational Programme Prague – Growth Pole, 2014-2020

Industry

- Operational Programme Enterprise and Innovation
- Operational Programme Enterprise and Innovation for Competitiveness

Detailed descriptions of the contents of the above programmes are given in an annex to this document.

Other instruments

Based on the recommendations in the Report on the achievement of national energy efficiency targets, measures must be adopted to improve the use of existing instruments for increasing energy efficiency in buildings and, at the same time, existing barriers to the fulfilment of the energy savings predictions to the policy measures adopted according to the NEEAP need to be eliminated. The following measures and instruments are involved in particular:

- making the disbursement of grant programme funds more effective by reducing the administrative burden on applicants and eliminating other barriers to disbursement,
- improving public awareness of the benefits of energy-saving measures (see chapter 3.1.4), and
- promoting opportunities for funding projects promoting energy savings from grant programmes.

3.3 Energy performance of the buildings of public bodies

3.3.1 Buildings of central government institutions

In 2013, the Czech Republic opted for the 'alternative' method for meeting the target under Article 5 of Directive 2012/27/EU. In connection with this decision, the Ministry of Industry and Trade, in collaboration with other members of the Government, leaders of other central public authorities and the director of the Office for Government Representation in Property Affairs imposed the following tasks by means of Government Resolution No 923 of 4 December 2013:

- compilation of a list buildings falling under Article 5 of the Directive, and
- preparation of the means of organisation, funding and evaluation of the implementation of energy-saving measures in state-owned buildings used by organisational units of the state and state organisations, to be submitted to the Government by 28 February 2014.

2016 saw the revision of data provided during 2014, 2015 and 2016. The need to update stemmed from the 'Report on the fulfilment of the Structure Reconstruction Plan within the scope of Article 5 of Directive 2012/27/EU of the European Parliament and of the Council 2012 on energy efficiency for 2016, with a look ahead to 2020' for 2015, which was discussed by the Government on 21 September 2016 due to the addition of Prison Service buildings pursuant to Article 5 of Directive 2012/27/EU.

The Czech Republic decided on the alternative approach mainly due to the state of the stock of buildings owned and occupied by central government institutions (many of which are historical and listed buildings), where complex renovations can sometimes be very difficult to carry out. This approach allows combinations of different ways of reducing energy consumption in the buildings of central government institutions. The measures adopted by the Czech Republic to meet the obligations of Article 5 of Directive 2012/27/EU by an 'alternative' approach are changes in building management behaviour, that is, no-cost or low-cost measures, measures with an economic return of 10 years, in particular the reconstruction of heat sources and heating systems, including the introduction of effective regulate suitable for the Energy Performance Contracting (EPC) method, and measures with a longer return period, i.e. construction and technical measures. This approach has been adopted with a view to financial demands; it is necessary to give priority to measures leading to maximum energy savings.

Even though the Czech Republic chose an 'alternative' approach to fulfil its commitment under Article 5 of Directive 2012/27/EU, it based its specification of the commitment on the list of buildings falling under Article 5 of Directive 2012/27/EU. The list thus created enables the identification of buildings that do not satisfy the requirements for the energy performance of buildings, thus ensuring that the target improvement in the energy performance of buildings is equivalent to the 'standard' approach. Annex IV of the Public Procurement Directive (2004/18/EC), which contains a list of central government authorities in all Member States, was used to create a list of affected institutions and buildings in their ownership and use. In the Czech Republic, they are the following 42 institutions:

January	Security Information Service	*22*	Ministry of Foreign Affairs
February	Academy of Sciences of the Czech Republic	*23*	Ministry of Health
3	Czech National Bank	*24*	Ministry of Agriculture
April	Czech Mining Authority	*25*	Ministry of the Environment
5	Czech Statistical Office	*26*	National Security Authority
June	Czech Telecommunications Office	*27*	Supreme Audit Office
July	Czech Surveying and Land Registry Office	*28*	Supreme Court
8	Energy Regulatory Office	*29*	Supreme Administrative Court
9	Grant Agency of the Czech Republic	*30*	General Attorney's Office
10	Office of the President	*31*	Chamber of Deputies of the Parliament of the Czech Republic

11	Office of the Public Defender of Rights	*32*	Senate of the Parliament of the Czech Republic
December	Ministry of Transport	*33*	Administration of the State Material Reserves
13	Ministry of Finance	*34*	State Labour Inspection Office
14	Ministry of Culture	*35*	State Office for Nuclear Safety
15	Ministry of Defence	*36*	Office for the Protection of Economic Competition
16	Ministry of Labour and Social Affairs	*37*	Office for Personal Data Protection
17	Ministry of Regional Development	*38*	Industrial Property Office
18	Ministry of Industry and Trade	*39*	Office of the Government of the Czech Republic
19	Ministry of Justice	*40*	Constitutional Court
20	Ministry of Education, Youth and Sports	*41*	Prison Service
21	Ministry of the Interior	*42*	Office for Government Representation in Property Affairs[9]

In view of the above, the obligation to renovate the buildings owned and occupied by central government institutions applies to 36 out of the 42 central government institutions, i.e. six central government institutions from the main list do not satisfy both conditions at the same time (building is owned and occupied), or are exempt under Article 5(2) of Directive 2012/27/EU.

The institutions are:

- The Office of the President – does not own any buildings;
- BIS – the objects were exempted due to their nature and at the request of the BIS;
- Academy of Sciences of the Czech Republic – does not own any buildings;
- The Czech National Bank – according to the guidelines on Directive 2012/27/EC, the CNB falls within the obligated entities under Annex IV of the Public Procurement Directive (2004/18/EC). From a substantive perspective, the obligation does not in practice apply under Czech law to the Czech National Bank and the buildings it owns;
- Grant Agency of the Czech Republic – does not own any buildings;
- Ministry of the Interior – does not own any buildings;

The buildings within the scope of Article 5 of Directive 2012/27/EU exclude selected buildings of the Ministry of Defence that qualify for exemption under Article 2012/27(5) of the Directive, i.e. they are owned by the armed forces or central government institutions serving national defence purposes.

The following table shows that these **36 central government institutions own and occupy 781 buildings with an energy reference area of over 250 m2 with a total energy reference**

[9] A non-obligated institution, included at its own request.

area of 2,211,344 m². Of these 781 buildings, 561 buildings with a total energy reference area of 1,563,941 m² do not meet the required energy performance rating C – energy efficient building.

Table: Total number and area of structures

Institutions	Number of structures owned and occupied	Number of compliant structures:	Energy reference area of compliant structures [m²]	Number of non-compliant structures	Energy reference area of non-compliant structures [m²]
Security Information Service	0	0	0	0	0
Academy of Sciences of the Czech Republic	0	0	0	0	0
Czech National Bank	0	0	0	0	0
Czech Mining Authority	5	2	2,406	3	8,217
Czech Statistical Office	8	5	31,875	3	10,326
Czech Telecommunications Office	2	2	9,339	0	0
Czech Surveying and Land Registry Office	3	1	945	2	23,250
Energy Regulatory Office	1	0	0	1	1,975
Grant Agency of the Czech Republic	0	0	0	0	0
Office of the President	0	0	0	0	0
Chancellery of the Senate of the Czech Republic	4	3	19,207	1	1,232
Office of the Public Defender of Rights	1	0	0	1	6,880
Ministry of Transport	1	0	0	1	47,975
Ministry of Finance	7	0	0	7	62,121
Ministry of Culture	3	1	624	2	13,830
Ministry of Defence	54	12	75,079	42	234,229
Ministry of Labour and Social Affairs	6	0	0	6	32,312
Ministry of Regional Development	9	7	13,539	2	11,235
Ministry of Industry and Trade	3	2	44,999	1	8,240
Ministry of Justice	12	1	41,822	11	42,377
Ministry of	10	3	2,797	7	14,144

Education, Youth and Sports					
Ministry of the Interior	0	0	0	0	0
Ministry of Foreign Affairs	8	1	400	7	56,123
Ministry of Health	1	1	17,974	0	0
Ministry of Agriculture	62	51	143,711	11	19,258
Ministry of the Environment	1	1	17,015	0	0
National Security Authority	3	2	11,508	1	5,053
Supreme Audit Office	1	1	3,434	0	0
Supreme Court	1	0	0	1	12,496
Supreme Administrative Court	3	0	0	3	9,939
General Attorney's Office	2	0	0	2	5,532
Chamber of Deputies of the Parliament of the Czech Republic	8	4	11,353	4	48,717
Administration of the State Material Reserves	10	2	1,349	8	9,769
State Labour Inspection Office	19	8	11,428	11	7,918
State Office for Nuclear Safety	6	1	465	5	12,696
Office for the Protection of Economic Competition	2	2	9,840	0	0
Office for Personal Data Protection	1	1	3,612	0	0
Office for Government Representation in Property Affairs	59	9	18,402	50	137,437
Industrial Property Office	2	0	0	2	10,970
Office of the Government of the Czech Republic	11	0	0	11	35,683
Constitutional Court of the Czech Republic	1	1	17,308	0	0
Prison Service of the Czech Republic	451	96	136,971	355	674,009
Total	**781**	**220**	**647,403**	**561**	**1,563,941**

Following the procedures described in the Commission staff working document *Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EC, and repealing Directives 2004/8/EC and 2006/32/EC – Article 5: Exemplary role of public bodies' buildings – accompanying the document Communication from the Commission to the European Parliament and the Council – Implementing the Energy Efficiency Directive*, a determination was made of the annual energy saving to be achieved as a result of energy saving measures.

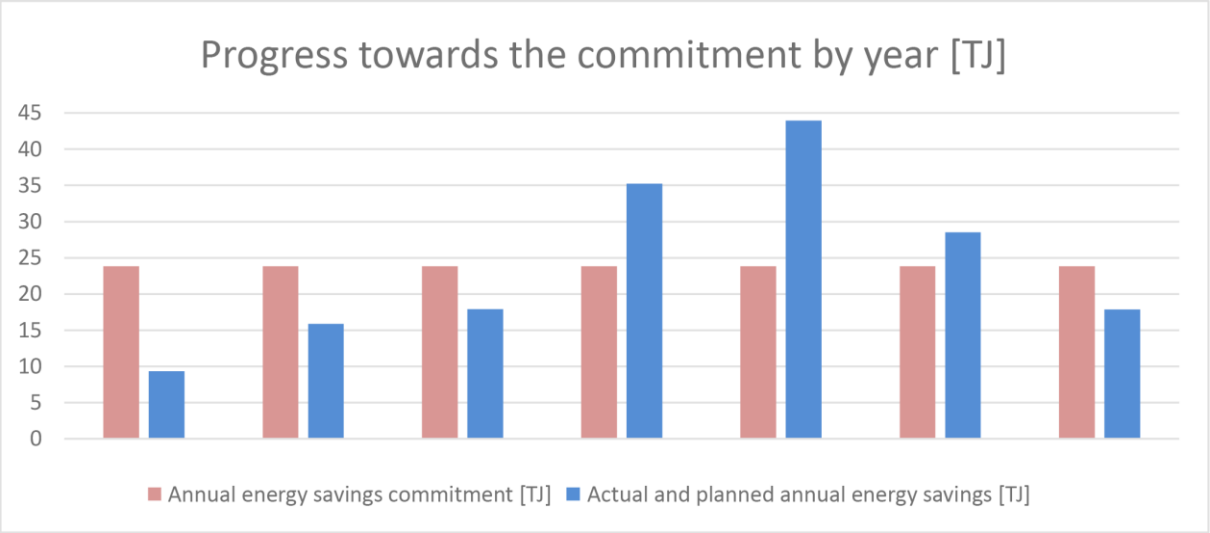
The target for savings to be achieved by energy saving measures in the buildings of central government institutions was calculated at **23.8 TJ.**

Table: Energy savings commitments in buildings of central government institutions

	2014	2015	2016	2017	2018	2019	2020	total
Annual energy savings commitment [TJ]	23.8	23.8	23.8	23.8	23.8	23.8	23.8	**166.8**
Annual energy savings commitment, cumulative [TJ]	23.8	47.7	71.5	95.3	119.2	143.0	166.8	
	Actual			**Planned**				
Annual energy savings [TJ]	9.4	15.9	17.9	35.2	43.9	28.5	17.9	**168.8**
Annual energy savings, cumulative [TJ]	9.4	25.3	43.2	78.4	122.4	150.9	168.8	
Progress towards the commitment (plan – commitment) [TJ]	-14.5	-7.9	-5.9	11.4	20.1	4.7	-6.0	**2.0**
Cost of renovations [CZK million]	139	277	346	394	755	897	505	**3,312**

The analysis carried out shows that, during the period 2014-2016, a deficit of 28.3 TJ arose in the fulfilment of the commitment. From following chart it is clear, however, that in 2017-2020 there is significantly increased interest in renovations by the organisations affected as a result of funding for the implementation of energy-saving measures. Achievement of these objectives should compensate for the lack of fulfilment in previous years. Regulatory and fiscal instruments are used to promote energy efficiency.

Graph: Progress towards the commitment under Article 5 of the Directive



3.3.2 Buildings of other public bodies

Regulatory and fiscal instruments are used to promote energy efficiency improvements. Regulatory instruments ensure that public authorities play an exemplary role in the energy performance of buildings.

Regulatory instruments

In accordance with Article 13 of Directive 2010/31/EU, public authorities have a duty under Section 7a(1)(b) of the Energy Management Act to obtain an energy performance certificate (hereinafter referred to as the 'certificate') from 1 July 2013 for buildings with a total energy reference area greater than 500 m^2 , and from 1 July 2015 for buildings with a total energy reference area greater than 250 m^2. Furthermore, if the building is frequently visited by the public, the public authority is required to display the certificate in a visible location.

In addition, public authorities are obliged to meet the requirements for nearly-zero energy buildings in advance of other entities:

(b) fulfilment of requirements for the energy performance of nearly-zero energy buildings ***owned or occupied by a public authority or an entity established by a public authority (hereinafter referred to as the 'public authority')*** *and having a total energy reference area*

1. greater than 1,500 m2 with effect from 1 January 2016, or

2. greater than 350 m2 with effect from 1 January 2017, or

3. or less than 350 m2 with effect from 1 January 2018,

(c) fulfilment of requirements for the energy performance of nearly-zero energy buildings with a total energy reference area greater than ***1 500 m2 with effect from 1 January 2018, or a total energy reference area greater than 350 m2 with effect from 1 January 2019, and a total energy reference area less than 350 m2 with effect from 1 January 2020****.*

Since 2015, Czech regions and the City of Prague have been obliged to prepare a Territorial Energy Policy. This strategy document:

- sets out the objectives and principles for energy management in the regions and the City of Prague;
- creates conditions for efficient energy management in accordance with economic and social development needs, including environmental protection and sound management of natural energy resources;
- includes defined and projected areas or corridors for public works for the development of the energy sector, while taking into consideration the potential for using efficient heating and cooling systems, particularly ones using high-efficiency cogeneration, and heating and cooling from renewable energy sources, where appropriate.

At least once every 5 years, a report is drawn up on the application of the Territorial Energy Policy during the previous period. This report forms the basis for any updating of the Policy.

Territorial Energy Policies can also be drawn up by municipalities on the basis of the rules laid down by the Energy Management Act.

Below is an overview of the documents drawn up by the entities concerned, which were drawn up during the previous period (2014-2016). Data from Territorial Energy Policies and reports on their application are continuously evaluated by the Ministry of Industry and Trade with regard to the fulfilment of the SEP.

Region	Year	Document	Reference
Liberec	2015	Report on the application of the Territorial Energy Policy of Liberec Region 2010	Territorial Energy Policy of Liberec Region
Liberec	2015	Territorial Energy Policy of Liberec Region - 2015 update	Territorial Energy Policy of Liberec Region
Olomouc	2016	Territorial Energy Policy of Olomouc Region - update (2015-2040)	
Karlovy Vary	2016	Report on the application of the Territorial Energy Policy of Karlovy Vary Region	
Moravian-Silesian	2016	Report on the application of the Territorial Energy Policy of the Moravian-Silesian Region	

Hradec Králové	2016	Report on the application of the Territorial Energy Policy of Hradec Králové Region	
South Bohemian	2017	Report on the application of the Territorial Energy Policy of the South Bohemian Region	
City of Prague	2014	Territorial Energy Policy of the City of Prague (2013-2033)	Territorial Energy Policy of the City of Prague (2013-2033)

Fiscal instruments

Financial incentives for public authorities can be divided into two categories:

- support for soft measures - EFEKT Programme
- support for the implementation of energy saving measures – Operational Programme Environment 2014-2020, New Green Savings Programme, EFEKT Programme

Both cases are policy measures, the effect of which is shown in the context of the fulfilment of the commitment under Article 7 of Directive 2012/27/EU (Energy efficiency obligation schemes and alternative measures).

The EFEKT Programme has, since 2012, promoted the introduction of energy management in regions and cities in accordance with ČSN EN ISO 50001 (see Energy audits and energy management systems) and also the drawing up of analyses of the suitability of applying EPC method.

As this programme is complementary to the programmes financed through the Structural Funds and proceeds from the sale of emission allowances, this programme provides investment support for increasing the efficiency of public lighting. Support for the reconstruction of resources was suspended in 2015 to avoid overlapping with support programmes.

The Operational Programme Environment 2014-2020, under Specific Objective 5.1, supports the improvement of the energy performance of public buildings and the increased use of renewable energy sources.

On the basis of changes made to the programme documentation in 2016, the **New Green Savings Programme** enables the reconstruction to be financed of buildings coming under the obligation to renovate pursuant to Article 5 of the Energy Efficiency Directive. New Green Savings Programme funds are complementary to the funding of the reconstruction of public buildings from to the Operational Programme Environment.

3.3.3 Purchasing by public bodies

Central to the awarding of public contracts in the Czech Republic is Act No 134/2016 on public procurement, as amended (hereinafter referred to as the 'Public Procurement Act'). The Act follows on from the approval in 2014 of three new directives (the Directive on public procurement replacing Directive 2004/18/EC, the Directive on procurement by entities operating in the water, energy, transport and postal services sectors replacing Directive 2004/17/EC, and the directive on the award of concession contracts) regulating public investments at EU level.

Since November 2010, 'Rules for the application of environmental requirements in central and local government procurement procedure and purchasing' have applied in the Czech Republic. These rules were adopted by the Government to promote green procurement in the public sector. The rules only define basic parameters, i.e. they state the bodies for which they are binding, and how and when their implementation is to be evaluated. Selected product groups are regulated by more detailed methodologies. These methodologies establish environmental requirements for products and services procured, and also include detailed instructions on how to incorporate these requirements into public procurement.

At present, methodologies are available for the purchase of furniture and office computer equipment, which, as of 1 November 2010, should govern the procedure followed by central bodies of state administration (the Government Office, ministries and other institutions, such as the Energy Regulatory Office, etc.). Further to international developments, methodologies that are also significant from the perspective of energy consumption are also due to be incorporated into the rules:

- energy-saving and environmentally friendly buildings;
- public street lighting;
- wall panels;
- cogeneration;
- boilers;
- air conditioning and heat pumps;
- windows.

The requirements of Article 6 of Directive 2012/27/EU were transposed by the last amendment to the Energy Management Act (Act No 103/2015). Beyond the scope of the above measures, the new provisions deriving from the Public Procurement Act oblige central institutions in the case of above-threshold public service contracts or public supply contracts to establish special technical requirements. These special technical requirements specify:

(a) for the supply of a product associated with energy consumption to which energy labelling requirements apply, the highest available energy efficiency class determined in accordance with the directly applicable EU provisions on energy

labelling requirements,

(b) for the supply of a product associated with energy consumption to which ecodesign requirements apply, unless energy labelling requirements apply to that product, the highest available efficiency of energy use determined in accordance with the directly applicable EU provisions on ecodesign requirements,

(c) for the supply of office equipment as defined by Council Decision 2013/107/EU of 13 November 2012 on the signing and conclusion of the Agreement between the Government of the United States of America and the European Union on the coordination of energy-efficiency labelling programmes for office equipment, the minimum efficiency of energy use set out in Annex C to that Agreement,

(d) for the supply of tyres as defined by Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters, the highest class of fuel efficiency under that Regulation,

(e) for the purchase of new goods as defined in points (a) to (d) for the purpose of service contracts, the purchase of goods meeting the conditions referred to in points (a) to (d),

(f) for the acquisition of buildings, with the exception of the acquisition of buildings for the purpose of making major alterations to the completed buildings or demolition, and the acquisition of buildings that are a cultural monument, or that are not a cultural monument but are not located in the conservation area or zone, the efficiency classification of the energy performance of buildings, and

(g) for the lease of buildings better than the less efficient class of building energy performance.

3.4 Further measures to improve energy efficiency in industry and transport

3.4.1 Measures in industry

List of measures contributing to improvements in energy efficiency in industry

- Operational Programme Enterprise and Innovation 2007-2013
- Operational Programme Enterprise and Innovation for Competitiveness 2014-2020
- Operational Programme Transport

Energy intensity is one of the factors that affect the competitiveness of undertakings, as well as the economy as a whole. Since its creation, the Czech Republic has made substantial progress in reducing the energy intensity of industrial processes. Nevertheless, energy intensity in gross value added in Czech industry remains higher than the EU-28 average. There is a great untapped economic potential for energy savings with a lower cost per unit of

energy saved than normally applies in the residential sector.

The main tool for the implementation of energy-saving measures in industry is the Operational Programme Enterprise and Innovation for Competitiveness (OP EIC). Two basic types of supported measures are: increasing energy performance in buildings and increasing energy efficiency in technology. The measures have a service life of at least 10 years. Specifically, the activities to be supported in 2014-2020 include:

- modernisation or replacement of existing energy production installations for internal use, leading to an increase their efficiency;
- the introduction and modernisation of measurement and control systems;
- modernisation, reconstruction and loss reduction in electricity and heat distribution systems in buildings and production plants;
- implementation of measures to improve energy performance of buildings in the business sector;
- re-use of waste energy in production processes;
- improvements in energy performance and energy efficiency in production and technological processes,
- the installation of renewable energy sources for an undertaking's own consumption;
- installation of cogeneration units with maximum use of electricity and thermal energy for the undertaking's own consumption;
- support for additional costs to reach the standard of a nearly-zero energy building and passive energy standard in the case of renovation or construction of new commercial buildings.

The above measures will be carried out either separately, or as a set of several measures (comprehensive projects) based on recommendations arising from an energy audit. The measures are planned to be financed using the conventional subsidy scheme, as well as financial engineering instruments.

According to original estimates, the OP EIC should induce new energy savings of 20 PJ during the 2014-2020 period. To achieve these savings, the allocation of the programme will total CZK 20 billion. This prediction is, however, highly unlikely to be realised. Based on an evaluation of the drawdown of funds, and assuming a constant cost of the measure to increase energy intensity, it is expected that energy savings of 9.62 PJ will be achieved under the OP EIC.

In addition to operational programmes, it is possible from 2017 to fund projects for reducing industrial energy intensity using a new financial instrument in the form of the **ENERG Programme**. This is a pilot financial instrument in the area of energy efficiency that aims to support the achievement of energy savings in final consumption in the SME sector. The programme plugs a gap in the financing of energy saving projects for businesses operating in the City of Prague as, under the conditions of the European Structural and Investment Funds, support is provided in geographical terms to businesses throughout the Czech

Republic except Prague. The programme is financed from the proceeds of emission allowance sales.

The aim of the programme is to provide soft loans for the implementation of projects reducing the energy intensity of small and medium-sized enterprises operating in the City of Prague. The objective of the programme is to facilitate access by small and medium-sized enterprises in the City of Prague to funding for projects aimed at reducing the energy intensity of their activities in order to achieve energy savings in final consumption, thereby contributing to increasing their competitiveness in line with the European Union's environmental policy for sustainable development.

'Voluntary agreements', which the Ministry of Industry and Trade intends to develop further, are an alternative measure to grant programmes and financial instruments. Voluntary agreements with entities and associations in industry are a flexible tool for meeting energy efficiency targets without having to introduce additional legislative or other regulatory measures.

3.4.2 Measures to promote energy efficiency in transport

In recent years, the growth dynamic of passenger road transport output has fallen, while passenger rail transport output has grown by 26 % during the same period, due in particular to increased attractiveness of long-distance passenger transport thanks to investments in rolling stock (the average distance travelled has increased from 40 to 47 km on the railways, while it has decreased to 32 km for road transport). From the energy perspective, this is a great benefit because the energy intensity of electric-traction rail transport is about one-seventh that of passenger car transport.

No similar effect has occurred yet in freight transport (freight road transport rose by 13% in the Czech Republic between 2010 and 2015 while freight rail transport output grew by 11% in the same period). The weak development of energy-efficient freight rail transport is cause, for example, by lack of capacity of east-west railway lines, which will soon be addressed by investments in the development of railway infrastructure (the construction of new rail lines and electrification) and slow renewal of rolling stock by transport companies.

The Czech Republic is aware of the potential for energy savings in the transport sector. The most suitable way to make savings measures seem to be to shift transport from highly energy-intensive modes, which at present account for the largest share of transport output (passenger and freight road transport) in the Czech Republic, to less intensive modes of transport, which could lead to energy savings of 80-90%. This is primarily a tool for building up infrastructure and a predominantly electric public transport fleet of high quality and sufficient capacity. It is also important to improve the quality and attractiveness of energy-efficient modes of transport so that person choose to use them; this could involve the Operational Programme Transport, which is administered by the Ministry of Transport.

Energy savings in the transport sector are also partly covered by the Operational Programme

Enterprise for Innovation and Competitiveness in providing support to more energy-efficient technologies. Improved energy efficiency in the transport sector will also be achieved by measures ensuring better connections between the various modes of transport. In freight transport, these measures include combined transport, which will provide services for road carriers (carriage of road trailers and containers by rail); in passenger transport, they include measures aimed at greater use of public transport, particularly in areas with strong traffic flows.

Projects are planned under the Operational Programme Transport to support energy savings in rail transport. The near future, for example, should see the start of implementation of a long-term project to reduce losses in the operation of power systems and electric traction equipment in the rail network. In December 2016, the Ministry of Transport approved a study of the transition of the railway to a uniform 25 kV system, which will have an impact on the reduction of energy consumption in transport through four effects:

- reduced losses in overhead lines,
- increased regenerative braking range,
- increased throughput capacity of main corridors (enabling high-speed operation of heavy trains in rapid succession) – creating capacity for the transfer of road transport to the railways,
- increased attractiveness of the as-yet unelectrified lines in the north of the Czech Republic by their electrification with the 25 kV system, which is significantly cheaper and therefore economically more realistic than the original 3 kV system – creating the conditions for the transfer of road traffic to rail.

Also of significance is the equipping of the railways in the Czech Republic with the uniform European Train Control System (see the National ERTMS Implementation Plan) which, in addition increasing safety substantially, also brings two effects in the area of the reduction of energy consumption in transport by means of a double effect:

- energy-efficient train management through knowledge of the speed profile far ahead of the train,
- increased throughput capacity of main corridors (enabling high-speed operation of heavy trains in rapid succession) – creating capacity for the transfer of road transport to the railways,

An essential step is the programmatic design of the construction of high-speed railways in the Czech Republic. In addition to the benefits in terms of social geography and travelling time savings, there will also be greater energy efficiency since their streamlined aerodynamic shape makes high-speed trains much less energy intensive than self-propelled cars.

In the 2017-2020 period, the introduction of measures is being considered to promote ecodriving that would reduce final energy consumption in the transport sector by altering the behaviour of drivers. They would primarily be soft measures such as creating an

ecodriving manual, arranging training and extending regular training in the principles and practices of ecodriving.

An important document for increasing energy efficiency in transport is the National Action Plan for Clean Mobility (hereinafter referred to as the 'NAP CM'), which was approved at a meeting of the Czech Government 20 November 2015 (https://www.mpo.cz/assets/dokumenty/54377/62106/640972/priloha001.pdf). The NAPCM is based on a European directive that, in the case of electric mobility and natural gas (and partly also hydrogen), lays down an obligation on Member States to develop an appropriate infrastructure for charging and filling stations. In the document, the Czech Government expresses the wish of the state actively to promote the development of alternative transport fuels and thus meet the previously defined targets of the Czech Republic in the areas of energy, transport and the environment. The preparation of the document was based on current and expected future EU commitments of the Czech Republic relating to the reduction of greenhouse gas emissions, and on the relevant Europe 2020 Strategy targets, particularly regarding the decarbonisation of the transport sector. In all these respects, the NAPCM also contributes to the fulfilment of the 2014 and 2015 National Reform Programme of the Czech Republic.

The NAPCM lays down requirements for the construction of filling and charging stations between 2020 and 2030. Support for low-emission vehicles will contribute to a reduction of road transport emissions, especially in cities and agglomerations, where transport is the main factor affecting air quality. In addition to the positive effects on the environment and public health, the development of clean mobility will also lessen dependence on oil and present a huge opportunity for the Czech automotive industry.

3.5 Promotion of efficient heating and cooling

3.5.1 Comprehensive assessment

Description of the procedure and methodology used to conduct a cost-benefit analysis meeting the criteria laid down in Annex IX to the Directive.

In accordance with Directive 2012/27/EU, the Ministry of Industry and Trade made an assessment of the potential of cogeneration of heat and power (CHP) by 31 December 2015. After the incorporation of comments of Government Council Working Group 1, the document entitled 'Assessment of the potential of high-efficiency cogeneration and efficient district heating and cooling in the Czech Republic' was sent to the European Commission.

The procedure and methodology for the cost-benefit analysis was drawn up in accordance with Part 1 of Annex IX.

The aim of the CBA (cost-benefit analysis) for the Czech Republic was to evaluate the defined composition of the generation/supply of heat for the 2016-2025 period in the baseline and alternative scenarios in terms of the society-wide benefit (CHP scenario, high CHP scenario).

The identification of the most appropriate scenario resulted from the comparison of incremental costs/benefits of alternative scenarios compared to the baseline scenario.

With regard to the comparability of results, the same amount of supplied heat and power was assumed in all scenarios. Therefore, the benefits in scenarios with higher levels of power from CHP include fuel cost savings (primary energy savings), reduced losses in the electricity grid and cost savings on externalities compared to the separate generation of heat and power.

Based on the cost-benefit analysis, it was found that the incremental benefits outweigh the incremental costs in both alternative scenarios. The society-wide benefit is highest in the case of the CHP scenario. Converted to net present value, additional savings under this scenario amount to CZK 17.65 million. The utilisation of the technical potential in heat supply with the emerging CHP technologies is shown in the following table.

Table: Use of the technical potential in emerging CHP technologies

	Technical potential	CHP scenario
Micro-cogeneration	5.0 PJ in 2025	0.9 PJ in 2025
Small and medium CHP, gas fuels	13.7 PJ in 2025	4.6 PJ in 2025
CHP, RES and other alternative fuels	9.5 PJ in 2025	3.2 PJ in 2025

With the installation of these new small and medium sources with CHP, power generation from high-efficiency CHP could increase by 1.3 TWh (in 2025).

In the case of the high CHP scenario, the relatively high total fuel costs (resource mix with intensive use of natural gas) and high investment in new cogeneration sources largely eliminate the benefits of this scenario, and therefore it does not reach the absolute benefits of the CHP scenario.

The sensitivity analysis shows a significant impact on the resulting NPV (net present value) by fuel prices, the price of emission allowances and the costs of externalities, which may vary significantly, depending on the methodology. Under the CHP scenario, however, NPV should not be less than zero.

The above shows that the Czech Republic should create conditions for the development of cogeneration as a contributor to the CHP scenario, which was shown to provide the highest society-wide benefits.

Heat supply systems in the Czech Republic include approximately 2,000 registered heat sources, of which 1,800 are sources with an output of over 5 MWt. Of the 4.1 million households, district heating is used in 1.6 million households, i.e. approximately 40 %. The total length of heat networks is approximately 10,000 km, of which 1,458 km are steam distribution lines, that is, approximately 15%. District heating uses 1,129 km of steam distribution lines, of which about 900 km require reconstruction. Their replacement with hot water distribution lines can achieve annual energy savings of 5.2 PJ. The savings achieved will be reflected in the annual balances as a reduction in the amount of primary energy. It is

envisaged that the cost of completely replacing steam distribution lines with hot water distribution lines would cost CZK 19-24 million.

3.5.2 Other measures for efficient heating and cooling

Under the State Environmental Policy of the Czech Republic 2012-2020, the thematic area Climate protection and improvement of air quality, Priority 2.1 Reducing greenhouse gas emissions and reducing the negative impacts of climate change includes Objective 2.3.3: Ensuring compliance with the commitment to increase energy efficiency by 2020. One of the measures for achieving this objective reads as follows: 'Support an increase in the share of the cogeneration of heat and power'. The policies for this area are defined by the following strategic documents:

- State Environmental Policy of the Czech Republic 2012-2020,
- SEP,
- Biomass Action Plan of the Czech Republic 2012-2020,
- National Action Plan for Energy from Renewable Sources,
- National Action Plan for Smart Grids.

Specific measures for achieving the strategic objectives in the Czech Republic include the introduction of investment and operational support for the generation of CHP power. The amount of support for CHP electricity is determined together with other supported sources in Energy Regulatory Office price decisions.

Table: Support for electricity generation from high-efficiency CHP in 2013 and 2014

	Total production (GWh)		Supported production (GWh)		Support paid (CZK million)	
	2013	**2014**	**2013**	**2014**	**2013**	**2014**
Plants up to 5 MW_e (inclusive)	---	3,269	989	886	680	760
Plants over 5 MW_e	---	9,561	7,370	5,943	1,293	901
Total	**11,965**	**12,830**	**8,359**	**6,829**	**1,973**	**1,661**

Under Act No 165/2012, distribution system operators and the transmission system operator are obliged to preferentially connect power plants with high-efficiency cogeneration of heat and power in the specified territory.

Under Act No 261/2007, as amended, and pursuant to Directive 2003/96/EC, fuel used for cogeneration is exempted from the gas tax and solid fuels tax.

Under the Energy Act, the construction of a power plant with a total installed capacity of 1 MW or more is possible only with a state authorisation granted for the construction of a power plant by the Ministry of Industry and Trade. The Ministry will not grant authorisation if the energy assessment shows that the planned power plant will not ensure high-efficiency cogeneration of heat and power in accordance with the Energy Management Act.

In accordance with the Energy Management Act, from 1 July 2015 a builder or owner of an energy sector undertaking must secure an energy assessment to assess the costs and benefits of providing high-efficiency cogeneration in the case of construction of a new power plant or substantial renovation of an existing power plant with a total thermal input exceeding 20 MW, except for power plants with an operating time of less than 1,500 hours per year, and nuclear power plants.

In relation to existing measures under the 'Assessment of the potential of high-efficiency cogeneration and efficient district heating and cooling in the Czech Republic', the following measures were proposed to promote high-efficiency CHP and efficient district heating and cooling systems in the Czech Republic, the possible implementation of which has yet to be discussed, along with the evaluation of their impact on other areas:

- Ensure continued operational support for high-efficiency CHP and heat from RES compatible with the rules governing EU public support for new installations commissioned from 2016, and ensure adequate legislative regulation of the support scheme.
- An increase in taxes on the consumption of fossil fuels in stationary sources other than cogeneration in installations not covered by the emissions trading scheme to a level corresponding to the price of CO2 emissions resulting from the expected allowance price.
- When updating the National Action Plan for Smart Grids, assess the possibilities for providing support services at the distribution system level (voltage control, reactive power control, short-circuit contribution, black start, island operation, etc.).
- The inclusion of a primary energy factor for efficient heat supply systems in the evaluation of the energy performance of buildings (amendment to Implementing Decree No 78/2013).
- To accelerate and simplify the approval processes for high-efficiency CHP installations and for the construction and renovation of heat supply networks.
- Set motivational and economic conditions for energy recovery from residual municipal waste after sorting recyclable components. Link any public support to the use of heat.
- Ensure the provision of adequate resources to stimulate the renovation and development of heat distribution systems (HDS) after 2020 also by using part of the funds from the sale of greenhouse gas emission allowances and other support mechanisms.

3.6 Energy transformation, transmission, distribution, and demand response

3.6.1 Energy efficiency criteria for network tariffs and regulations associated with network use

The regulatory framework for distribution system operators includes an incentive to reduce overall losses in distribution networks. A loss specification (i.e. the permitted rate [%] relative to the planned quantity of electricity on entry into the distribution system) is established as a constant for the entire regulatory period (three years in the case of regulation period IV) based on actual (measured) values in the previous regulation period. Permitted costs of losses are obtained by multiplying the norm by the planned quantity of electricity at the entry to the system and the prescribed price of electricity for loss coverage. If the level of losses in the distribution system planned by the distribution system operator is lower than those calculated under the normative formula, permitted costs of loss are to be calculated using the amount of losses planned by the distribution system operator. If the distribution system operator achieves a reduction in the share of losses in distribution, 50% of the difference between the actual costs of losses (up to the level of the permitted costs) and the actual revenues from network use fees (intended to cover losses) constitute additional profit for the distribution system operator. This means that distribution companies have a financial incentive to increase the efficiency of electricity distribution.

Network tariffs incorporate time differences so that, when the network load is high, a high tariff is applicable, and at other times a low tariff is used. This time-of-use tariff system is accompanied by technical measures for the use of controlled appliances (particularly heating appliances). This system makes it possible to shift the use of controlled appliances into bands where the load on the distribution system is lower. The system has been in use for several decades now, and limits peaks in the grid load diagram (this is known as peak shaving). This has facilitated the optimisation of investment in the distribution network in recent decades. Peak shaving also reduces electricity losses in the network.

The following types of dual tariff exist in the Czech Republic:

- Eight-hour accumulation – this is designed for supply points equipped with a storage electrical appliance (e.g. a boiler) used to heat water or a building. With this tariff, the installed electrical equipment and its load must have a value corresponding to at least 55% of the value of the main circuit breaker before the electricity meter (in the case of heating a building). These appliances heat water during the cheap tariff. The low tariff is controlled during the day based on developments in electricity consumption in the Czech Republic. The low tariff switchover time is determined by the distributor. The low tariff may be broken down into several intervals throughout the day, but the aggregate of these times must always be at least eight guaranteed hours. The

minimum uninterrupted interval for the low tariff is one hour. Modes: Low tariff lasting at least eight hours a day, high tariff lasting a maximum of 16 hours a day.

- Electromobility – This tariff is intended for supply points where the applicant provides credible proof of right of ownership or right of use (leasing etc.) of an electric car. The period of validity of the low tariff is determined by the distributor and must be not less than eight hours a day from at least 8 hours a day, between 6 p.m. and 8 a.m. During the day, the distributor may change the period of validity of the low tariff as needed. The definition of these bands in terms of time need not be the same for all customers or days, and need not even be continuous in length. An eight-hour low-tariff band can be divided during a specific period into a maximum of two segments.
- Sixteen-hour accumulation – intended for supply points equipped with hybrid electrical appliances (a combination of storage and convector heating appliances) used to heat water or a building. This tariff can be provided to households only until 31 March 2016 (if provided before 31 March 2016, this tariff can continue to be applied), and for small-scale business consumers until 31 March 2017. The sum of the output of all devices must correspond to at least 50% of the value of the main circuit breaker before the electricity meter. Modes: Low tariff lasting at least 16 hours a day, high tariff lasting a maximum of eight hours a day.
- Convector heating – designed for supply points equipped with electric convector heating appliances. This tariff can be provided only until 31 March 2016 (if provided before 31 March 2016, this tariff can continue to be applied), and for small-scale business consumers until 31 March 2017. The sum of the consumption of all devices must correspond to at least 40% of the value of the main circuit breaker before the electricity meter. Modes: Low tariff lasting at least 20 hours a day, high tariff lasting a maximum of four hours a day. This tariff was introduced on 1 April 2017 for convector and hybrid heating for small-scale business consumers, and is conditional upon the hybrid and convector appliances are powered by a separate supply and metered by a separate metering device.
- Heat pumps – designed for heating by means of a heat pump. This tariff can be provided only until 31 March 2016 – does not apply to tariff C – small-scale business consumers – (if provided before 31 March 2016, this tariff can continue to be applied). Modes: Low tariff lasting at least 22 hours a day, high tariff lasting a maximum of two hours a day.
- Electric heater – designed for household heating by an electric heating appliance and operational management of the low tariff validity period for a period of 20 hours. This tariff can be provided 1 April 2016. The period of validity of the low tariff is determined by the distributor and must be at least 20 hours a day. During the day, the distributor may change the period of validity of the low tariff as needed. If the 20-hour low-tariff validity band is split into time segments during the day, with a maximum of seven segments, none of them can be shorter than one hour. The

maximum continuous length of validity of the high tariff is one hour. The total installed supply for convector and hybrid electric appliances or a heating system with a heat pump, including the installed supply for storage appliances for heating water, where such appliance is installed, must be at least 40% of the supply corresponding to the value of the main circuit breaker before the electricity meter.

- Weekend – designed for recreational cottages and structures intended for weekend stays, where the cheap electricity tariff (the lower tariff) is set year-round from midday on Friday until 10 p.m. on Sunday.

3.6.2 Facilitation and promotion of demand response

In performing Task 14 in the Annex to Communication COM (2012) 663 final, 'Ensure the functioning of the internal energy market', of 15 November 2012, the Czech Republic has drawn up a National Action Plan for Smart Grids (NAPSG), which also includes measures to facilitate and develop the demand-side response.

Demand-side management is currently facilitated primarily by the ripple control system. The possibility of directly controlling consumption using ripple control technology has long been used in the Czech Republic. The ripple control system is a unidirectional group communication system using the electricity distribution network as a joint transmission channel shared by many receiving end stations. The distribution network predicted for the transmission of electricity with a frequency of 50 Hz is also used for the transmission of various higher-frequency ripple control signals. From this perspective, ripple control can be ranked among the narrow-band PLC technologies.

At present, approximately 46% of the overall household electricity consumption and 31% of the overall small-business electricity consumption takes place in the ripple-controlled low tariff. Ripple control receivers control the operation of electric heating systems and electric storage heating of water and the recharging of electric vehicles for households or small enterprises. In this respect, ripple control plays the role of a platform offering deferred consumption.

The primary reason for deploying ripple control in the 1960s was to reduce investment in the distribution system and production sources by optimising the system load. Ripple control distributed the energy-intensive consumption of households throughout the day.

Distribution system operators also use ripple control for the following purposes: System load optimisation (loss reduction in and increased throughput of the distribution system), dealing with emergency situations in the transmission system of the Czech Republic and the management of power generation in scattered sources. In the course of normal operations, distribution system operators use ripple control to distribute the controllable consumption in order to satisfy the needs of as many customers as possible, to ensure optimal use of networks, to increase transmittance and to ensure low losses in networks, to carry out switching in networks for operating purposes where necessary, and to optimise the purchase of electricity to cover losses.

Ripple control is managed, operated and financed by distribution system operators. These costs are incorporated into the price for the distribution of electricity. The main reason for using ripple control is to spread out consumption evenly, i.e. to optimise the operation of the distribution system. Ripple control is also used to handle emergencies in the grid. In the face of emergencies and other high-alert situations, ripple control is used to prevent and eliminate such situations and to clear up any consequences thereof.

The ripple control system is closely linked to the dual tariff system described above. Electricity customers who make some of their consumption available through controlled appliances are compensated for deferred consumption in the form of a lower rate for electricity distribution and, in most cases, also lower price of the actual electricity. Customers' consent to the control of specified appliances by the distribution system operator is included in connection contracts. Distribution tariffs are defined by the Energy Regulatory Office, including pricing. This system's traders use and offer commercial dual tariffs to customers with ripple control. Commercial tariffs are valid for the same duration as distribution tariffs. However, the difference in commercial low/high tariffs is not as pronounced as in the distribution tariffs (especially in the eight-hour accumulation), mainly thanks to the situation on the electricity market.

4. List of annexes

Annex 1

List of alternative policy measures according to Article 7 and quantification of the energy savings in final consumption made by such measures.

Annex 2

Detailed description of individual energy-saving measures under Article 7

Annex 3

Methodology for reporting energy savings from alternative policy measures pursuant to 7(9) of the Energy Efficiency Directive (2012/27/EU)

Annex 4

Building renovation strategy in accordance with Article 4 of the Energy Efficiency Directive – December 2016 update

Annex 5

Assessment of the potential for high-efficiency cogeneration and efficient district heating and cooling for the Czech Republic

Annex 1: List of alternative policy measures according to Article 7 and prediction of the energy savings in final consumption made by such measures

Measure number 2.2	Measure	Achieved savings			Expected savings[10]	Total savings	Allocation (expected)
		2008-2010	2011-2013	2014-2016	2017-2020	2014-2020	2014-2020
		TJ	TJ	TJ	TJ	TJ	CZK CZK
Implemented measures to support energy savings							
1.1	Regeneration of pre-fabricated concrete buildings – PANEL, NEW PANEL (Ministry of Regional Development) and PANEL 2013+ Programmes	-	-	106.9	100	206.9	4.5
1.2	Green Savings Programme (Ministry of the Environment)	2,950	2,950	-	-	-	-
1.3	New Green Savings Programme 2013 (Ministry of the Environment)	-	-	311.3	-	311.3	0.55
1.4	New Green Savings Programme 2014-2020 (Ministry of the Environment)	-	-	734.8[11] (2,710)	7,855[12]	10,565	19.36
1.5	JESSICA Programme (Ministry of Regional Development)	-	-	73.9	-	73.9	0.6
1.6	Integrated Regional Operational Programme (Ministry of Regional Development)	-	-	0	3,100	3,100	16.9
1.7	Joint Boiler Replacement Scheme (Ministry of the Environment)	-	-	49.6	-	49.6	-
1.9	Operational Programme Environment 2014-2020 (Ministry of the Environment) (Priority Axis 2 – SO 2.1)	-	-	817.2	2,300	3,117	10
1.8	Operational Programme Environment 2007-2013 (Ministry of the Environment)	139	1,168	2,060	-	2,060	-
1.9	Operational Programme Environment 2014-2020 (Ministry of the Environment) (Priority Axis 5 – SO 5.1)	-	-	0.00	1,500	1,500	14.6

[10] Evaluation as at 20 April 2017

[11] According to the verified data (approx. 5,117 paid applications were evaluated of the total number of 18,245 active applications) energy savings of 734.8 TJ were achieved. After evaluating the remaining implemented and paid applications, it can be expected that the programme made an overall contribution of 2,710 TJ for the 2014-2020 period, based on the real costs of the measures.

[12] Expected savings during 2017-2023/2024

1.10	State programmes to promote energy savings and the use of renewable energy sources (EFEKT) (Ministry of Industry and Trade)	165	21	28.4	-	28.4	0.1
1.11	State programme to promote energy savings (EFEKT 2) (Ministry of Industry and Trade)	-	-	-	400	400	0.6
1.12	OP Prague Growth Pole – buildings section (City of Prague)	-	-	0	10	10	1
1.13	Operational Programme Enterprise and Innovation 2007-2013 (Ministry of Industry and Trade)	1,569	4,000	2,098.8	-	2,098.8	-
1.14	Operational Programme Enterprise and Innovation for Competitiveness 2014-2020 (Ministry of Industry and Trade)	-	-	19	9,600	9,619	20
1.15	ENERG Programme (Czech-Moravian Guarantee and Development Bank)	-	-	-	40	40	0.13
1.16	Reasonable Energy Savings Programme (Ministry of Industry and Trade)	-	-	-	-	-	-
1.17	Alternative measures for increasing energy efficiency in Czech industry and in municipalities and regions	-	-	100	400	500	-
1.18	Operational Programme Transport (Ministry of Transport)	-	-	-	21	21	-
1.19	Strategic Framework for Sustainable Development	-	-	10,645	5,200	15,845	-
Total		**4,823**	**8,139**	**17,045**	**30,526**	**49,546**	**88.3**
The potential introduction, setting and evaluation of measures will take place during 2017-2020							
1.20	Promoting the ecodriving of cars				200		
1.21	Organisation of ecodriving training for lorry and bus drivers				1,800		
1.22	Support for the installation of cogeneration units				600		
1.23	Energy Savings Fund				2,600		
1.24	Support for the construction sector in the Czech Republic is improving energy efficiency and environmental protection in line with the EU 2020 environmental strategy				1,000		
1.25	Programmes supporting research and development						
1.26	Summary of measures to increase the energy efficiency of agricultural plants						
Total					**6,200**		

The table in Annex 1 summarises all measures which, in accordance with additionalities and significance, the Czech Republic plans to use to meet the objective under Article 7 of the Directive. The measures will be evaluated on an ongoing basis and modified and updated with regard to cost effectiveness so that they lead to the proper fulfilment of the Directive.

Annex 2: Detailed description of individual energy-saving measures under Article 7

Measure number 2.2	**1.1**

TITLE OF THE MEASURE	**Regeneration of pre-fabricated concrete buildings – PANEL, NEW PANEL and PANEL 2013+ Programmes**

Sector	**households**

Brief summary	The provision of subsidies to cover interest on loans and to secure and provide loans for the comprehensive regeneration of multi-family buildings.

Description of the measure	The Ministry of Regional Development programme, administered by the State Housing Development Fund, offers low-interest loans for repairing and modernising multi-family buildings. An emphasis is placed on comprehensive repairs so that owners spend financial resources in a purposeful manner. Projects supported include: • Rehabilitation of foundations and repairs of substructure waterproofing • Rehabilitation of static disorders in the supporting structure • Building envelope repair and repair of the contacts of building envelope components • Repair of enclosed or open balconies, including railings • **Insulation of that part of the envelope impervious to light with concurrent rehabilitation of the building envelope** • **Replacement of external doors and windows with enhanced materials in terms of heat and noise technology** • **Repair and insulation of roofs, including vertical extensions, e.g. machine rooms, pergolas, etc.** • **Regulation of the heating system** • Repair or replacement of the distribution systems for sanitary installations and gas • Replacement of open balconies or repair of enclosed and open balconies, including railings • **Insulation of selected internal structures** • **Improvement in the central regulation of the heating system** • Lift repair or replacement, including necessary intervention in the lift shaft

	• Repair or replacement of electrical equipment and wiring, heavy and light current • Replacement of the entrance walls to structures with a design ensuring protection from damage by vandals • Refurbishment or replacement of flat entrance doors • **Repair of building transfer stations or machine rooms with water heating equipment** • **Modernisation of the heating system, including the use of renewable energy sources, associated with the replacement of distribution systems and, where appropriate, radiators** • **Construction of a new boiler room for a building** • Repair or modernisation of flat sanitary units, including distribution systems for electricity, sanitary installations and gas • Repair or modernisation of ventilation technology • The installation of a new lift or the repair or replacement of a lift, including necessary intervention in the lift shaft • Repair of lightning rods and fire equipment and structures • **Installation of thermo-solar panels** • **Glazing of enclosed or open balconies** • **Installation, repair or modernisation of ventilation technology** • Replacement of entry steps and railings, low walls and paving located in front of a building • Repair of interior walls and ceilings • Repair of floor finishes and floor constructions in common areas • Repair of pathways • Modification of the entrance and staircase area, including mailboxes and lighting • **Measurement of heat consumption for the heating system, hot water consumption, cold water consumption** • Replacement of cooking gas distribution systems with an electricity distribution system • Modernisation of the hot water system, especially lever taps, riser pipe insulation, household hot water meters • Changes to the layout of a flat • Duplex extension by merging a flat on the top floor • Project work, design documentation • Static report • Building equipment inspections • **Acquisition of building energy performance certificate**

Regional application	This measure can be applied throughout the Czech Republic.

Target group	This programme is intended for all owners of multi-family buildings, irrespective of the technology used in construction (prefab, brick). The programme is open to cooperatives, associations of owners, natural and legal persons, and municipalities which own a multi-family building.

Effectiveness	This programme focuses primarily on the overall regeneration of apartment buildings owned by municipalities. One of the requirements is compliance with the heat and technical parameters of buildings required by the relevant standard. From this perspective, the measure can be regarded as effective.

Service life	This is a measure with a service life of 15 or more years.

Monitoring of the benefits of the measure	The production of underlying documentation for an application is divided into two parts for the sake of simplification and in order to make the whole process cheaper. Mandatory particulars of a loan application – Part I – include a Building energy performance certificate, now renamed as an 'Energy assessment' (if it needs to be provided) and the average thermal transmittance coefficient. The building energy performance certificate specifies the class before and after implementation of the measure. The thermal transmittance coefficient for the building envelope must comply with standard values. In the absence of this obligation, compliance with the prescribed average thermal transmittance coefficient (Uem) at the structure for which the loan is to be used (in accordance with the government regulation) is documented. Use of the loan must commence within six months of the date on which the loan agreement is signed. Use of the loan must end within three years of the date on which the loan agreement is signed. The borrower completes the repairs or upgrading of the building within three years of conclusion of the loan agreement. To calculate the energy savings, the implementing public authority uses the method of forecast savings. An ex ante generic approach is used in the case of applications for a loan from State Housing Development Fund resources for the repair and modernisation of buildings in the Czech Republic under with Government Regulation No 468/2012, and, for measures relating to the building envelope, also in the case of the building energy performance certificate and the average thermal transmittance coefficient certificate. The energy savings calculated in this manner will be clearly quantified in

	terms of its composition, durability, and the technology used. In relation to the energy performance of buildings, additionality is set at the minimum amount required or at an amount higher than that permitted under existing legislation. Detailed information about the programme can be found on the following website: http://www.sfrb.cz/programy/uvery-na-opravy-a-modernizace-domu/

Measure number 2.2	1.2

TITLE OF THE MEASURE	Green Savings Programme

Sector	Households and public sector buildings

Brief summary	The programme of the Ministry of the Environment administered by the State Environmental Fund focuses on support for the installation of heating sources using renewable energy sources, and on investments in energy savings during reconstruction and new development projects. The programme supports the high-quality insulation of single-family buildings and multi-family buildings, the replacement of non-ecological heating with low-emission sources running on biomass and efficient heat pumps, the installation of such sources in low-energy new structures, the installation of solar thermal collectors, and construction to a passive energy standard. The Czech Republic has obtained financial resources for this programme mainly by selling Assigned Amount Units (AAU) under the Kyoto Protocol on reducing greenhouse gas emissions. Under an amendment to Act No 695/2004 of 18 July 2008 on conditions for trading in greenhouse gas emissions, the revenue from the sale of AAUs is revenue of the State Environmental Fund (SEF) and can be used only to promote activities and projects aimed at reducing greenhouse gas emissions. The State Environmental Fund is responsible for the administration of the Green Savings Programme. In the preparation of the programme for the period from 2008-2012, an emission surplus of about 150 million tonnes of CO_2 eq. (AAUs) was expected, of which around 100 million AAUs were to be traded under the IET (International Emission Trading) mechanism pursuant to Article 17 of the Protocol. It was estimated that the revenue from the sale of this quantity of AAUs would be between CZK 15 billion and CZK 25 billion (at a price of EUR 10 per AAU). The final programme allocation was CZK 20 million. The support was conceived to be semi-mandatory, i.e. prepared so that programme resources could be used throughout the programming period from 1 April 2009 to 31 December 2012 without any major change in conditions, and so that subsidies could be granted to anyone who applied for support and met those conditions. Resources can be used throughout the whole period from the announcement of the programme until 31

	December 2014. Applications for subsidies could be made either before or after the implementation of the measure, but it was not possible to apply for support under measures completed before the announcement of the programme. The Green Savings programme was extended for the funding of public buildings (GS PB) until 2016 (amendment 3 to Directive 7/2010). At the end of 2015, the 2nd call under GS PB was announced (amendment 4 to Guideline 7/2010, where the disbursement of funds will run until the end of 2017, not 2014).

Description of the measure	The Green Savings Programme supports the following measures in single-family buildings, multi-family buildings and public buildings: • Heating energy savings ✓ A.1 Comprehensive insulation of the outer building shell, leading to a low-energy standard ✓ A.2 Quality insulation of selected parts of the outer building shell (partial insulation). • B. New construction to nearly zero energy standard B1. Promotion of new construction to nearly zero energy standard • C. Use of renewable energy sources for heating and hot water ✓ C.1 Replacement of non-ecological heating with low-emission sources running on biomass and efficient heat pumps. ✓ C.2 Installation of low emission sources running on biomass and efficient heat pumps in new buildings. ✓ C.3 Installation of solar thermal collectors. • D. Bonus subsidy for selected combinations of measures • E. Subsidies for the preparation and implementation of measures supported under the programme • F. Achievement of energy savings in public buildings. • Since a change was made in the conditions of the Green Savings subsidy programme on 10 August 2009, it has also been possible to assist the complete insulation of pre-fabricated multi-family buildings under the A.1 area of intervention.

Regional application	Projects may be implemented anywhere in the Czech Republic.

Target group	Eligible aid applicants are owners of single-family buildings and multi-family buildings, i.e. natural persons, associations of housing unit owners, housing cooperatives, towns and municipalities (including municipal districts) or businesses. According to Guidelines of the Ministry of the Environment 7/2010, the Green Savings Programme was also open to the owners of public-sector buildings (e.g. schools, social care institutions, retirement homes, etc.).

Effectiveness	In the secondary programme documents, the Green Savings Programme clearly defines the requirements for each supported measure having an immediate effect on reducing fuel and energy consumption in the final consumption of energy for heating and hot water. From this perspective, the measure may therefore be regarded as effective.

Service life	The average service life of these measures is 15 to 30 years after they are put into operation. The applicant is contractually obliged to operate the facility for at least 15 years. The applicant is obliged contractually or under the grant decision to operate the facility for at least 15 years in the case of public buildings.

Monitoring, verification, methodology for establishing energy savings and additionality	The benefits of the programme were monitored ex ante using the data from energy audits in public buildings; an expert opinion pursuant to Annex I/7 to Ministry of the Environment Guideline No 9/2009 was required for single-family buildings and multi-family buildings. These data are used for the additional calculation of savings in CO_2 emissions according to a validated method of calculation. This calculation is verified. It is also possible to calculate the savings of heat used for heating and heat production from RES.

Measure number 2.2	1.3

TITLE OF THE MEASURE	New Green Savings Programme 2013

Sector	households

Brief summary	This programme of the Ministry of the Environment, administered by the State Environmental Fund, focuses on energy savings and renewable energy sources in single-family buildings. The programme ran in 2013. The call published in August 2013 focused exclusively on the insulation of single-family buildings, conditional on the replacement of unsatisfactory heating sources powered by solid fossil fuels, separately in buildings which were already insulated to the required standard, and the installation of solar systems for hot water in single-family buildings.

Description of the measure	This programme is broken down into the following basic areas of intervention:
	
	A. Improvement in the energy performance of existing single-family buildings
	
	• A.1 Level 1
	  ○ A.1.1 Level 1, requirement to comply with the average thermal transmittance coefficient for the building envelope
	  ○ A.1.2 Level 1, requirement to comply with the specific annual heat demand for spatial heating
	
	• A.2 Level 2
	• A.3 Level 3
	
	B. Construction of single-family buildings with very high energy performance
	
	• B.1 Level 1
	• B.2 Level 2
	
	C. Efficient use of energy sources
	
	• C.1 Replacement of heat sources using solid and specified liquid fossil fuels with efficient, environmentally friendly sources (with the simultaneous implementation of measures under area of intervention A)

	○ C.1.1 Biomass boilers with manual fuel feeding ○ C.1.2 Biomass boilers with automatic fuel feeding ○ C.1.3 Biomass fireplace stoves with a heat exchanger with manual fuel feeding and closed fireplace inserts with heat exchanger ○ C.1.4 Biomass fireplace stoves with an exchanger with automatic fuel feeding ○ C.1.5 Heat pumps (water – water system) ○ C.1.6 Heat pumps (ground – water system) ○ C.1.7 Heat pumps (air – water system) ○ C.1.8 Gas condensing boilers • C.2 Replacement of heat sources using solid and specified liquid fossil fuels with efficient, environmentally friendly sources (without the simultaneous implementation of measures under area of intervention A) ○ C.2.1 Biomass boilers with manual fuel feeding ○ C.2.2 Biomass boilers with automatic fuel feeding ○ C.2.3 Biomass fireplace stoves with a heat exchanger with manual fuel feeding and closed fireplace inserts with heat exchanger ○ C.2.4 Biomass fireplace stoves with an exchanger with automatic fuel feeding ○ C.2.5 Heat pumps (water – water system) ○ C.2.6 Heat pumps (earth – water system) ○ C.2.7 Heat pumps (air – water system) ○ C.2.8 Gas condensing boilers • C.3 Installation of thermic solar systems ○ C.3.1 solar system for heating water ○ C.3.2 solar system for hot water and auxiliary heating • C.4 Installation of mechanical ventilation systems with heat recovery (with the simultaneous implementation of measures from area of intervention A) **D. Support for the preparation and implementation of the supported measures** • D.1 Production of an expert opinion for area of intervention A • D.2 Arrangements for the professional technical supervision of a client for area of intervention A • D.3 Production of an expert opinion and measurement of the building envelope's airtightness for area of intervention B • D.4 Production of an expert opinion for area of intervention C.2 **E. Bonus for a combination of selected measures** • E.1 Combination bonus with the simultaneous implementation of measures from area of intervention A and sub-area of intervention C.3

	• E.2 Combination bonus with the simultaneous implementation of measures from area of intervention A, sub-area of intervention C.3, and sub-area of intervention C.1 • E.3 Combination bonus with the simultaneous implementation of measures from sub-area of intervention C.2 and sub-area of intervention C.3

Regional application	Projects may be implemented anywhere in the Czech Republic.

Target group	Support applicants are owners of and investors behind single-family buildings – both natural and legal persons.

Effectiveness	The New Green Savings Programme 2013, in the secondary programme documents, clearly defines the requirements for each measure supported with an immediate effect on reducing the consumption of fuel and energy in final energy consumption for heating and hot water. From this perspective, the measure may therefore be regarded as effective.

Service life	The average service life of these measures is 15 to 30 years after they are put into operation. The applicant is contractually obliged to operate the facility for at least 10 years.

Monitoring, verification, methodology for establishing energy savings and additionality	Administration is governed by rules laid down in Guidelines of the Ministry of the Environment + Annexes (Guideline of the Ministry of the Environment No 9/2013, as amended by Addendum No 2/New Green Savings 2013/). Applicants submit applications initially electronically and then on paper. In addition to the formal annexes, the following items are submitted: - A cover sheet setting up the technical parameters (a summary of fundamental technical information and figures – similar to a registration sheet) - An expert opinion (general label – it contains two parts): - (a) project documentation (accompanying and technical report, drawings) – only a person authorised by the Czech Chamber of Chartered Engineers

	and Technicians or the Czech Chamber of Architects may draw up such documentation - (b) energy assessment (in accordance with Implementing Decree No 480/2012) – only an energy specialist with authorisation to conduct energy audits and energy assessments may draw up this documentation Applications are evaluated at various stages of implementation – some before commencement, others while they are in progress, and some on completion of implementation (chosen by the applicant). Checks on the correctness of applications (the sample size is 100% of applications) focus primarily on inspecting the cover sheet setting out technical parameters and the expert opinion (the assessment of input data and a comparison of resultant values with the programme terms and conditions) However, subsidies are always paid out ex post. Before payment, applicants are required to present the fund with all documents associated with the implementation of the measure (invoices, proof of payment, handover reports, final approbation consent/consent to the use of a structure – if relevant) A selected sample of applications is also subject to supervision or public-administration checks (associated with an on-the-spot check). To calculate the energy savings, the implementing public authority uses the method of forecast savings. An ex ante generic approach is applied on the basis of an expert opinion and, where measures relate to the building envelope, on the building energy performance certificate. A precise description of the parameters required can be found here: New Green Savings 2013: http://www.nzu2013.cz/vyrobci-a-dodavatele/vyrobci/smernice-c-9-2013-ve-zneni-dodatku-c-1/

Measure number 2.2	1.4

TITLE OF THE MEASURE	New Green Savings Programme 2014-2020

Sector	Households and public sector buildings

Brief summary	This programme of the Ministry of the Environment, administered by the State Environmental Fund, focuses on energy savings and the efficient use of the energy sources in structures. This programme is running in 2014-2020, and can be used to support energy efficient measures in single-family buildings and multi-family buildings, as well as public sector buildings. The first call of 2014 was announced in April 2014 and centres on three types of measures – improving the energy performance of existing single-family buildings, constructing single-family buildings with very high energy performance, and the efficient use of energy sources. The next call focusing on single-family buildings was announced in May 2015. In this second call, support was provided for the following measures: measures improving the energy performance of existing single-family buildings **(**subsidies for thermal insulation of building envelopes – replacement of windows and doors, thermal insulation of exterior walls, roofs, ceilings, floors, support for partial and comprehensive measures**);** measures supporting the construction of single-family buildings with very high energy performance **(**subsidies for the construction of new houses with very high energy performance**);** measures supporting the efficient use of energy **(**subsidies for the replacement of environmentally unfriendly sources of heat (for example those burning coal, coke, coal briquettes or fuel oil) by efficient environmentally-friendly sources (e.g. biomass boiler, heat pump or condensing gas boiler); measures for the replacement of electric heating by systems using heat pumps; measures for the installation of solar thermal systems; measures for the installation of forced ventilation systems with heat recovery from exhaust air). Together with this call, the first call for multi-family buildings in Prague was also announced in May 2015, aimed at supporting measures for improving the energy performance of existing single-family buildings in the City of Prague **(**subsidies for thermal insulation of building envelopes – replacement of windows and doors, thermal insulation of exterior walls, roofs, ceilings, floors; for the replacement of environmentally unfriendly

	sources of heat (for example those burning coal, coke, coal briquettes or fuel oil) by efficient environmentally-friendly sources (e.g. biomass boiler, heat pump or condensing gas boiler)**;** measures for the replacement of electric heating by systems using heat pumps**;** measures for the installation of solar thermal systems**;** measures for the installation of forced ventilation systems with heat recovery from exhaust air**;** the measures may be implemented individually or in different combinations. In October 2015, the third call for single-family buildings was announced; it was designed as an ongoing call. The receipt of applications will run continuously during implementation of the sub-programme for single-family buildings, depending on the funds obtained for the programme from the proceeds of emission allowance auctioning in the EU ETS (submission of applications is expected up to the end of 2021). The funds will be added to the allocation of the call continuously; the system allows a pipeline, where the application will be included in the absence of currently available funds. In the third call, support is provided to the following measures: measures improving the energy performance of existing single-family buildings **(**subsidies for thermal insulation of building envelopes – replacement of windows and doors, thermal insulation of exterior walls, roofs, ceilings, floors, support for partial and comprehensive measures)**,** measures supporting the construction of single-family buildings with very high energy performance **(**subsidies for the construction of new houses with very high energy performance)**,** measures supporting the efficient use of energy **(**subsidies for the replacement of environmentally unfriendly sources of heat (for example those burning coal, coke, coal briquettes or fuel oil) by efficient environmentally-friendly sources (e.g. biomass boiler, heat pump, gas condensing boiler or connection to a district heating network) – this support may not be provided to natural persons who are currently entitled to support for source replacement under Operational Programme Environment (PA 2, SO 2.1); measures for the replacement of electric heating by systems using heat pumps; measures for the installation of solar thermal and photovoltaic systems; measures for the installation of forced ventilation systems with heat recovery from exhaust air). In February 2016, the second call was announced for multi-family buildings in the City of Prague. The call is continuous and allocation is determined by the actual proceeds from auctions of emission allowances. Under this call, applicants can submit requests before, during or after the implementation of the measures. The deadline for proving completion of implementation is set at 18 months from the date of acceptance of the request. Payment of the grant is always ex post, after proof of the implementation of the supported measures has been approved. The main change in the continuous second call for multi-family buildings compared to the previous call is an increase in the maximum possible amount of support to 25-30% (depending on the amount of the energy savings achieved) of eligible

	expenditure due to the approximation to the amount of support under the IROP. A new area of intervention C Efficient use of energy resources is introduced here. Previously, measures to ensure the efficient use of energy sources came under area of intervention A Improving the energy performance of existing multi-family buildings, where they were implemented in combination with measures to improve the thermal and technical characteristics of the building envelope. In area of intervention C Efficient use of energy resources, these measures can be implemented without also insulating the multi-family building at the same time. A grant preference has been introduced if materials are used that have been issued a product environmental declaration under area of intervention A, and last but not least, it is also possible to provide support for connection to a heat supply system, gas pump, cogeneration system, photovoltaic system etc. In November 2016, an addendum extended the above call to include the possibility of supporting the construction of green roofs and the use of heat from waste water, and the possibilities of installing photovoltaic systems were also extended to include the possibility of using photovoltaic roofing or facade systems instead of photovoltaic panels. A third call for multi-family buildings was also announced in November 2016, which focused on supporting the construction of multi-family buildings with very high energy performance throughout the Czech Republic. CZK 100 million. The second change to the New Green Savings (hereinafter referred to as 'NGS') Programme Document, which extends the NGS to include the sub-programme Public sector buildings, was approved in Government Resolution No 955 of 2 November 2016. According to this Resolution, support will be provided from the NGS Programme for the implementation of energy-saving measures in central institution buildings by strengthening applicants' own resources in the case of approved applications submitted in published calls under Specific Objective 5.2 (Improve the energy performance of public buildings and increase the use of renewables).

Description of the measure	Under the programme, support within the calls announced so far is directed towards the following intervention areas: **<u>SINGLE-FAMILY BUILDINGS</u>** **A. Improvement in the energy performance of existing single-family buildings** • Sub-intervention areas: o A.0 – sub-measures on building envelopes o A.1 – shallow comprehensive measures on building envelopes o A.2 – comprehensive measures on building envelopes o A.3 – deep comprehensive measures on building envelopes

	• A.4 Preparation of an expert opinion and ensuring professional technical supervision for sub-intervention areas A.0, A.1, A.2 or A.3 **B. Construction of single-family buildings with very high energy performance** • B.1 Buildings with very high energy performance • B.2 Buildings with very high energy performance with an emphasis on the use of renewable energy sources • B.3 Preparation of an expert opinion and measurement of the building envelope's airtightness for sub-area of intervention B.1 or B.2 • B.4 Preferential treatment when using products with type III environmental declaration **C. Efficient use of energy sources** • C.1 Replacement of heat sources using solid and listed liquid fossil fuels by efficient, environmentally friendly sources (with the simultaneous implementation of measures under intervention area A) o C.1.1 Biomass boilers with manual fuel feeding o C.1.2 Biomass boilers with automatic fuel feeding o C.1.3 Biomass fireplace stoves with a heat exchanger with manual fuel feeding and closed fireplace inserts with a heat exchanger o C.1.4 Biomass fireplace stoves with an exchanger with automatic fuel feeding o C.1.5 Heat pumps (water – water) o C.1.6 Heat pumps (ground – water) o C.1.7 Heat pumps (air – water) o C.1.8 Gas condensing boilers o C.1.9 Connection to a heat supply system with more than 50 % share of RES • C.2 Replacement of heat sources using solid and listed liquid fossil fuels by efficient, environmentally friendly sources (without the simultaneous implementation of measures under intervention area A) o C.2.1 Biomass boilers with manual fuel feeding o C.2.2 Biomass boilers with automatic fuel feeding o C.2.3 Biomass fireplace stoves with a heat exchanger with manual fuel feeding and closed fireplace inserts with a heat exchanger o C.2.4 Biomass fireplace stoves with a heat exchanger with automatic fuel feeding o C.2.5 Heat pumps (water – water) o C.2.6 Heat pumps (ground – water) o C.2.7 Heat pumps (air – water) o C.2.8 Gas condensing boilers

- C.1.9 Connection to a heat supply system with more than 50 % share of RES

- C.3 Installation of solar thermal and photovoltaic systems
  - C.3.1 Solar thermic system for hot water
  - C.3.2 Solar photovoltaic system for hot water and auxiliary heating
  - C.3.3 Solar photovoltaic system for hot water with direct heating
  - C.3.4 Solar photovoltaic plants connected to the distribution system without accumulation
  - C.3.5 Solar photovoltaic systems connected to the distribution system with accumulation and total useful gain ≥ 1 700 kWh·year-1
  - C.3.6 Solar photovoltaic systems connected to the distribution system with accumulation and total useful gain ≥ 3 000 kWh·year-1

- C.4 Installation of forced ventilation systems with heat recovery

- C.5 Preparation of an expert opinion and measurement of the building envelope's airtightness for sub-intervention area C.1, C.2, C.3 or C.4

- C.6 Preferential treatment when using products with type III environmental declaration

MULTI-FAMILY BUILDINGS

A. Improvement in the energy performance of existing multi-family buildings

(includes thermal insulation and the replacement or installation of a heat source, etc.), support for the preparation of an expert opinion and provision for professional technical supervision

Sub-area of intervention: 1) A.0 - sub-measure

- serves as the input sub-area and enables the implementation of sub-measures
- reduction in the calculated specific non-renewable primary energy EpN,A or total energy supplied EP,A after the implementation of measures by at least
- 20% compared to the situation before implementation

achievement of the value of the thermal transmittance coefficient U required by the programme for supported building envelope structures2) A.1 - comprehensive measure

- reduction in the calculated specific non-renewable primary energy EpN,A or total energy supplied EP,A after the

	implementation of measures by at least o 30% compared to the situation before implementation o achievement of class C for the parameter Non-renewable primary energy EpN,A or total energy supplied EP,A o compliance with the requirement for the thermal transmittance coefficient according to ČSN 73 0540-2 for supported building envelope structures o 3) A.2 – deep complex measure reduction in the calculated specific non-renewable primary energy EpN,A or total energy supplied EP,A after the implementation of measures by at least 40% compared to the situation before implementation o achievement of class A or B for the parameter Non-renewable primary energy EpN,A or total energy supplied EP,A o compliance with the requirement for the thermal transmittance coefficient according to ČSN 73 0540-2 for supported building envelope structures **C. Efficient use of energy sources** o replacement of the original main sources of heat for heating using solid fossil fuels below emission class 3 parameters by efficient, environmentally-friendly sources; (Intervention area C1 and C2) o replacement of electric heating by systems with a heat pump (intervention areas C1 and C2) o replacement of natural gas heating by systems with a gas heat pump or by a CHP unit using natural gas as fuel. (intervention areas C1 and C2) o installation of solar thermal and photovoltaic systems (intervention area C3) o installation of forced ventilation systems with heat recovery from exhaust air (intervention area C4) o support for the preparation of an expert opinion and ensuring professional technical supervision (intervention area C5) Ina AI C1 and C2, support is provided to the installation of listed sources meeting the ecodesign requirements pursuant to Commission Regulation (EU) No 813/2013 and (EU) 2015/1189.

Regional application	Projects for the support of single-family buildings may be supported across the entire Czech Republic; projects for the support of multi-family buildings may be supported only in the City of Prague.

Target group	SINGLE-FAMILY BUILDINGS Support applicants are owners of and investors behind single-family buildings – both natural and legal persons. *Note: Support may not be provided for the replacement of solid fuel boilers owned by natural persons after 15 July 2015 (inclusive) if those natural persons are eligible for 'boiler subsidies' under the Operational Programme Environment 2014-2020, Priority Axis 2, Specific Objective 2.1 Reduction of emissions from local household heating contributing to the population's exposure to concentrations of pollutants.* MULTI-FAMILY BUILDINGS Applicants for support are owners of multi-family buildings – both natural and legal persons.

Effectiveness	The New Green Savings Programme, in the secondary programme documents, clearly defines the requirements for each measure supported with an immediate effect on reducing the consumption of fuel and energy in final energy consumption for heating and hot water. From this perspective, the measure may therefore be regarded as effective.

Service life	The applicant is contractually obliged to operate the facility for at least 10 years.

Monitoring, verification, methodology for establishing energy savings and additionality	Administration is governed by rules laid down in the applicable guideline of the Ministry of the Environment + annexes (Guideline No 1/2014, as amended by Addendum No 2/NGS/, and Guideline No 2/2015). Applicants submit applications initially electronically and then on paper. In addition to the formal annexes, the following items are submitted: - A cover sheet of technical parameters (a summary of fundamental technical information and figures – similar to a registration sheet) - An expert opinion (general label – it contains two parts): - (a) project documentation (accompanying and technical report, drawings) – only a person authorised by the Czech Chamber of Chartered Engineers and Technicians or the Czech Chamber of Architects may draw up such documentation

	- (b) energy assessment (in accordance with Implementing Decree No 480/2012) – only an energy specialist with authorisation to conduct energy audits and energy assessments may draw up this documentation - (c) Building energy performance certificate (according to Implementing Decree No 78/2013) – From the second call for single-family buildings and first call for multi-family buildings, energy assessment may also be performed by a specialist authorised to draw up building energy performance certificates; energy assessment was replaced in the programme conditions by energy evaluation. Applications are evaluated at various stages of implementation – some before commencement, others while they are in progress, and some on completion of implementation (chosen by the applicant). Checks on the correctness of applications (the sample size is 100% of applications) focus primarily on inspecting the cover sheet setting out technical parameters and the expert opinion (the assessment of input data and a comparison of resultant values with the programme terms and conditions) However, subsidies are always paid out ex post. Before payment, applicants are required to present the fund with all documents associated with the implementation of the measure (invoices, proof of payment, handover reports, final approbation consent/consent to the use of a structure – if relevant) A selected sample of applications is also subject to monitoring visits or public-administration checks (associated with an on-the-spot check). The fund does not carry out ex post monitoring of supported buildings. Reporting of energy savings under the NGS 2014-2020 will be conducted ex ante. The beneficiary contractually undertakes to implement energy savings according to the approved project. The energy savings under the NGS 2014-2020 will be evaluated within a separate evaluation of individual implemented projects. To calculate the energy savings, the implementing public authority uses the method of forecast savings. An ex ante generic approach is applied on the basis of an expert opinion and, where measures relate to the building envelope, on the building energy performance certificate. The energy savings calculated in this manner will be clearly quantified in terms of composition, durability, and the technology used. A precise description of the parameters required can be found here: New Green Savings:

	http://www.novazelenausporam.cz/zadatele-o-dotaci/rodinne-domy/prvni-vyzva/smernice-c-1-2014-ve-zneni-dodatku-c-1/

Measure number 2.2	**1.5**

TITLE OF THE MEASURE	**JESSICA Programme**

Sector	**households**

Brief summary	A programme of the Ministry for Local Development administered by the State Housing Development Fund focusing on the provision of low-interest long-term loans to revitalise deprived urban areas

Description of the measure	This programme offers long-term low-interest loans for the reconstruction and upgrading of multi-family buildings in deprived zones. Support is provided to the following activities: • Thermal insulation of building envelopes, thermal insulation of internal structures • Removal of static disorders in load-bearing structures; removal of structural and functional defects • Rehabilitation of foundations and substructure waterproofing • Reconstruction of technical equipment of buildings (modernisation of the heating system, wiring, replacement of heat, gas and water distribution lines, modernisation of air conditioning, lifts) • Replacement or modernisation of enclosed and open balconies, including railings Ensuring modern social housing

Regional application	This measure may be applied only in the deprived zones of 41 towns and cities with an Integrated Urban Development Plan.

Target group	This programme is intended for all owners of multi-family buildings, irrespective of their legal personality. • Municipalities;

	• Housing cooperatives; • Other legal and natural persons owning a multi-family building; • Associations of owners of residential units; • Municipalities, cities and non-profit organisations specialising in social housing.

Effectiveness	The programme focuses on renovation and modernisation of multi-family buildings. For projects focusing on thermal insulation of the envelope, monitoring indicator 'Savings in energy consumption of multi-family buildings' is monitored. The target value of the monitoring indicator has been exceeded. From this perspective, the measure can be regarded as effective.

Service life	This is a measure with a service life of 20 or more years.

Monitoring, verification, methodology for establishing energy savings and additionality	To calculate the energy savings, the implementing public authority uses the method of forecast savings. An ex ante generic approach is used based on the building energy performance certificate. The building energy performance certificate is part of the loan application. The energy savings calculated in this manner will be clearly quantified in terms of its composition, durability, and the technology used. This way, additionalities will be clearly controlled separately for each project under the JESSICA programme, and the overall additionality as a whole will therefore be respected for the JESSICA programme. In relation to the energy performance of buildings, additionality is set at the minimum amount required or at an amount higher than that permitted under existing legislation. Detailed information about the programme can be found on the following website: http://www.sfrb.cz/programy/program-jessica/

Measure number 2.2	1.6

TITLE OF THE MEASURE	Integrated Regional Operational Programme

Sector	households

Brief summary	A programme of the Ministry of Regional Development Focusing on for basic objectives of the Czech Republic's regional policy, as formulated in the Czech Republic's Regional Development Strategy for 2014-2020: • to promote an increase in competitiveness and the harnessing of the economic potential of the regions (growth objective); • to lessen the growing gaps in the negative regional differences (balancing objective); • to reinforce environmental sustainability (preventive objective); • and to optimise the institutional framework for regional development (institutional objective).

Description of the measure	This programme is broken down into the following priority axes: 1. Competitive, accessible and safe regions 2. Improvements in public services and living conditions for regional inhabitants 3. Good territorial governance and in more efficient public institutions 4. Community guided local development 5. Technical assistance In terms of energy savings, importance is attached to priority axis 2 and its investment priority 4 – Support for energy efficiency, smart energy management systems, and the use of energy from renewable sources in public infrastructure, in public buildings and in housing, among other things.

Regional application	All Czech regions (NUTS 3) except the City of Prague

	- Support will be provided in the form of a subsidy everywhere in the Czech Republic except the City of Prague. - Loans will be provided in territories defined in the conclusions of the ex ante assessment of the financial instrument.

Target group	- Owners of multi-family buildings - Residents of multi-family buildings - inhabitants of cities and municipalities Types of beneficiaries in the case of a subsidy: owners of multi-family buildings and associations of unit owners – buildings with four or more apartments, except for natural persons other than self-employed natural persons. Types of beneficiaries in the case of a financial instrument: owners of multi-family buildings and associations of unit owners – buildings with four or more apartments; fund administrator / administrator of the financial instrument based on the result of ex ante assessment of the financial instrument.

Effectiveness	The individual supported measures have an immediate impact on reducing energy consumption; therefore, this measure can be regarded as effective.

Service life	The average service life of these measures is 15 to 30 years.

Monitoring, verification, methodology for establishing energy savings and additionality	Unlike the Operational Programme Enterprise and Innovation for Competitiveness and the Operational Programme Environment, for example, the Integrated Regional Operational Programme does not have a direct predecessor. Until now, the support for multi-family buildings has been provided in the Czech Republic by programmes which provided support for comprehensive measures in the renovation of multi-family buildings under the Ministry of Regional Development (i.e. not only measures supporting energy efficiency), or by a sub-programme of the Green Savings Programme (2009-2012). The IROP programme document was approved by the European Commission in the first half of 2015. In the second half of the year, the first call is prepared under investment Priority 4, Priority Axis 2 – Support for energy efficiency, smart energy management systems, and the use of energy from renewable sources in public infrastructure, in public buildings and in housing, among other things.

	Energy savings will be evaluated by a public body using the ex ante deemed savings method. The generic method of ex ante calculation will use the documents pursuant to Act No 406/2000 on energy management. These documents will form part of an application for a subsidy or financial instrument. The energy savings calculated in this manner will be clearly quantified in terms of composition, durability, and the technology used. This way, additionalities will be clearly controlled separately for each project under IROP, and the overall additionality as a whole will therefore be respected for IROP.

Measure number 2.2	**1.7**

TITLE OF THE MEASURE	**Joint Boiler Replacement Promotion Scheme**

Sector	**households**

Brief summary	A programme of the Ministry of the Environment administered by the State Environmental Fund of the Czech Republic focusing on grants for the replacement of manually filled boilers running on solid fuel with new efficient low-emission heat sources in households.

Description of the measure	The aim of the Joint Boiler Replacement Promotion Scheme is to reduce air pollution generated by small combustion sources up to a thermal output of 50 kW, i.e. local incinerators using solid fuel. The subsidy is for the replacement of existing manually filled boilers running on solid fuel with new efficient low-emission heat sources. The programme is based on the principle that equal amounts are contributed by the Ministry and the region. This means that the more money the regions manage to find, the more they will receive from the Ministry.

Regional application	Projects may be implemented anywhere in the Czech Republic.

Target group	Owners of single-family buildings in Czech regions signing up for the programme. So far, the regions involved are the Ústí Region, Moravian-Silesian Region, Central Bohemian Region, Hradec Králové Region and the Pilsen Region.

Effectiveness	The programme only supports low-emission heat sources. Therefore, the measure may be regarded as effective.

Service life	The average service life of these measures is 15 years.

Monitoring, verification, methodology for establishing energy savings and additionality	Administration will be governed by rules laid down in Guidelines of the Ministry of the Environment. However, subsidies are always paid out ex post. Before payment, applicants are required to present the fund with all documents associated with the implementation of the measure. A selected sample of applications is also subject to supervision or public-administration checks (associated with an on-the-spot check). The fund does not carry out retrospective monitoring of supported projects. To calculate the energy savings, the implementing public authority uses the method of forecast savings. An ex ante generic approach is used based on the number of installations replaced.

Measure number 2.2	1.8

TITLE OF THE MEASURE	Operational Programme Environment 2007-2013

Sector	Services

Brief summary	An operational programme under the auspices of the Ministry of the Environment administered by the State Environmental Fund of the Czech Republic to support energy efficiency in two priority axes

Description of the measure	The Operational Programme Environment is one of the Czech Republic's sectoral programmes approved by the European Commission for the 2007-2013 programming period. The Operational Programme Environment focuses on improving the quality of the environment. It helps to improve the state of the air, water and soil, it addresses waste and industrial pollution, and it promotes care for the landscape, the use of renewable sources of energy and the building of infrastructure for environmental awareness. The Operational Programme Environment has eight priority axes, which are broken down into areas of intervention. The priority axes are: 1. Improvement of water management infrastructure and reduction of flood risk 2. Improvement of air quality and reduction of emissions 3. Sustainable use of energy sources 4. Improvement of waste management and rehabilitation of old ecological burdens 5. Limitation of industrial pollution and reduction of environmental risks 6. Improvements in nature and the landscape 7. Development of infrastructure for environmental education, consultancy and awareness 8. Technical assistance

Regional application	This measure can be applied throughout the Czech Republic.

Target group	This programme is intended primarily for beneficiaries in the public sector. The beneficiaries may include, for example, municipalities, regions, publicly co-funded organisations, State enterprises, State organisations, State organisational units, churches and religious societies, non-governmental organisations, and, in certain intervention areas, also business entities and natural persons.

Effectiveness	In terms of energy savings, the most significant priority axis is PA 3, which supports projects for the construction or renovation of installations using RES and CHP, and projects aimed at energy savings and the reuse of waste heat in the non-business sector. Priority axis 2 is also significant. It focuses on improving air quality which, in some cases, leads to reductions in energy consumption.
Service life	For investment measures, the service life is 15 or more years.

Monitoring, verification, methodology for establishing energy savings and additionality	1. Submission of an application – the basic documents accompanying the application are the energy audit, the building envelope energy label, the budget and a declaration by the designer on the area of structures insulated. The energy consumption balance before and after implementation, and the project benefits (in particular the reduction in CO2 emissions and the energy savings achieved), are taken from the energy audit and included in the application. In the application, the average building envelope coefficient (before and after implementation) and the required building envelope coefficient (a reference building) are sourced from the building envelope energy label (this may be part of the energy audit). Compliance with the thermal transmittance coefficient for the individual structures insulated is also checked by reference to the building envelope energy label. 2. Project documentation, including any updates to the declaration on the area of the structures to be insulated, and a works contract, including the budget, are submitted for the issuance of a grant decision. The indicator values in the grant decision are taken from the design documentation or the designer's declaration (the metres of insulated structures). The energy-saving parameters and CO2 reductions are based on the application or, where appropriate, the updated energy audit (if there is a change in the project). If the figures differ from those in the application, a reassessment must be conducted to determine whether the project would

	be supported even with the changed parameters. If this is not confirmed, the result would be withdrawal from support. 3. Final project evaluation (typically 50 months from permanent commissioning – approbation). Here, the opinions of the designer and the energy auditor are put forward. The designer's opinion confirms the compliance of implementation with the design documentation submitted for the grant decision (the scope of the work, the structures insulated). The energy auditor's opinion, by reference to real data (energy consumption), confirms compliance or non-compliance with the monitoring indicators (energy savings, reductions in CO2), and where appropriate comments are added on non-compliance, accompanied by a proposal for remedial action. 4. Operational monitoring reports (over the duration of sustainability) – here only confirmation that, following implementation, there have been no changes in relation to the use and ownership of the subject of support is evidenced. The energy savings under the programme OPE 2007-2013 are evaluated within a separate evaluation of individual implemented projects. The evaluation of each project precisely quantifies the energy savings according to the energy carrier. The energy savings calculated in this manner are clearly quantified in terms of composition, durability, and the technology used. This way, additionalities are clearly controlled separately for each project under OPE 2007-2013, and the overall additionality as a whole will therefore be respected for OPE 2007-2013. To calculate the energy savings, the implementing public authority uses the deemed savings and metered savings method. It uses two generic approaches. An ex ante approach based on energy audits, and an ex post approach based on monitoring reports or energy assessments. Additionality is established by higher required heat and technical properties of the building envelope than those provided for by legislation. A 'best available technique' requirement is established for the technical facilities of buildings.

Measure number 2.2	1.9

TITLE OF THE MEASURE	Operational Programme Environment 2014-2020

Sector	Services, households, industry

Brief summary	An operational programme under the auspices of the Ministry of the Environment administered by the State Environmental Fund of the Czech Republic focused on supporting energy efficiency in two priority axes of the Operational Programme Environment.

Description of the measure	The Operational Programme Environment focuses on improving the quality of the environment. It helps to improve the state of the air, water and soil, it addresses waste and industrial pollution, and it promotes care for the landscape, the use of renewable sources of energy and the building of infrastructure for environmental awareness. The Operational Programme Environment 2014-2020 has two priority axes fewer than in 2007-2013. It has six priority axes, which are broken down into areas of intervention. The priority axes are: 1. Improvement of water quality and reduction of flood risk 2. Improvement of air quality in human settlements 3. Waste and material flows, ecological burdens and risks 4. Protection of and care for nature and the landscape 5. Energy savings 6. Technical assistance For the purposes of energy savings, the most important priority axes are PA 2 and PA 5. PA 2 PA 2 – SO 2.1 – Specific objective 1: Reduce the emissions from local heating of households that contribute to the population's exposure to above-limit concentrations of pollutants PA 2 – SO 2.2 – Specific objective 2: Reduce the emissions from stationary

	sources that contribute to the population's exposure to above-limit concentrations of pollutants PA 5 PA 5 – SO 5.1 – Specific objective 1: Improve the energy performance of public buildings and increase the use of renewable energy sources PA 5 – SO 5.2 – Specific objective 2: Achieve high energy standards for new public buildings

Regional application	This measure can be applied throughout the Czech Republic except for the City of Prague.

Target group	In priority axis 2: SO 2.1 – Owners of single-family buildings. SC 2.2 Regions, municipalities, associations of municipalities, State organisational units, State enterprises, public research institutions, public institutions, boroughs of the City of Prague, publicly co-funded organisations, universities, schools and educational institutions, non-governmental organisations (publicly beneficial organisations, foundations, endowment funds, institutes, associations), churches and religious societies and their unions, businesses, companies, cooperatives, self-employed natural persons. In priority axis 5: State organisational units, publicly co-funded organisations of the State, publicly co-funded organisations of municipalities, publicly co-funded organisations of regions, municipalities, regions, associations of municipalities, public research institutions, public and State higher-education institutions, legal persons providing educational services, civic associations, churches and religious societies, publicly beneficial companies, other entities serving the public interest, in particular organisational units of municipalities, organisational units of regions, State organisations established by a special act.

Effectiveness	Measures in PA 2 and PA 5 can be regarded as effective.

Service life	For investment measures, the service life is 15 or more years.

Monitoring, verification, methodology for establishing energy savings and additionality	The methodology and procedures are similar to the procedure applied under OP E 2007-2013. January Submission of an application – the basic documents accompanying the application are the Energy Assessment (the 'EA'), the Building Envelope Energy Label, the building energy performance certificate (BEPC), the budget and a declaration of the designer. on the area of the structures insulated. February Project documentation, including any updates to the declaration on the area of the structures to be insulated, and a works contract, including the budget, are submitted for the issuance of a grant decision. The indicator values in the grant decision are taken from the project documentation or the designer's declaration (the metres of structures to be insulated). The energy-saving parameters and CO2 reductions are based on the application or, where relevant, the updated Energy Assessment (if there has been a change in the project). If the figures differ from those in the application, a reassessment must be conducted to determine whether the project would be supported even with the changed parameters. If this is not confirmed, the result would be withdrawal from support. 3 Final project evaluation (typically 50 months from permanent commissioning – approbation). Here, the opinions of the designer and the energy auditor are put forward. The designer's opinion confirms the compliance of implementation with the design documentation submitted for the grant decision (the scope of the work, the structures insulated). The energy auditor's opinion, by reference to real data (energy consumption), confirms compliance or non-compliance with the monitoring indicators (energy savings, reductions in CO2), and where appropriate comments are added on non-compliance, accompanied by a proposal for remedial action. April Operational monitoring reports (over the duration of sustainability) – here only confirmation that, following implementation, there have been no changes in relation to the use and ownership of the subject of support is evidenced. The energy savings under the OPE 2014-2020 will be evaluated within a separate evaluation of individual implemented projects. The evaluation of each project will precisely quantify the energy savings according to the energy carrier. The energy savings calculated in this manner will be clearly

	quantified in terms of composition, durability, and the technology used. This way, additionalities will be clearly controlled separately for each project under OPE 2014-2020, and the overall additionality as a whole will therefore be respected for OPE 2014-2020. According to a binding document of the Czech Republic sent to the European Commission in December 2013: 'Policy measures implemented in order to achieve energy savings among final customers in the Czech Republic', the additionalities of OPE 2014-2020 are as follows: PA 2 and PA 5 – BAT (services, households, industry) Reporting of energy savings under the OPE 2014-2020 will be conducted ex ante. The beneficiary contractually undertakes to implement energy savings according to the approved project. Another ex post verification will be conducted once every five years in the form of an ex post energy assessment.

Measure number 2.2	**1.10**

TITLE OF THE MEASURE	**State programme for energy saving and the use of renewable energy sources - EFEKT Programme (2014-2016)**

Sector	**cross-cutting measures**

Brief summary	The aim of the EFEKT Programme, which is under the auspices of the Ministry of Industry and Trade, is to increase energy savings by raising awareness among small customers, by increasing the quality of energy services and increasing support for the public sector in the economical management of energy. It focuses on raising awareness and disseminating information (with a stress on energy-saving measures and the use of renewable sources of energy), and on small-scale investment projects (the implementation of energy-saving projects primarily in municipalities).

Description of the measure	The aim of the measure is to increase energy savings through investment projects aimed at increasing the energy performance of public lighting or at reconstructing heating systems or sources in a building. An important part of the programme is non-investment support for soft measures in the field of energy consultancy and education with a focus on raising awareness among the general public and the professional community in all sectors concerning the economical use of energy and the possibilities of energy savings, e.g. in the form of feasibility studies on the introduction of energy management and EPC, organising conferences and seminars, publishing educational publications.

Regional application	This measure can be implemented throughout the Czech Republic.

Target group	The target groups vary according to the individual activities - businesses, municipal districts, municipalities, regions, schools, social and health care facilities, special-interest associations, societies and chambers.

Effectiveness	This measure is quite clearly effective because it helps to increase energy savings while reducing energy intensity and incurring relatively low measured costs.

Service life	For investment measures, the service life is 10 or more years. The effect of procuring noninvestment projects can be considered permanent.

Monitoring of the benefits of the measure	To calculate the energy savings, the implementing public authority uses the deemed savings and metered savings method. It uses two generic approaches. An ex ante approach based on energy audits, and an ex post approach based on monitoring reports or energy assessments. Projects where the return is too quick and measures with a particularly long return are not supported.

Measure number 2.2	**1.11**

TITLE OF THE MEASURE	**State programme to promote energy savings - EFEKT 2 Programme (2017-2021)**

Sector	**cross-cutting measures**

Brief summary	The EFEKT 2 Programme is under the auspices of the Ministry of Industry and Trade and focuses on investment support for public lighting non-investment support for developing awareness of energy savings among the general public and the professional community

Description of the measure	The aim of the measure is to increase energy savings by means of investment projects focusing on: • Measures to reduce the energy intensity of public street lighting; • Renovation of heating systems and sources in a building; • Energy-saving measures in buildings using the EPC method • Specific and pilot projects An important part of the programme is non-investment support for soft measures in the field of energy consultancy and education with a focus on raising awareness among the general public and the professional community in all sectors about the economical use of energy and the possibilities for energy saving. Supported activities include: • Energy Consulting and Information Centres (ECIS); • Projects aimed at the active dissemination of information and education in the field of energy saving; • Publications, background documents and tools for the dissemination of information and education in the areas of energy saving, including support for international cooperation and activities in accordance with Article 17 and Article 25 of the Energy Efficiency Directive; • Introduction of an energy management system; • Assessment of the suitability of structures for energy-saving projects using the EPC method.

Regional application	This measure can be implemented throughout the Czech Republic.

Target group	professionals and general public from all sectors

Effectiveness	This measure is quite clearly effective because it helps to increase energy savings while reducing energy intensity and incurring relatively low measured costs.

Service life	The service life of information dissemination can be difficult to estimate – it encompasses events with a longer life, such as the purchasing of more efficient appliances and the implementation of certain physical measures, but also transient effects, such as changes in the behaviour of energy consumers.

Monitoring of the benefits of the measure	Benefits can be monitored indirectly based, on the resources spent on disseminating information about the possibilities for energy savings within the EFEKT Programme.

Measure number 2.2	**1.12**

TITLE OF THE MEASURE	**Operational Programme Prague – Growth Pole**

Sector	**Services; Transport**

Brief summary	The operational programme under the auspices of the City of Prague focuses on support for improving the energy performance of buildings and the technical equipment used to ensure the operation of municipal public and road transport, implementation of pilot projects to convert energy intensive municipal buildings into nearly-zero energy buildings.

Description of the measure	The aim of the Operational Programme Prague – Growth Pole is to contribute to the Union strategy for smart, inclusive and sustainable growth and to the attainment of economic, social and territorial cohesion. The Operational Programme contains five priority axes, namely: Priority Axis 1: Reinforcement of research, technological development and innovation **Priority Axis 2: Sustainable mobility and energy savings** Priority Axis 3: Support of social inclusion and the fight against poverty Priority Axis 4: Training and education Priority Axis 5: Technical assistance Investment Priority 1, Priority Axis 2 – Specific Objective 2.1 is interesting in terms of energy savings: Energy savings in municipal buildings also achieved thanks to the use of appropriate renewable energy sources, energy-efficient equipment and intelligent control systems. The Specific Objective should therefore be pursued in particular by promoting improvements in the energy performance of buildings and the technical equipment used to ensure the operation of municipal public and road transport, as well as by implementing pilot projects for the conversion of energy-intensive public buildings into nearly-zero energy buildings (or passive energy standard buildings) with integrated intelligent systems. Throughout the Specific Objective, support will be provided to

	the use of solutions based on ICT for energy efficiency, smart energy management and ITS. Support is not provided to the housing sector.

Regional application	This measure can be applied only in the City of Prague.

Target group	City of Prague Organisations founded by the City of Prague Dopravní podnik hl. m. Prahy a.s. [Prague Public Transport Company j.s.c.] Prague Technical Road Administration Research and knowledge dissemination organisations (as defined in the Community framework for State aid for research and development and innovation.)

Effectiveness	The objective is aimed at supporting energy efficiency, smart energy management and renewable energy use in public infrastructure and in public buildings

Service life	This is a measure with a service life of 30 or more years.

Monitoring of the benefits of the measure	Within the scope of energy savings, this programme is complementary to the Operational Programme Environment in the City of Prague. Nevertheless, to calculate the energy savings, the implementing public authority uses the deemed savings and metered savings method. It uses two generic approaches. An ex ante approach based on energy audits, and an ex post approach based on monitoring reports or energy assessments. Additionality will be established through higher requirements for the thermal and technical properties of the building envelope than those specified by legislation. A requirement relating to best available techniques will be established for the technical facilities of buildings. The energy savings under the OPPGP will be evaluated within a separate evaluation of individual implemented projects. The evaluation of each project will precisely quantify the energy savings according to the energy

	carrier. The energy savings calculated in this manner will be clearly quantified in terms of its composition, durability, and the technology used. This way, additionalities will be clearly controlled separately for each project under OPPGP and the overall additionality as a whole will therefore be respected for OPPGP.

Measure number 2.2	1.13

TITLE OF THE MEASURE	Promotion of energy efficiency under the Operational Programme Enterprise and Innovation 2007-2013

Sector	Industry, services

Brief summary	The aim of the programme under the auspices of the Ministry of Industry and Trade was to provide investment support to increase energy efficiency in industry

Description of the measure	Within the period 2007-2013, the receipt of investment support was possible under Priority Axis 3 Effective energy OP EI 2007-2013 (Eco-energy). The Ministry of Industry and Trade is the Managing Authority of the programme, which is funded by the ERDF. The supported measures for the activity of increasing efficiency in the generation, transmission and consumption of energy include: • modernisation of existing energy production installations for internal use, which will increase their efficiency; • the introduction and modernisation of measurement and control systems; • modernisation, reconstruction and loss reduction in electricity and heat distribution systems; • Improvements in the thermal and technical properties of buildings, except for single-family buildings and multi-family buildings; • use of waste energy in industrial processes for the undertaking's own consumption; • increasing energy efficiency by introducing high-efficiency cogeneration[13], • improvements in energy performance and energy efficiency in production and technological processes;

[13] from the third call, extended only in the case of maximum use of the generated power and heat for the undertaking's own consumption, with regard to the operating conditions of the undertaking;

Regional application	This measure can be applied throughout the Czech Republic except for the City of Prague.

Target group	Business entities owning energy management systems or buildings

Effectiveness	This measure is highly effective because investments are channelled comprehensive projects to promote increased energy efficiency in industry.

Service life	This is a measure with a service life of 10 or more years.

Monitoring, verification, methodology for establishing energy savings and additionality	When the registration application is submitted, a basic project description is provided. This is merely a brief outline of the investment plan and is assessed from the perspective of compliance with the activities supported. In the registration application approval procedure, the assessment focuses in particular on the applicant in terms of the financial and non-financial health of the undertaking (applicant). Upon approval of the registration application, applicants are required to submit a full application, which must contain a more detailed description of the project, with a list of specific saving measures which must be presented in the recommended version of the energy audit, or clarified in a feasibility study. These documents are mandatory attachments to the full application. The full application must also include the value of the binding indicator 'Annual energy savings in GJ/year', which must be consistent with the projected energy savings in the energy audit registration sheet. In the approval procedure for a full application, a project manager from the mediating agency CzechInvest initially conducts an assessment of compliance with the activities supported under the programme call, and then passes it on to an external evaluator for assessment. This evaluator calculates a score based on the pre-published selection criteria. In particular, these criteria reflect cost-effectiveness, the benefit to the improved environment, and the investment return of the whole project. If the project score is more than 50 points, according to the selection criteria, it is forwarded for the production of two technical-economic opinions (or three opinions in case of discrepancies), which assess the project in terms of its economic returns and correct use of technology, etc. The project is then forwarded to an evaluation committee composed of

	representatives of specialist units, universities, energy associations etc. Based on the presentation of all opinions and representations concerning the project from the CzechInvest PM, the evaluation committee will then either recommend or not recommend approval. Savings are reported within the scope of project monitoring upon project completion. This means that applicants must report the value presented in the energy audit registration sheet and, by extension, in the full application, in the form of monitoring reports for 12 consecutive months following the date of project completion specified in the full application. The reporting period is two years and in at least one of them the specified value must be reached or exceeded. Within the scope of extensive projects, applicants also submit an energy audit addendum. However, this is not mandatory. In extensive projects, applicants also submit an energy audit addendum. However, this is not mandatory. With regard to the eligibility of costs, an essential condition is that the costs are eligible after the approval of the registration application and, naturally, they must be consistent with the full application, the assessment and the energy audit. They must also be directly related to the project and have a positive impact on energy savings. To calculate the energy savings, the implementing public authority uses the deemed savings and metered savings method. It uses two generic approaches. An ex ante approach based on energy audits, and an ex post approach based on monitoring reports or energy assessments. The energy savings under OP EI 2007-2013 will be evaluated within a separate evaluation of individual implemented projects. The energy savings calculated in this manner are clearly quantified in terms of composition, durability, and the technology used. This way, additionalities are clearly controlled separately for each project under OP EI, and the overall additionality as a whole will therefore be respected for OP EI. Projects where the return is too quick and where the measures do not support a particularly long return are not supported. Implementation of these measures is accelerated by this alternative scheme policy measure. The text of the call for projects under OP EI EKOENERGIE, which includes the evaluation criteria, is available for download below: http://www.mpo.cz/dokument104996.html

Measure number 2.2	1.14

TITLE OF THE MEASURE	Operational Programme Enterprise and Innovation for Competitiveness 2014-2020

Sector	Industry, services

Brief summary	The aim of the programme under the auspices of the Ministry of Industry and Trade was to provide investment support to increase energy efficiency in industry

Description of the measure	In the period 2014-2020, it will be possible to obtain investment support or support in the form of a financial instrument within OP EIC 2014-2020, Priority Axis 3 Effective energy, Specific Objective 3.2 Increase energy efficiency in the business sector. The Ministry of Industry and Trade is the Managing Authority of the programme, which is funded by the ERDF. The allocation for this specific objective is CZK 20 million. Under Specific Objective 3.2: Increase energy efficiency in the business sector, support is provided to the following measures: • Modernisation and renovation of electricity, gas and heat distribution lines in buildings and energy management systems of production plants in order to increase efficiency; • introduction and modernisation of measurement and control systems[14]; • modernisation and renovation of existing energy production installations for internal use that will increase their efficiency; • modernisation of lighting systems for buildings and industrial complexes (only in the case of replacement of obsolete technologies by new highly efficient lighting systems, for example LEDs) • the implementation of measures to improve the energy performance of buildings in the business sector (building envelope insulation, the replacement and renovation of windows and doors, other structural measures having a demonstrable influence on the energy performance of buildings, the installation of ventilation technology with waste heat recuperation);

[14] Hardware and network measures including related software associated with the introduction of energy management system according to ČSN EN ISO 50001 are eligible measures.

	• re-use of waste energy in production processes; • improvements in energy performance and energy efficiency in production and technological processes; • installation of RES for the undertaking's own consumption (biomass, solar systems, heat pumps and photovoltaic systems[15]); • installation of a cogeneration unit using electricity and thermal energy for the undertaking's own consumption with respect to its operating conditions[16] (measures concerning cold generation as part of trigeneration are also eligible). • support for additional costs to reach the standard of a nearly-zero energy building and passive energy standard in the case of renovation or construction of new commercial buildings. Extra costs will be derived from model examples and, for the purposes of support, will be set as a fixed amount for a clearly measurable quantity (e.g. per square metre of energy-related area). The outputs of all these measures should make a fundamental contribution to compliance with Directive 2012/27/EU on energy efficiency, which is also the result of this Specific Objective. Below is a link to the programming document. http://www.mpo.cz/dokument157679.html As the European Commission approved the OP EIC 2014-2020 in late April 2015, the announcement of the planned calls was delayed by about a year. On 1 June 2015, the first continuous call was published for Specific Objective 3.2 (Energy Savings Programme) with an overall allocation of about CZK 5 million. On 28 11 2016, the second continuous call was published with a total allocation of CZK 11 million. Acceptance of applications started on 15 December 2016, and is scheduled to end on 30 3 2018. The specific conditions of the Energy Savings Programme, chapter 9.3 of the call, which the project must meet, are set with regard to the requirements of the European Commission mentioned in the programming document and with regard to the Energy Efficiency Directive in relation to the eligibility of energy savings. Below is a link to the second call of the Energy Savings Programme, including annexes. https://www.mpo.cz//cz/podnikani/dotace-a-podpora-podnikani/oppik- 2014-2020/vyzvy-op-pik-2016/uspory-energie---ii--vyzva--222707/

[15] The maximum installed capacity of a photovoltaic system is 30 kWp, which must be placed on a roof structure or perimeter wall of one building attached to the ground by solid foundation and recorded in the land registry.

[16] The maximum annual generation of electricity and heat from high-efficiency CHP should correspond to the annual consumption of electricity and heat of the undertaking concerned.

Regional application	Improvements in the energy performance of the business sector, and the broader use of energy services in all regions of the Czech Republic, excluding the City of Prague.

Target group	Business entities (small, medium-sized and large enterprises) for interventions in the field of energy savings (thermal insulation of production and business structures), also agricultural entrepreneurs, food businesses and retail organisations

Projects targeted at end users	The main objective is to promote competitiveness of businesses and the sustainability of the Czech economy by reducing the energy intensity of the business sector. The above measures will be carried out either separately, or as a set of several measures (comprehensive projects) based on recommendations arising from an energy audit. Eligible expenses include only the investment costs of measures that lead to energy savings (construction costs, acquisition of technology, preparation of project documentation and energy assessment, etc.). The determination of eligible costs (hereinafter referred to as the 'EC') is in accordance with Articles 38[17] and 49 of Commission Regulation (EU) No 651/2014 of 17 June 2014. Funding rate ranges from 30%, 40% and 50% of eligible costs, depending on whether it is a large, medium-sized or small enterprise. The minimum grant is CZK 500 million. The maximum grant is CZK 250 million according to the first and second calls.

Effectiveness	This measure is highly effective because investments are channelled comprehensive projects to promote increased energy efficiency in industry.

Service life	This is a measure with a service life of 10 or more years.

[17] If the EU specifies an obligation to implement mandatory standards whose validity is known upon the submission of the full application, a benchmark variant will have to be applied to determine the eligible costs. The benchmark variant is determined by subtracting the investment costs necessary for achieving these mandatory EU standards from the total investment costs of the submitted project in the full application. This difference will be the eligible cost. Where there is no valid EU legislation requiring compliance with standards on submission of the full application, no benchmark variant is required.

Monitoring, verification, methodology for establishing energy savings and additionality	The Operational Programme Enterprise and Innovation for Competitiveness will follow up on the Operational Programme Enterprise and Innovation 2007-2013. The programme also anticipates the introduction of financial engineering instruments. A required annex to a full application according to the first call is an energy assessment which, according to the applicable legislation that came into force on 1 July 2015, will be required for the feasibility assessment for the grant pursuant to Section 9(1)(e) of Act No 406/2000 on energy management (hereinafter referred to as the 'Act'), as amended, drawn up specifically by the aid provider to take account of the requirements of the support programme. The energy assessment quantifies savings that will also be used to evaluate the project within the selection criteria methodology. These savings are specified in the grant terms signed by the applicant and the grant manager of the Ministry of Industry and Technology. The energy savings under the OP EIC will be evaluated within a separate evaluation of individual implemented projects. The evaluation of each project will precisely quantify the energy savings according to the energy carrier. The energy savings calculated in this manner will be clearly quantified in terms of composition, durability, and the technology used. This way, additionalities will be clearly controlled separately for each project under OP EIC and the overall additionality as a whole will therefore be respected for OP EIC. The reporting of energy savings under the OP EIC will be conducted ex ante. The beneficiary contractually undertakes to implement energy savings according to the approved project. Another ex post verification will be conducted once every five years in the form of an ex post energy assessment.

Measure number 2.2	**1.15**

TITLE OF THE MEASURE	**ENERG Programme to support the achievement of final energy savings in the small and medium-sized enterprises sector.**

Sector	**industry & services**

Brief summary	This programme of the Ministry of Industry and Trade is focused on the provision of soft loans for the implementation of projects improving energy performance. The administrator of the financial instrument is the Czech-Moravian Guarantee and Development Bank.

Description of the measure	The ENERG Programme is a pilot financial instrument aimed at supporting the achievement of final energy savings in the small and medium-sized enterprises sector. The purpose of the programme is to provide soft loans for the implementation of projects to improve energy performance and use renewable energy for own consumption by small and medium-sized enterprises operating in the City of Prague. The objective of the programme is to facilitate access by small and medium-sized enterprises in the City of Prague to funding for projects aimed at reducing the energy intensity of their activities in order to achieve energy savings in final consumption, thereby contributing to increasing their competitiveness in line with the European Union's environmental policy for sustainable development. The programme plugs an existing gap in the funding of energy saving projects for businesses operating in Prague. The programme is funded from the proceeds of selling emission allowances and is expected to be launched during the first half of 2017. <u>The main activities supported by this programme are:</u> • improving the energy efficiency of economic activities; • increasing the energy efficiency of buildings (reconstruction of distribution systems, modernisation of energy sources, insulation and replacement of doors and windows etc.); • generation of energy from renewables for own use; • introduction and modernisation of measurement and regulation systems associated with the introduction of an energy management system.

Regional application	City of Prague

Target group	Small and medium-sized enterprises

Effectiveness	It is a supplementary but very effective tool that opens up the possibility of applying financial instruments to promote energy efficiency.

Service life	10 and over

Monitoring of the benefits of the measure	The supported entity must have a verifying energy assessment drawn up with the scope set out in Section 9a(1)(f) of Act No 406/2000 on energy management. The verifying energy assessment must set out the final energy consumption values achieved by the grant beneficiary during any 12-month period after the expected date of completion of the implementation of the project so that it is possible to determine whether the final energy savings were achieved by the beneficiary as a result of the implementation of the project.

Measure number 2.2	1.16

TITLE OF THE MEASURE	The Reasonable Energy Savings Programme

Sector	cross-cutting measures

Brief summary	The aim of the programme under the auspices of the Ministry of Industry and Trade is to foster the development of awareness about the benefits of energy savings, and to stimulate the development and preparation of high-quality energy-saving measures without using investment funds

Description of the measure	The Reasonable Energy Savings Programme is focused on the promotion of successful energy-saving projects, and thus has the potential to create an environment that will facilitate the development of the awareness and stimulate the development and preparation of high-quality energy-saving measures, without using investment funds in the public and private sectors. Under the programme, a register will be established of implemented measures to promote energy savings and their benefits in those cases where no support was used under operational or national grant programmes for the reduction of energy consumption. A website is created in which it will be possible to register implemented energy-saving projects (www.usporysrozumem.cz). Registered projects must comply with quality requirements and the principles of good practice. Projects can be registered if they are well-implemented and satisfy the qualitative elements specified in the programme. After implementation, such projects can be awarded a **certificate of quality,** along with the possibility of using the quality mark with the programme's logo. After the registration of at least ten projects that bear the quality certification and in which the energy services provider has actively participated as the project quality guarantor, such a provider may be granted the designation of a high-quality energy services provider. This may bring the company a competitive advantage on the market.

Regional application	This measure can be applied throughout the Czech Republic.

Target group	owners of single-family buildings, multi-family buildings, public-sector buildings and business-sector buildings

Effectiveness	This is a very effective tool for the preparation and implementation of high-quality comprehensive solutions with an emphasis on a combination of energy-saving measures that will 'pay the investor dividends'.

Service life	The measures will mainly have a service life of 10 or more years.

Monitoring of the benefits of the measure	After each project has been implemented, the means of implementation and, in particular, the quality of the installed measures will be verified in order to be able to grant a quality certificate with the option of using the quality mark with the programme's logo.

Measure number 2.2	1.17

TITLE OF THE MEASURE	**Additional alternative measures in the industry and services sectors, and the public sector – guarantor of the Ministry of Industry and Trade agreement**

Sector	**Industry, public sector, services**

Brief summary	Support for the implementation of additional alternative measures to increase energy efficiency in industry, services and the public sector

Description of the measure	Additional alternative measures will be aimed at reducing energy consumption and related emissions, or at increasing energy efficiency. The main advantage of possible additional alternative measures should be that they promote an active approach by industry towards better energy efficiency or towards addressing environmental protection issues. As part of the energy saving measures in the industrial sector, the State imposes an obligation to increase energy efficiency, and the industry proposes a potentially more convenient alternative method of meeting this obligation. Similar additional measures should be implemented in the public sector (regions, municipalities, cities) and should be primarily focused on supporting soft measures (training, information campaigns for self-government employees, education of people in the issues of energy efficiency and savings) and hard measures (support for the introduction of ISO 50001 standard, the implementation of energy management, EPC), and also on the possibility of introducing voluntary agreements. To encourage undertakings, energy efficiency will be incorporated into natural motivational incentives to change behaviour: • Economic benefits for undertakings (a cut in energy costs, lower charges for discharging pollutants); • Soft measures directly promoting energy efficiency in an industrial undertaking (education, assessments, audits, consulting, construction and design activities); • Replacement of regulation with voluntary commitments. In the case of self-government bodies, the greatest incentive is to save budget resources and the effort to improve the provision of public services by modernising and improving energy efficiency in their publicly co-funded and subordinate organisations: schools, social facilities, healthcare facilities, transport companies, etc. For this purpose, support may be provided for the following measures:

	• Support for the introduction of ISO 50001 standard • implementation of energy management • introduction of building information modelling (BIM) • EPC support • educating the public in the issues of energy efficiency and savings • access of municipalities to the Covenant of Mayors for Climate and Energy, and the drafting of the Action Plan on Sustainable Energy • introducing the Smart Cities agenda into municipal management and infrastructure As part of additional alternative measures, a whole range of variants are opening up in terms of how they can be implemented in practice. These variants differ in the scope and method of application.

Regional application	This measure can be applied throughout the Czech Republic.

Target group	Owners of industrial plants, industrial associations, Czech Confederation of Industry, Association of Building Entrepreneurs of the Czech Republic. Self-government bodies of the Czech Republic and their organisational units

Effectiveness	This measure has the potential to be effective as it increases public awareness about the importance of saving energy and thus contributes to enhancing the potential of other policy measures. The measure also encourages private entities to reduce energy consumption, and replaces regulations with voluntary commitments, which enhances the effectiveness of the system for achieving energy savings.

Service life	This is a measure with a service life of 10 or more years.

Monitoring of the benefits of the measure	The benefits of the measure will be monitored for each industrial undertaking and self-government unit. The entire programme will be monitored in depth and the benefits of the measure regularly published up to 2017.

Measure number 2.2	1.18

TITLE OF THE MEASURE	Operational Programme Transport

Sector	Transport

Brief summary	The aim of the operational programme under the auspices of the Ministry of Transport is to support an increase in energy efficiency in the rail transport sector.

Description of the measure	A central part of support for energy savings in rail transport under the Operational Programme Transport is the planned implementation of a long-term project to reduce electricity losses as a result of the transition from a direct current system to an alternating current single-phase system. Two electric traction systems dominate in the Czech Republic – the 3 kV direct current system and the 25 kV, 50 Hz alternating current single-phase system. Extent of electric traction systems in the Czech Republic: Total track length 9,459 km 3 kV direct current system 1,795 km 25 kV, 50 Hz alternating current single-phase system 1,382 km Total above electrified systems 3,177 km In the past, starting in 1957, 3 kV direct current system was the most important electrified system, usually on double-rail tracks. The first alternating operation was on the Plzeň – Blovice line, starting in 1961. Other lines were subsequently electrified. The result is that the total annual consumption for tracks electrified with the 25 kV system is roughly a third that of tracks electrified with the 3 kV system. In the case of the 3 kV system, the transmission capability is at a much lower level than in the 25 kV system. This results in limited performance of the vehicles and throughput capacity of the tracks.

	According to results, we have determined losses in the systems used: DC 3 kV ..... approx. 22.5% AC 25 kV, 50 Hz ..... approx. 35% In the case of the use of the modern AC traction power using power inverters or balancers, the average loss **drops to 1%**! This form of power is preferred.

Regional application	Northern Czech Republic (Ústí nad Labem, Central Bohemian and Prague, Hradec Králové, Pardubice, Olomouc, Moravian-Silesian and Zlín Regions)

Target group	Railway Infrastructure Administration, as an investor and future operator; train operators in particular will also benefit from the savings.

Effectiveness	This measure is effective since the investments are channelled into the reduction of losses in the operation of power systems and equipment using electric traction. The total cost for the 2017-2037 period will be CZK 58 billion, of which direct investment costs of the transition to AC traction will be **CZK 8.4 billion**. After transition to AC traction has been completed (estimate - 2037), the potential savings, including 6% for recuperation, are **241,745 MWh/year**

Service life	This is a measure with an unlimited lifetime, assuming regular maintenance and renewal.

Monitoring of the benefits of the measure	The benefits of the measure will be regularly monitored by individual track sections in which the electric traction power is to be changed. The energy benefits will be evaluated after the implementation of individual investment units. Expected implementation period: 2017-2037; the first section, Nedakonice-Říkovice, should be completed in 2019.

Measure number 2.2	1.19

TITLE OF THE MEASURE	Fulfilment of the strategic framework for sustainable development according to specified priority axes, priorities and objectives

Sector	cross-cutting measures

Brief summary	Support for the interdependence of sectoral and territorial measures to maximise synergies between the social, environmental and economic areas in order to accelerate the parameters of sustainable development.

Description of the measure	The aim of the measure is to provide a long-term (until 2030) stimulation framework for policy-making at the national, regional and local levels in order to minimise the negative effects of economic activities on human health and natural ecosystems; make effective use of resources; and unlock innovation potential aiming to create sustainable, green-friendly communities that ensure economic prosperity and enhance social cohesion. This framework includes a combination of instruments ranging from reinforced regulation to subsidy measures which, on super-departmental/super-sectoral cross-cutting basis, make it possible to find and implement appropriate measures in accordance with established priorities, priority axes, objectives and calls at the level of national, regional and local decision-making.

Regional application	The measure is implemented across the Czech Republic at a national level (public administration) as well as at a substantial regional level within autonomous local authorities and those with delegated powers.

Target group	All state administrative authorities and territorial self-governing authorities in the mixed model of territorial public administration, the whole private and public sectors and all citizens.

Effectiveness	The measure is a long-term strategic vision of sub-sectoral practical steps towards sustainability, defined as the mutual balance of economic, environmental and social forces. Its regularly updated subdivisions – currently comprising five priority axes – with a description of the main problems in the area concerned and proposed priorities and objectives that can be reported using clear, interdependent indicators ensure the immediate and long-term maximisation of efficiency, including cost and energy efficiency, regardless of related measures in other areas.

Service life	This is a measure with a service life that is generally 10 or more years.

Monitoring of the benefits of the measure	Benefits are monitored directly on the basis of the indicators specified below, which are an integral part of the strategic framework. The systematic accuracy and dynamism of the framework is then ensured by means of situational evaluation reports submitted to the Government every two years and the regular updating of the strategic framework every four years. Regular monitoring is carried out by designated state administrative authorities and territorial self-governing authorities, the results of which are reported in basic registers, information systems and consequently in data reported by Czech Statistical Office. Key energy efficiency indicators - Energy intensity of GDP (II.E) – GJ/CZK CZK - Consumption of primary energy sources (II.F) – PJ - Material consumption (II.H) – million tonnes, index - Transport intensity (II.D) – passenger-km per CZK 1,000, tonne-km per CZK 1,000 - Greenhouse gas emissions per capita and per unit of GDP (V.G) – tonnes of CO2 eq. per capita, kg CO2 eq. per CZK 1,000 - Ecological footprint (0.A) – global hectares per person

Measure number 2.2	**1.20**

TITLE OF THE MEASURE	**Promoting the ecodriving of cars**

Sector	**Transport**

Brief summary	The measure is at the preparation stage. It consists of support for ecodriving by car drivers through the introduction of regular free training.

Description of the measure	A number of sub-measures are involved that inform drivers and improve their habits while driving cars, leading to energy-efficient management, energy savings, improved safety and the smooth flow of traffic. The sub-measures are: • the creation of an ecodriving manual. Applicants for a driving licence will receive training on ecodriving as part of standard theoretical instruction. • the organisation of training (under the auspices of the Ministry of Transport) for drivers that will include ecodriving, following on from the ECOWILL project (http://www.uspornajizda.cz/usporna-jizda/), which responded to a Europe-wide information campaign under the slogan 'Looking for class A drivers' in 2007 and ran from May 2010 until April 2013 under the auspices of the Ministry of Transport of the Czech Republic. Twelve driving instructors and examiners will receive training focusing on teaching energy-saving driving.

Regional application	City of Prague

Target group	Natural persons

Effectiveness	This is an effective measure with low implementation costs.

Service life	30 years

Monitoring of the benefits of the measure	The estimate of energy savings is based on the average car consumption from the ODYSSEE database (http://www.indicators.odyssee- mure.eu). The potential saving is 1% of this value.

Measure number 2.2	**1.21**

TITLE OF THE MEASURE	**Organisation of ecodriving training for lorry and bus drivers**

Sector	**Transport**

Brief summary	The measure is at the preparation stage. It is an extension of regular training pursuant to Act No 247/2000 to include ecodriving training.

Description of the measure	Extension of the subject of regular training according to Act No 247/2000 to introduce training principles and practical ecodriving lessons. The obligation applies to drivers of C1, C1+E, C, C+E, D1, D1+E, D or D+E group vehicles who undergo regular training of 35 hours within five years of their licence entering validity. The Act imposes subjects to be taught: (a) the theory of advanced rational driving and the principles of safe and defensive driving, (b) the application of national and international legislation relating to road transport, (c) traffic safety and the ecological operation of the vehicle, (d) the provision of services and logistics, (e) the economic environment and organisation of the transport market, (f) the social and legal environment in road transport, (g) health risks and their prevention in road traffic, (h) the prevention and resolution of emergencies in road traffic. This would therefore be extension or clear definition of paragraph (c).

Regional application	This measure can be applied throughout the Czech Republic.

Target group	The target group for the measure comprises legal and natural persons in the transport sector.

Effectiveness	This is an effective measure with low implementation costs.

Service life	30 years

Monitoring of the benefits of the measure	The energy consumption of lorries and consumption of buses are taken from the ODYSSEE database (http://www.indicators.odyssee-mure.eu).

Measure number 2.2	**1.22**

TITLE OF THE MEASURE	**Support for the installation of cogeneration units**

Sector	**households, services, public administration**

Brief summary	Investment support for micro-cogeneration and small and medium cogeneration

Description of the measure	The aim of the measure is to provide investment support for cogeneration units. The measure will, among other things, contribute to an increase in the gas connections as yet unused, the development of a decentralised energy sector and, in some cases, improvements in air quality.

Regional application	This measure can be implemented throughout the Czech Republic.

Target group	Natural and legal persons

Effectiveness	The measure is effective due to the saving of primary fuel that is not consumed.

Service life	20 years.

Monitoring of the benefits of the measure	It is possible to monitor the benefits by monitoring the energy-saving projects supported by the programmes. It will only be possible to determine the amount of energy saved after the implemented projects have been analysed.

Measure number 2.2	1.23

TITLE OF THE MEASURE	Energy Savings Fund

Sector	Households, services, industry

Brief summary	A fund from which various forms of funding would be provided for measures to reduce energy consumption.

Description of the measure	The Energy Savings Fund is a potential measure for preparation and application. It is an instrument that is under consideration pursuant to Article 20 of the Energy Efficiency Directive. The fund should be an instrument for the application of different forms of financial instruments to support activities related to improving energy efficiency and possible technical assistance. In the optimal variant, the fund manager would be an entity within the existing state organisations. The Fund could be financed from multiple sources. The specific sources, however, are still a matter of debate. One option is to involve obligated parties who could use the Fund to meet their obligations under Article 7(1) by contributing each year to a national energy efficiency fund. However, the mechanisms and options must be specified after discussion with all potential stakeholders. However, there should be a condition that finances for which a rule would be established for depositing in a fund should not be used for another purpose in the future.

Regional application	This measure can be applied throughout the Czech Republic.

Target group	Natural and legal persons

Effectiveness	A financial instrument to support the implementation of measures aimed at increasing energy efficiency in different areas (e.g. industry, buildings, transport). If the model for the flow of funds and their use is set appropriately, greater efficiency of expenditure can be expected than in the case of direct grants.

Service life	Minimum of 20 years

Basis of calculation	Ex ante evaluation of the measure and the expected savings, with reference to the results of previous independently monitored energy measures of a similar nature.

Monitoring, verification, methodology for establishing energy savings and additionality	Monitoring of the benefits would be direct and based on specified indicators proposed during the preparation of the operation of the Energy Savings Fund in communication with all stakeholders.

Measure number 2.2	1.24

TITLE OF THE MEASURE	Support for construction in the Czech Republic relating to EE improvement and environmental protection in line with the strategy EU 2020 for smart, sustainable and inclusive growth

Sector	Households, industry, services

Brief summary	Support for construction which obliges private entities to voluntarily contribute to increasing energy efficiency and protecting the environment in line with the EU 2020 environmental strategy in relation to construction and use of new building materials and structures, technologies and technical equipment of buildings, including their systematic use.

Description of the measure	In private construction, allow preference for measures that are efficient in terms of construction and energy, and increase support for these from the providers of financial services used in the funding of private construction. Primarily, the measures may involve, for example, providing better credit conditions for projects increasing energy efficiency (possibly in combination with EPC) support for the preparation of an energy assessment, or commitments from construction companies and developers to carry out construction using more energy efficient technologies and materials.

Regional application	This measure can be applied throughout the Czech Republic.

Target group	(1) Entities involved in construction: - Property development (office buildings, shopping centres, multi-family buildings) - Housing cooperatives - Associations of owners of apartment units - Industrial companies - New construction of production plants in industrial zones

	(2) Providers of financial services to entities involved in construction - Banks - Mortgage centres - Investment funds (3) State administration and self-government bodies (4) Manufacturers of building materials and construction businesses

Projects targeted at end users	- provision of better credit conditions for projects increasing energy efficiency (possible combination with EPC); - support for the preparation of energy assessment; - commitment of construction companies and developers to carry out construction using more energy-efficient technologies and materials

Effectiveness	Support for construction in the Czech Republic that improves energy efficiency and environmental protection in line with the EU 2020 environmental strategy operates entirely outside the private construction sector in the Czech Republic, but clearly targets a conscious and maximum increase in energy efficiency in construction in the Czech Republic across all the entities involved so as to clearly show the possibility for construction businesses to use this measure.

Basis of calculation	• Direct data of entities involved in the building construction code increasing EE (energy assessment and audit, BEPC, statistical data and measurement) • Annual reports: Czech Statistical Office • Number of loans granted under the code • Union of Bohemian and Moravian Housing Cooperatives • Association of Building Entrepreneurs • Confederation of Industry of the Czech Republic • Population and Housing Census, Czech Statistical Office • Normative requirements and legislation

Service life	This is a measure with a service life of 15 or more years.

Monitoring of the benefits of the measure	To monitor the benefits of measures, use will be made of energy assessments, energy performance certificates of buildings and statistical data combined with scaled savings in which technical and engineering estimates are used based on the number of renovated structures. Entities involved in construction in the Czech Republic will ratify in 2016-2017 the Support for the construction sector in the Czech Republic in improving energy efficiency and environmental protection in line with the EU 2020 environmental strategy. Based on the final text of the support and in relation to the final conditions, the prediction of the potential amount of energy savings and the methodology of their reporting will be further specified. According to the final text of the support, in the next NEEAP this chapter will be updated to include specific performances, methodology calculation and reporting, and energy savings reporting.

Measure number 2.2	1.25

TITLE OF THE MEASURE	Programmes supporting research and development

Sector	Industry, services

Brief summary	Support for projects under scientific research and development programmes, the results of which directly or indirectly lead to energy savings.

Description of the measure	The aim of the measure is to increase energy savings through support for projects under scientific research and development programmes, increasing the energy efficiency of production, and support for programmes aimed at research and development with the subsequent transfer of knowledge into practice. The measure includes support for applied research, experimental developments and innovation that contribute directly or indirectly to energy saving.

Regional application	This measure can be implemented throughout the Czech Republic.

Target group	The specialist scientific community, research institutions and private companies in all sectors.

Effectiveness	The measure is effective in terms of the long-term need to constantly develop new improved technologies to enhance energy efficiency, and to create the necessary space for the use of these technologies as one of the fundamental elements of stable and sustainable environmental policy of the Czech Republic and the EU.

Service life	The service life of research is difficult to predict – it includes both events with longer life, e.g. the research results and their application in practice, and effects with a much shorter life, such as conferences, seminars etc.

Monitoring of the benefits of the measure	It is possible to monitor the benefits by extending the monitoring to include energy-saving projects supported by the programmes. It will only be possible to determine the amount of energy saved after the projects implemented in the relevant programmes have been analysed. Other possibility for monitoring is indirect and based on the dissemination of information on opportunities for energy savings in scientific research (conferences, seminars, technical literature and publications).

Measure number 2.2	**1.26**

TITLE OF THE MEASURE	**Summary of measures to increase the energy efficiency of agricultural plants**

Sector	**farming**

Brief summary	Reduction in energy intensity in agricultural production.

Description of the measure	This measure combines a legislative instrument with grant funds in agricultural production. Energy savings can be achieved by means of the following measures: • renovation and construction of buildings including improvements to their insulation • purchase of new technologies, which are normally more energy-efficient and better sized to current business needs • modernisation of ventilation, including recuperation of heat and cold • installation of more efficient lighting • use of cogeneration in the local production of electricity and heat • more energy-efficient road and non-road transport and machines • control systems and ICT systems

Regional application	This measure can be implemented throughout the Czech Republic.

Target group	agricultural and forestry holdings

Effectiveness	Part of the measure will result in direct energy savings; the use of renewable sources does not in itself reduce energy consumption - it only crowds out non-renewable sources.

Basis of calculation	The basis of calculation is the total consumption of fuels and energy in agriculture according to Czech Statistical Office methodology. The estimated annual savings achieved as a result of a combination of legislative measures and the influence of subsidy funds in agricultural production. These savings range from 0.35 % to 0.8 % annually between 2008 and 2016. The lower rate of savings in the first AP can be attributed in part to the financial situation in agricultural holdings and a lack of investment in energy savings, the replacement of technology, or use of RES. Of the total consumption, we forecast savings of 4.78% as of 2018.

Service life	This is a measure with a service life that is generally 15 or more years.

Monitoring of the benefits of the measure	Considering the comprehensive nature of the measure, its benefits can only be monitored indirectly by reference to statistics.

Annex 3

MINISTRY OF
INDUSTRY AND TRADE

Drawn up and published in connection with Czech Government Resolution No 923 of 4 December 2013, Resolution No 1085 of 22 December 2014, and Resolution No 215 of 16 March 2016

Methodology for reporting energy savings achieved by means of alternative policy measures

pursuant to Article 7(9)
of the Energy Efficiency Directive (2012/27/EU).

Methodology for reporting energy savings achieved by means of alternative policy measures pursuant to Article 7(9) of the Energy Efficiency Directive (2012/27/EU)

1. Introduction

In accordance with Article 7 of Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (hereinafter referred to as the 'Directive'), the Czech Republic has set a national target for new energy savings in final consumption currently amounting to 50.67 PJ in 2020 (cumulative), which is equivalent to an annual saving in final consumption of 7.24 PJ. When setting this target, the option was used of reducing the national target by 25% in accordance with Article 7(2) and (3) of the Directive. To meet this target, an alternative approach was chosen to the obligatory scheme pursuant to Article 7(1) of the Directive, based on the adoption of policy measures so that the volume of new energy savings achieved under this approach corresponds to the volume of energy savings according to the obligatory scheme.

On the basis of Czech Government Resolution No 1085 of 22 December 2014, an update to the National Energy Efficiency Action Plan (hereinafter referred to as the 'NEEAP') was drawn up and submitted to the Czech Government following on from the completion of the process of approving programmes financed by the European Investment and Structural Funds. The updated NEEAP was approved by the Government on 16 March 2016 in Resolution No 215.

2. Basic Information

The alternative base scenario

The main alternative policy measures (the 'alternative scheme') include, in particular, **support programmes financed by the European Investment and Structural Funds** (for both the 2007-2013 period and, especially, the 2014-2020 period), revenue from emission allowances auctions under the European Emission Trading System, and other national resources.

For these programmes, which are run by a number of different departments of the Government and Prague City Hall, a uniform approach must be adopted, pursuant to Article 7(6) of the Directive, to the reporting of energy savings, including the control of savings calculations and verification of the reported energy savings values. The calculation of achievable energy savings must consistent with the rules set out in points 1 and 2 of Annex V to the Directive.

The objective of this methodology is to focus on all of the following aspects: the calculation, control and verification of the energy savings achieved.

In addition to calculating the savings achieved from the support programmes, this methodology addresses the means of reporting savings under measures other than those supported in the operational and national programmes, such as measures relating to the implementation of projects in the form of the provision of energy services with a guarantee (Energy Performance Contracting), advice supported from public funds, and additional measures in the industry, services and public sectors.

1. Principles of reporting according to the Directive

The volume of energy savings that can be calculated for individual measures is determined by the Member States on the basis of one of the established methods for calculating deemed, metered, scaled and surveyed savings. All policy measures must comply with the principles referred to in points 1 and 2 of Annex V to the Directive.

At present, the deemed and scaled savings method is used for the energy efficiency obligation. Different methods can be used for different measures and its choice depends on the type of measure it is to be used with:

- ✓ For measures for which there exist independently proven or already-established energy savings standards, the Member States will be able to use the deemed savings or scaled savings method based on technical and engineering estimates. Scaled savings should specifically be determined 'on the basis of nationally established methodologies and benchmarks by qualified or accredited experts that are independent of the obligated, participating or entrusted parties involved'.
- ✓ For energy savings resulting from changes in consumer behaviour, 'surveyed savings', determined on the basis of a consumer survey, are appropriate.
- ✓ For the remaining measures, savings will have to be metered, thus establishing the 'metered savings'.

The basic issue when setting the methodology for calculating energy savings is the eligibility of the reported savings pursuant to Article 7 of and Annex V to the Directive.

Under Article 7 of the Directive, energy savings can be reported if there exist alternative policies (such as financial and tax incentives and voluntary agreements) that speed up the introduction of, say, more efficient products, buildings, vehicles or services. In this case, full account can be taken of energy savings from individual measures in all policy measures other than those set out in Annex V, points 2

a) (a) and 3(a). For these specified exceptions, only energy savings exceeding the level defined on the basis of EU law can be included.

It follows that the above savings measures considered in the alternative schema described in the NEEAP, including improving the technical insulation properties of buildings, have 100% additionality, that is, they will lead to energy savings that can be reported in full if their introduction is accelerated by financial and tax incentives or voluntary agreements. Because of the wide range of grant headings introduced across sectors of the national economy, financial incentives are essential for the Czech Republic. Details are given in chapter 2.2 and 6.1 in the background document.

This document takes account of all requirements under the Directive describing the method for reporting energy savings.

Principles of eligibility of energy savings

The basic rules for being able to report alternative scheme energy savings are:

- the energy-saving measures are implemented as a result of policy measures,
- the reported energy savings are in accordance with the requirements of European legislation (according to Annex V to the Directive),
- the specific project was implemented between **1 January 2014 and 31 December 2020**.

The **saving of 'purchased energy'** is reported, that is, the difference between the final energy consumption before and after the implementation of the measure.

Energy-saving measures are implemented as a result of policy measures

In accordance with the provisions of Article 7 of the Directive, the required volume of energy savings is to be achieved through a national energy efficiency obligation scheme or other 'policy measures'. The policy measures must be designed with the aim of achieving 'energy savings' among 'final customers' (as set out in Article 7(1) and (9); these measures are defined as 'regulatory, financial, fiscal, voluntary or information provision instrument formally established and implemented in a Member State to create a supportive framework, requirement or incentive for market actors to provide and purchase energy services and to undertake other energy efficiency improvement measures' (Article 2(18)).

This definition excludes political measures intended to support policy objectives other than energy efficiency and energy services, and policies aimed at final energy savings that are not made among final customers.

The policy measures set out in the updated NEEAP satisfy this requirement, and the savings achieved under these measures can therefore be recorded and evaluated in order to report savings in achieving the target specified in Article 7 of the Directive.

Eligibility of savings compared to European legislative requirements

The combination of several policy measures can lead to the implementation of a single individual measure. Article 7(12) expressly states that, in such cases, energy savings stemming from that individual measure cannot be counted twice.

It can again be noted that the support programmes included in the alternative scheme as set out in the updated NEEAP meet the energy savings eligibility criterion.

When reporting energy savings, account must be taken lifetime of the savings. Annual energy savings achieved from the implementation of measure concerned until the end of 2020 can be included. The length of the savings lifetime is given in the NEEAP for individual policy measures with regard to the requirements of the Directive.

3. Overview of the instruments and methods for reporting energy savings for individual policy measures

Pursuant to Article 7(1), it can be stated that:

- the Directive does not precisely specify the range of data to be reported, but it does contain a transparency requirement;
- the volume of energy savings is determined by the parameter of final energy consumption;
- energy savings are calculated using the methods and principles set out in points 1, 2 and 3 of Annex V to the Directive,
- where feasible, the participating parties provide a report every year on the savings achieved and the development of energy savings.

The following overview of alternative policy measures provides a summary of the instruments used and forms for the reporting of savings by programme and project type.

Alternative policy measures in accordance with NAPEE are:

- Operational Programme Enterprise and Innovation for Competitiveness 2014-2020 (OP EIC 2014-2020)
- Operational Programme Enterprise and Innovation 2007-2013 (OP EI 2007-2013)
- Operational Programme Environment 2014-2020 (OP E 2014-2020)
- Operational Programme Environment 2007-2013 (OP E 2007-2013)
- Integrated Regional Operational Programme 2014-2020 (IROP 2014-2020)
- Integrated Operational Programme 2007-2013 (IOP 2007-2013)
- EFEKT Programme
- Panel Programme
- JESSICA Programme
- Clean Energy Prague Programme
- New Green Savings 2014-2020 (NGS 2014-2020)
- New Green Savings 2013 (NGS 2013)
- Green Savings 2009-2012 (GS 2009-2012)
- National Programme Environment

Other potential measures under consideration for achieving the objectives of the NEEAP in the future:

- Energy savings achieved using the EPC method
- Energy savings from the fulfilment of additional measures in the private sector, that is, the industry and services sectors, the public sector and the housing sector.

Overview of instruments for reporting savings by programme and project type

Programme / savings project	Form of support	Construction of new buildings to a high energy standard	Energy-saving renovations of existing buildings	Energy savings and increased energy efficiency in industrial processes and commercial services	Public lighting
OP EIC 2014-2020 Specific Objective 3.2, Energy Savings Programme	**Grant / financial instrument**	(A) Expert assessment based on an energy performance certificate	(B) Energy assessment	(B) Energy assessment	
OP EIC 2014-2020 Specific Objective 2.3, Real Estate Programme	**Grant / financial instrument**		(B) Energy assessment		
OP EI 2007-2013 Eco-energy Programme	**Grant**		(C) Energy audit	(C) Energy audit	(C) Energy audit
OP E 2014-2020 Priority Axis 5, Energy savings	**Grant / financial instrument**	(A) Expert assessment based on an energy performance certificate	(B) Energy assessment		
OP E 2014-2020 Specific Objective 2.1 Reduction of emissions from local household heating	**Grant / financial instrument**		(D) Independent entity report		
OP E 2007-2013 Priority Axis 3	**Grant**		(C) Energy audit		
IROP 2014-2020 Specific Objective 2.5 Improvement of energy performance in the housing sector	**Grant / financial instrument**		(A) Expert assessment based on an energy performance certificate		
IROP 2014-2020 Specific Objective 2.1 Improving the quality and accessibility of services leading to social inclusion	**Grant / financial instrument**	(A) Expert assessment based on an energy performance certificate	(A) Expert assessment based on an energy performance certificate		
IOP 2007-2013	**Grant**		(C) Energy audit		

OP PGP CR 2014-2020 Specific Objective 2.1 Energy savings in municipal structures	**Grant / financial instrument**	(A) Expert assessment based on an energy performance certificate	(B) Energy assessment		
EFEKT Programme investment measures	**Grant**			(B) Energy assessment	(B) Energy assessment
EFEKT Programme non-investment measures (ECIS, awareness-raising, seminars, training, publications	**Grant**	(D) Independent entity report	(D) Independent entity report	(D) Independent entity report	(D) Independent entity report
Panel 2013+ Programme (housing stock revitalisation programme)	**Soft loan**		(A) Expert assessment based on a simplified energy assessment		
JESSICA Programme	**Soft loan**		(A) Expert assessment based on an energy performance certificate		
Clean Energy Prague Programme	**Grant**		(D) Independent entity report		
NGS 2014-2020	**Grant**	(A) Expert assessment based on an energy performance certificate	(A) Expert assessment based on an energy performance certificate		
NGS 2013	**Grant**	(A) Expert assessment based on an energy performance certificate	(A) Expert assessment based on an energy performance certificate		
EPC-method energy savings	**Elimination of administrative barriers, uniform methodology, no edging out of support programmes**		(E) Energy services contract with guarantee	(E) Energy services contract with guarantee	(E) Energy services contract with guarantee
National Programme Environment (State Environmental Fund)	**Grant**				(B) Energy assessment

Energy savings from the fulfilment of additional measures	**Contribution beyond legal requirements**	(A) Expert assessment based on an energy performance certificate, (B) Energy assessment, (D) Independent entity report, (F) Report of the subject of an agreement – according to the programme's specifications
Other regional and local energy savings support programmes	**Grant / financial instrument**	For regional and local programmes, the methods for reporting savings will be used according to the conditions of the individual programmes

The Directive envisages that the Member States will report the benefits of the individual programmes on the basis of international standards, including technical and economic evaluations of the benefits of the energy efficiency programmes.

In the context of the evaluation of programmes, the Ministry of Industry and Trade requires a uniform method to be used for reporting savings to the EC. Given the diversity of the individual projects, from the partial insulation of a single-family building to measures at the scale of a large industrial complex, the specifics of each programme must be taken into account. For this reason, data collection has been divided into two parts: mandatory and specific data. Specific data are determined with regard to the scope of the applications submitted in the various programmes.

4. A uniform approach to means of reporting savings

This chapter describes the requirements for the collection of data from individual support programme managers. Data collection has been divided into two parts: mandatory and specific data. Specific data are determined with regard to the scope of the applications submitted in the various programmes.

In the case of smaller types of projects, the deemed savings method is proposed according to the methodology for drawing up building energy performance certificates (BEPCs). In the case of larger projects, and in the case of buildings for which it is difficult to prove the standardised use of the building, the initial state should be determined on the basis of actual consumption, that is, on the basis of an energy audit or energy assessment.

Regarding construction measures for buildings in the residential and public sector, the expected lifetime of a project (durability of energy savings, new buildings) is expected to be 40 years, and for business sector buildings, 15 years; and regarding technological measures for all buildings, the lifetime is expected to be 15 years unless another duration can be justified. If energy savings from construction and technological measures cannot be differentiated, or where this would cause too much of an administrative burden, the resulting lifetime of a project is calculated by means of an average weighted according to the investment share. Regarding the lifetime of savings, point 2(e) of Annex V to the Directive is followed when reporting energy savings.

Mandatory reporting of data

For support programmes under policy measures for the fulfilment of the objectives of Article 7 of the Directive, basic data on the registration of applications for financial aid are specified. This set of data is common to all such programmes. Details of the individual items are listed in the annexes to this document. The following project information is involved:

Identification of the facility

- **(a) Identification number of the programme** (ID)
- **(b) Status of the application**
- **(c) Project status**
- **(d) Type of applicant**
- **(e) ENEX number** (number of the document generated from records of the activities carried out by energy specialists)
- **(f) Grant programme**

(g) Number of the call within the grant programme used in which the application was submitted
(h) Project name
(i) Project subject
(j) Region of implementation
(k) Year of implementation
(l) Means of provision of support
(m) Project type
(n) Service life of the measure

Energy indicators

(a) Savings of total energy supplied (MWh/year)
(b) Primary energy savings (MWh/year)
(c) Energy reference area of the structure/building before project implementation (m2)
(d) Energy reference area of the structure/building after project implementation (m2)

Energy indicators

(a) Total investment costs of the project (CZK)
(b) Eligible costs (CZK)
(c) Amount of grant or other form of support (CZK)
(d) NPV – Net present value (CZK)
(e) Simple payback period (years)

The proposal for the means by which energy savings can be calculated if this indicator is not directly recorded in a submitted application is given in the relevant background document. Programme administrators can use this approach to determine energy savings. The method for calculating an indicator must be discussed with the department responsible for reporting energy savings in final consumption to the EC, that is, the Energy Efficiency and Savings Department of the Ministry of Industry and Trade.

For reporting energy savings to the Commission, the values of the main basic, highlighted indicators must be provided. If any data are not required by the provider and, therefore, are not available, the person authorised to collect data in the Energy Efficiency and Savings Department of the Ministry of Industry and Trade will provide information of this.

Specific reported data by type of documents appended to an application

These are data gathered beyond the framework of the mandatory information that is sufficient for reporting to the EC, but not for setting an energy efficiency strategy. In the case of a BEPC, in addition, these included the set of data necessary to calculate final energy consumption.

2. Expert assessment based on an energy performance certificate

Energy savings **from the renovation of existing buildings** are reported in comparison with the situation before renovation. Building energy performance certificates drawn up in respect of the situation before and after renovation are always used to calculate the savings achieved in the case of single-family buildings and multi-family buildings, and sometimes in the case of public and commercial buildings.

For new buildings with a high energy standard (e.g. passive), energy savings are reported in comparison to the legislative requirement for energy performance. The comparison is therefore with the requirements for new buildings under Act No 406/2000 and Implementing Decree No 78/2013. After the obligation of constructing nearly-zero energy buildings comes into being, the comparison will be against this level.

The BEPC, accompanied by other technical documents appended to an application, should be the source of the required data for calculating the final energy consumption within the following scope:

(a) Specific total supplied energy before project implementation (kWh/year)
(b) Specific total supplied energy after project implementation (kWh/year)
(c) Energy reference area before project implementation (m2)
(d) Energy reference area after project implementation (m2)
(e) Specific annual energy needs for heating before project implementation (kWh/m2 per year)
(f) Specific annual energy needs for heating after project implementation (kWh/m2 per year)
(g) Share of the i-th original source in heating (%)
(h) Efficiency of the i-th original source in heating (%)
(i) Share of the i-th new source in heating (%)
(j) Efficiency of the i-th new source in heating (%)
(k) Partially supplied energy for the preparation of hot water (KWh/year)
(l) Share of the i-th original source in the preparation of hot water (%)
(m) Efficiency of the i-th original source in the preparation of hot water (%)
(n) Share of the i-th original source in the preparation of hot water (%)
(o) Efficiency of the i-th original source in the preparation of hot water (%)

Based on the data collected on applications, the final energy consumption savings will be calculated as follows:

- $$\boldsymbol{Saving = EVP_p * m_{ptp} * \sum_{i=1}^{n} \frac{E_{ip}}{\gamma_{ip}} - EVP_n * m_{ptn} * \sum_{i=1}^{n} \frac{E_{in}}{\gamma_{in}} + S_{TUV} * (\sum_{i=1}^{n} \frac{E_{iptuv}}{\gamma_{iptuv}} - \sum_{i=1}^{n} \frac{E_{intuv}}{\gamma_{intuv}})}$$
- where: EVP_p … Original energy reference area of the structure (m2),
  - m_{ptp} … Specific annual energy needs for heating before the implementation of savings measures (kWh/m2),
  - EVP_n … New energy reference area of the structure (m2),
  - m_{ptp} … Specific annual energy needs for heating after the implementation of savings measures (kWh/m2),
  - E_{ip} … Share of the i-th original source in heating (%),
  - γ_{ip} … Efficiency of the i-th original source in heating (%),
  - E_{in} … Share of the i-th new source in heating (%),
  - γ_{in} … Efficiency of the i-th new source in heating (%),
  - S_{TUV} … Annual requirement of heat for the preparation of hot water (kWh/year)
  - E_{iptuv} … Share of the i-th original source in the preparation of hot water (%),
  - γ_{iptuv} … Efficiency of the i-th original source in the preparation of hot water (%),
  - E_{iptuv} … Share of the i-th new source in the preparation of hot water (%),
  - γ_{intuv} … Efficiency of the i-th new source in the preparation of hot water (%)

Where the installation of solar systems and biomass sources burning waste biomass demonstrably lead to a reduction in purchased energy among final consumers, that reduction can be considered to be an energy saving in final energy consumption. In this case, the coefficient for the share of new resources of this type is considered to be zero. The reporting of savings relates to the relevant department of the State Environmental Fund entrusted with communicating with the Ministry of Industry and Trade with regard to the deadlines for providing data as required by the Directive.

3. Energy assessment and energy audit

When reporting energy savings in cases where the document accompanying an application for support is an energy audit or an energy assessment, it is not necessary to calculate the final energy consumption. These documents, in their record sheets, contain all necessary information to the following extent:

(a) Savings in supplied energy across technical units (MWh/year)
(b) Savings in supplied energy according to energy carriers (MWh/year)
(c) Savings in total non-renewable primary energy (MWh/year)

As the record sheets of energy assessments and energy audits are collected on the registration system for energy specialists' documents, access to that system can be granted to support programme administrators on request in order to facilitate the reporting of the required data.

4. Independent entity report

A purchased energy saving is the difference between the final energy consumption before and after the implementation of measures.

Among other things, the report will contain a description of the types of projects implemented, the approach to the determination of the amount of energy savings for individual project types, their life cycles (durability of energy savings in the form of the service life of the measures), and a proposed method of verification of the energy savings achieved.

5. Energy services contract with a guarantee

In accordance with Article 18 of the Directive, the Czech Republic supports the provision of energy services by specifying particulars of energy supply contracts in Section 10e of Act No 406/2000 on management, as amended, by creating a list of energy service providers and by creating a methodology for the preparation of energy savings projects (Energy Performance Contracting). Therefore energy savings implemented using this method should be reported until the national target has been achieved by 2020.

The calculation of savings achieved uses the following rules:

6. Energy savings are reported that are specified and **guaranteed by a contract for the implementation of a project** for the provision of energy services with a guarantee in annual and overall terms.
7. The lifetime of an energy savings project (its durability) usually exceeds the term of the contract for the provision of energy services. The **length of the lifetime** will be reported in accordance with an expert estimate made by energy specialists or background documents drawn up for the beneficiary during the preparation of the energy services provision project.

In terms of the verification of achieved savings, these are reported in EPC projects according to a methodology that corresponds to the International Performance Measurement and Verification Protocol, IPMVP).

Reporting of savings will be based on a voluntary agreement between the Ministry of Industry and Trade and the Association of Energy Service Providers (AESP).

8. Report of the subject of an agreement

In accordance with Article 7(9) of the Directive, voluntary agreements are alternative policy measures and, at the same time, measures that go beyond legal obligations, and they are therefore measures that are eligible and count towards the achievement of the national target.

Voluntary agreements will be concluded between the Ministry of Industry and Trade on the one hand and entities that will achieve savings on purchased energy, on the other. Entities with a savings commitment can be private companies and public institutions.

An entity with a savings commitment reports purchased energy savings, that is, the difference between the final energy consumption before and after the implementation of measures.

The report will contain a description of the types of projects implemented, the approach to the determination of the amount of energy savings for individual project types, their life cycles (durability of energy savings), and a proposed method of verification of the energy savings achieved.

5. Process of reporting savings

Reporting of data by the entities concerned

A key institution in terms of the reporting of savings is the Ministry of Industry and Trade. The Ministry is in continuous communication with the European Commission and, in particular, it gathers the results of annual reporting of savings for the individual ministries and support programmes.

This document contains the range of data necessary to fulfil the obligation towards the EC. Also, the need for collaboration between the individual departments with regard to the Ministry of Industry and Trade stems from the document.
This fact is reflected in Government Resolution No 215 of 16 March 2016.Under the Resolution, the ministers for industry and trade, the environment and local development are to:

- **respect**, when administering support programmes financed from national and European funds and preparing calls for programmes, the need to channel financial support **effectively** to energy efficiency with a view to increasing the standard of living of Czech citizens, the competitiveness of the Czech economy and the energy security of the Czech Republic, promoting science and research in the introduction of energy- efficient technologies and innovations;
- effectively **use up**, by 31 December 2020, the allocated financial resources for operational and national programmes that are the basis of an alternative scheme pursuant to Article 7 of the Directive; ensure the maximisation of energy savings while adhering to the cost effectiveness of the financial support, collaborate in the

preparation and optimisation of individual calls relating to energy efficiency with Ministry of Industry and Trade and ensure the consistency of the implemented projects with the requirements of the Directive;

- **ensure** that sufficient data on the individual operational programmes are collected from applications for support for the purpose of the transparent reporting of final energy consumption savings to the European Commission so as to eliminate any risks to achievement of the 2020 energy savings target in the Czech Republic pursuant to Article 7 of the Directive;
- regularly **evaluate** energy savings support programmes in relation to the implementation of the alternative scheme pursuant to Article 7 of the Directive by firm deadlines, and to provide that evaluate to the relevant department of the Ministry of Industry and Trade responsible for setting strategy and providing information of progress made in energy efficiency, by **31 March and 30 September**.

The reporting dates are chosen with regard to Article 7(10)(j), which contains the obligation of annual publication of data on the year's developments in energy savings.

Method of verifying savings achieved

Every ministry, public administration body and entity with a savings commitment proposes means of verifying energy savings achieved and, after approval by the Ministry of Industry and Trade, performs verification.

For energy savings programmes in buildings, verification will be carried out on a sample of at least 5% of the supported projects if energy consumption after project implementation is not monitored for all projects. For energy savings achieved as part of EPC projects and additional measures, energy savings verification will be performed by an independent entity. In the case of energy savings reported from consultancy and awareness-raising, an external review of the report from the independent entity will be drawn up, which will determine the savings amount.

6. Contact

The contact person for the reporting of energy savings pursuant to Article 7 of the Energy Efficiency Directive and in accordance with this methodology is:

Ing. Vladimír Sochor
Director, Energy Efficiency and Savings Department

Ministry of Industry and Trade
Na Frantisku 32
110 15 Prague 1

sochorv@mpo.cz
+420 224 852 941
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Annex 1

I IDENTICATION DETAILS OF THE PROJECT – mandatory

- **a. Identification number of the programme** (ID)
- **b. Status of the application**
  - ✓ Application for support submitted
  - ✓ Application for support registered
  - ✓ Application for support met formal requirements and acceptance conditions
  - ✓ Application for support did not meet formal requirements
  - ✓ Application for support did not meet substantive evaluation/risk analysis requirements
  - ✓ Application returned
  - ✓ Application withdrawn
- **c. Project status**
  - ✓ Project with legal act on the provision of support transfer
  - ✓ Project being physically implemented
  - ✓ Project in full physical and financial implementation
  - ✓ Project physically completed
  - ✓ Project physically completed by the Managing Authority
  - ✓ Project physically completed by the Ministry of Finance-Payment and Certification Authority
  - ✓ Project finally closed
  - ✓ Project suspended
  - ✓ Project not completed - terminated by the beneficiary
  - ✓ Project not completed - terminated by the Managing Authority
- **d. Type of applicant**
  - ✓ natural person
  - ✓ legal person
  - ✓ association of unit owners
- **e. ENEX number** (number of the document generated from records of the activities carried out by energy specialists)
- **f. Grant programme**
  - ✓ NGS
  - ✓ OP E
  - ✓ OP EIC
  - ✓ IROP
  - ✓ OP PGP
  - ✓ EFEKT
- **g. Number of the call within the grant programme used in which the application was submitted**
- **h. Project name**

i. **Subject of the project** – brief description of the project (maximum of 250 characters)

▪

j. **Region of implementation**
   - ✓ City of Prague
   - ✓ Central Bohemian Region
   - ✓ South Bohemian Region
   - ✓ Plzeň Region
   - ✓ Karlovy Vary Region
   - ✓ Ústí nad Labem Region
   - ✓ Liberec Region
   - ✓ Hradec Králové Region
   - ✓ Pardubice Region
   - ✓ Olomouc Region
   - ✓ Moravian-Silesian Region
   - ✓ South Moravian Region
   - ✓ Zlín Region
   - ✓ Vysočina Region
   - ▪

k. **Year of implementation**
   - ✓ 2014
   - ✓ 2015
   - ✓ 2016
   - ✓ 2017
   - ✓ 2018
   - ✓ 2019
   - ✓ 2020
   - ✓ 2021
   - ✓ 2022
   - ✓ 2023
   - ▪

l. **Provision of a grant**
   - ✓ ex ante
   - ✓ ex post
   - ▪

m. **Type of project** (pre-defined selection: category)
   - ✓ MEASURE 1 – Insulation of external walls, reconstruction of light envelope
   - ✓ MEASURE 2 – Insulation of a roof or loft ceiling
   - ✓ MEASURE 3 – Insulation of a basement ceiling, basement walls or floor
   - ✓ MEASURE 4 – Replacement of windows and doors
   - ✓ MEASURE 5 – Reconstruction of a heat source
   - ✓ MEASURE 6 – Reconstruction of a heat distribution system
   - ✓ MEASURE 7 – Regulation of heating
   - ✓ MEASURE 8 – Reconstruction (or decentralisation) of the preparation and distribution of hot water
   - ✓ MEASURE 9 – Reconstruction of a ventilation system, recuperation
   - ✓ MEASURE 10 – Reconstruction of a cooling system
   - ✓ MEASURE 11 – Reconstruction of lighting
   - ✓ MEASURE 12 – Installation of photovoltaic panels

- ✓ MEASURE 13 – Use of secondary sources
- ✓ MEASURE 14 – Use of waste heat from engine cooling
- ✓ MEASURE 15 – Installation of frequency converters
- ✓ MEASURE 16 – Energy management
- ✓ MEASURE 17 – Other
- ▪

n. **Service life of the project**

II – ENERGY INDICATORS OF THE PROJECT – mandatory

a. **Energy reference area of the structure before project implementation** (m2)
▪
b. **Energy reference area of the structure after project implementation** (m2)
▪
c. **Savings of total energy supplied** (MWh/rok)
▪
d. **Savings of total primary energy** (MWh/rok)

II – a) SAVINGS OF TOTAL ENERGY SUPPLIED – mandatory for energy assessment

a. **Savings across technical units** (MWh/rok)
   - ✓ heating
   - ✓ cooling
   - ✓ ventilation
   - ✓ humidity treatment
   - ✓ preparation of hot water
   - ✓ lighting
   - ✓ technology

b. **Energy savings according to energy carriers** (MWh)
   - ✓ Electricity
   - ✓ Heat energy supply system
   - ✓ Natural gas
   - ✓ Heating oil
   - ✓ Coal (black)
   - ✓ Coal (lignite)
   - ✓ Renewables
   - ✓ Other

II – b) SAVINGS OF TOTAL SUPPLIED ENERGY – <u>mandatory for building energy performance certificate</u> (BEPC)

a. **Energy performance class before project implementation**
   - ✓ A
   - ✓ B
   - ✓ C
   - ✓ D
   - ✓ E
   - ✓ F
   - ✓ G

b. Energy performance class after project implementation

- ✓ A
- ✓ B
- ✓ C
- ✓ D
- ✓ E
- ✓ F
- ✓ G
- ▪

c. Specific total supplied energy before project implementation (kWh/rok)

- ▪

d. Specific total supplied energy after project implementation (kWh/rok)

III. ECONOMIC INDICATORS OF THE PROJECT – mandatory (d. and e. if available)

a. Total investment costs of the project (CZK)

- ▪

b. Eligible costs (CZK)

- ▪

c. Grant amount (CZK)

- ▪

d. NPV – Net present value (CZK)

- ▪

e. Simple payback period (years)

Annex 4

BUILDING RENOVATION STRATEGY

IN ACCORDANCE WITH ARTICLE 4 OF THE ENERGY EFFICIENCY DIRECTIVE (2012/27/EU)
UPDATED DECEMBER 2016

STRATEGY FOR ADAPTING BUILDINGS TO CLIMATE CHANGE ADDED

1. Introduction

Energy-saving building renovation is an opportunity for the Czech construction industry and energy sector. The implementation of the strategy will generate new jobs, especially among small and medium-sized enterprises, across the country. It can also enhance the comfort of housing and use of buildings. Households, institutions and undertakings will have higher disposable resources to purchase non-energy services and goods. Energy-efficient construction can significantly contribute to the growth of the Czech economy, depending on the leverage of public funds achieved. A fundamental consequence of high-quality building renovations is the saving of energy, and therefore less fossil fuels need to be used, leading to less local pollution, reduced greenhouse gas emissions, and greater energy security.

This strategy seeks out opportunities for a cost-effective approach to building renovation. Typically, it encompasses economically advantageous measures that also deliver long-term returns. A balance needs to be found between necessary initial investment costs and the benefits obtained, both on a microeconomic level (the building owner) and on a macroeconomic level (the state).

The document examines the building stock and opportunities for energy savings therein. It studies various scenarios for the renovation of the building stock, the costs and benefits thereof, and proposes policy, legislative and economic instruments to implement them. It focuses in detail on residential buildings. It has been possible to obtain high-quality statistics on this building stock and to classify measures leading to energy savings by type. This update now also includes data for non-residential buildings, that is, public and commercial buildings.

The document is a basis for the Ministry of Industry and Trade to prepare an updated report pursuant to Article 4 of the Energy Efficiency Directive (2012/27/EU) as part of the National Energy Efficiency Action Plan, but it can also be used for other national strategy documents in related areas.

Important sources of data for the preparation of this strategy were an updated survey of the residential building stock[18] and a newly drawn up survey of the residential building stock[19].

[18] Antonín J. 2016. Survey of the residential building stock in the Czech Republic and possibilities for savings in such buildings. Chance for Buildings for the Ministry of Industry and Trade.Available from: http://www.sanceprobudovy.cz/assets/files/Pruzkum%20rezidencnich%20budov%20v%20CR_SPB_13.12.%202016_verze33_final.pdf

[19] Antonín J. 2016. Survey of the non-residential building stock in the Czech Republic and possibilities for savings in such buildings. Chance for Buildings for the Ministry of Industry and Trade.Available from: Chances for buildings for the MPO.available from: Http://www.sanceprobudovy.cz/assets/files/Pruzkum%20nebytovych%20budov%20v%20CR_SPB_13.12.2016_verze24_final.pdf

2. Economic context

Promoting energy savings in buildings can have significant positive effects on the economy. According to studies carried out for the Ministry of the Environment and the Chance for Buildings alliance[20,21] CZK 1 billion of state investment in support programmes can produce a return back to public budgets of CZK 0.97-1.21 billion in income tax paid by companies and their employees, social and health insurance, and unpaid unemployment benefits. At the same time, it will induce GDP growth of CZK 2.13-3.59 million. These values reflected the situation during a crisis in which the crowding-out effect of public investments was small, but they correspond to the period until 2020 because a large part of the resources available for state investment in these programmes comes from external sources, in particular the European Structural and Investment Funds.

Total investment in energy-efficient renovation of buildings of CZK 40-45 billion a year, which is the estimated absorption capacity of the construction sector for this type of activity, could then lead to the induction of GDP up to +1% and the creation of roughly 35,000 jobs.

3 Background research for studies into the potential energy savings in buildings

Czech, European and global studies are carried out to determine potential energy savings. Each study presents several various scenarios of future consumption, each with a prediction for different years.

List of available studies:

- World Energy Outlook 2012, IEA:
- EU energy trends to 2030, update 2007, DG Energy
- EU energy trends to 2030, update 2009, DG Energy
- Outline of scenarios for the development of the Czech economy's energy demands, SEVEn – for the Independent Energy Commission, 2008
- Potential energy savings in buildings in the Czech Republic, Porsenna, 2013
- Study of potential energy savings in habitable buildings up to 2050, Porsenna, 2007
- Study of potential energy savings in the tertiary sector up to 2050, Porsenna, 2007

[20] Zámečník M., Lhoták T. 2012. Analysis of different means of allocating revenues from emission allowances auctions for the 2013-2020 period; Zámečník M., Lhoták T. 2012. Comparison of the macroeconomic impact of national programmes for increasing energy standards of buildings with other, state-funded alternatives, Chance for Buildings study; Analysis of the impacts and effects of allocating financial resources of the State Environmental Fund obtained from the sale of emission allowances to support programmes within its agenda, with an emphasis on the Green Savings Programme, State Environmental Fund study.

[21] Niedermayer L. 2012. Commentary on the study of the comparison of the macroeconomic impact of national programmes for improving the energy standards of buildings.Available from: http://sanceprobudovy.cz/images/docs/zamecnik_komentar_niedermayer.pdf

At must also be said that, in February 2017, the Czech Statistical Office published the results of Energo 2015, a statistical survey of the energy consumption and behaviour of households. For reasons of time, however, the results of that examination could not be incorporated into the strategy.

The updated building stock survey[1] defines potential energy savings for several selected scenarios relative to a baseline (benchmark) scenario. For example, the Efficient World scenario (WEO study, 2012) reports potential savings for the Czech Republic of 53 PJ in 2020 compared to the Current Policies scenario. Likewise, the Efficient World scenario reports potential of 87 PJ compared to the baseline scenario (Energy trends to 2030, 2007). The low scenario E (NEK study, 2008) reports potential of 52 PJ. The EKO scenario (Porsenna 2013) reports potential of 48 PJ and the TECH scenario (Porsenna 2013) reports potential of 74 PJ.

It can therefore be concluded that by 2020, given the effective setting of financial instruments and their use by target groups, it will be possible to save over 50 PJ on final energy consumption in residential and tertiary sector buildings. However, it should also be noted that all these studies envisaged the implementation of energy-saving measures before 2014.

4. Overview of building stock

This chapter reflects the requirement of the Energy Efficiency Directive under Article 4(a).

The basic source of statistical data on the building stock is the Czech Statistical Office. For single-family buildings and multi-family buildings, data was in particular obtained from the 2011 Population and Housing Census. For other buildings, data were obtained on the basis of a mandate from the Ministry of Industry and Trade.

4.1 Single-family buildings

The following tables present the numbers of buildings and apartments and the floor area of inhabited single-family buildings in the Czech Republic.

Table 1: Total number of single-family buildings in each category

Number of floors of the building	Total number of buildings [-]	Detached single-family building [-]	Semi-detached single-family building [-]	Terraced single-family building [-]
Total	**1,554,794**	1,163,655	133,877	257,262
	100.0%	74.8%	8.6%	16.5%
1	**584,075**	456,426	38,885	88,764
2	**861,774**	630,737	86,757	144,280
3	**45,995**	24,753	4,783	16,459
not determined	**62,950**	51,739	3,452	7,759

Table 2: Total number of dwellings in single-family buildings in each category

Number of floors of the building	Total number of dwellings [-]	Detached single-family building [-]	Semi-detached single-family building [-]	Terraced single-family building [-]
Total	**1,896,931**	1,417,272	170,847	308,812

	100.0%	74.7%	9.0%	16.3%
1	**638,573**	496,998	45,605	95,970
2	**1,115,606**	823,789	113,086	178,731
3	**72,404**	39,216	7,918	25,270
not determined	**70,348**	57,269	4,238	8,841

Table 3: Total internal floor area of single-family buildings in individual categories

Number of floors of the building	Total internal area of single-family buildings [m^2]	Detached single-family building [m^2]	Semi-detached single-family building [m^2]	Terraced single-family building [m^2]
Total	**194,957,505**	146,673,210	16,405,534	31,878,760
	100.0%	75.2	8.4	16.4
1	**59,426,442**	46,791,207	3,843,967	8,791,268
2	**122,834,323**	91,633,017	11,428,145	19,773,160
3	**7,941,825**	4,398,222	831,822	2,711,781
not determined	**4,754,915**	3,850,763	301,600	602,551

The method used to present the total internal floor area should be noted. The Czech Statistical Office's terminology distinguishes between 'total area of dwellings' and 'habitable area'. The habitable area is the sum of areas of in habitable rooms, while the total area is the sum of areas of all rooms in the dwelling. Therefore, in relation to the total internal floor area used as a matter of standard in calculations of the energy performance of buildings, the total area indicated in the statistics on the Czech Republic's housing stock is always smaller. In single-family buildings, the difference is the floor area taken up by partitions or shafts, and in multi-family buildings this difference also includes communal areas (corridors and staircases). The total internal floor area indicated in the tables is obtained for single-family buildings by adding 10% to the total area of inhabited dwellings (an estimate based on a survey carried out by the author of the background study). The energy evaluation pursuant to Implementing Decree No 78/2013 also includes the energy reference area. This area has not been taken into account in this strategy.

4.2 Multi-family buildings

The following tables present the numbers of buildings, flats and floor area of inhabited multi-family buildings in the Czech Republic.

Table 4: Total number of multi-family buildings in each category

NUMBER OF BUILDINGS [-]	construction period							
number of floors	total	1919 and before	1920-1945	1946-1960	1961-1980	1981-2000	2001-2011	not determined
	211,252	**26,077**	**27,775**	**30,573**	**71,429**	**38,042**	**12,674**	**4,682**
1 floor	**3,910**	1,199	612	473	556	526	488	56
2 floors	**37,708**	7,939	5,700	6,867	9,734	4,892	2,350	226
3 floors	**49,888**	7,714	8,909	11,226	12,154	6,209	3,420	256
4 floors	**48,000**	4,777	5,360	7,313	19,079	8,154	3,084	233
5 floors	**23,354**	3,175	3,905	2,916	8,573	3,203	1,452	130
6 floors	**10,192**	598	1,351	827	4,100	2,570	712	34
7 floors	**5,716**	138	838	272	2,780	1,337	330	21
8 floors	**15,259**	32	160	81	7,394	7,163	390	39

9 floors	**3,216**	0	16	12	1,852	1,226	101	9
10 floors	**700**	0	1	8	504	155	32	0
11 or more floors	**3,660**	0	15	21	2,397	1,134	88	5
not determined	**9,649**	505	908	557	2,306	1,473	227	3,673

Table 5: Total number of dwellings in multi-family buildings in each category

NUMBER OF DWELLINGS [-]	construction period							
number of floors	total	1919 and before	1920-1945	1946-1960	1961-1980	1981-2000	2001-2011	not determined
	2,416,033	**166,271**	**230,420**	**250,141**	**989,462**	**569,804**	**153,527**	**56,408**
1 floor	**18,466**	4,887	2,570	1,937	3,165	2,820	2,788	299
2 floors	**174,915**	34,391	25,014	31,127	45,086	24,281	13,697	1,319
3 floors	**324,604**	41,925	50,146	75,511	85,448	40,571	29,445	1,558
4 floors	**489,745**	37,579	46,586	70,586	204,713	89,104	39,189	1,988
5 floors	**310,593**	32,943	50,087	40,176	116,594	44,050	24,975	1,768
6 floors	**174,383**	7,365	22,427	14,894	69,256	44,733	15,209	499
7 floors	**115,119**	1,847	16,118	5,441	55,718	27,738	7,833	424
8 floors	**358,531**	468	3,279	1,671	174,960	167,842	9,475	836
9 floors	**81,354**	0	252	268	46,468	31,505	2,649	212
10 floors	**23,602**	0	8	276	16,536	5,570	1,212	0
11 or more floors	**183,950**	0	311	1,035	120,563	57,790	4,129	122
not determined	**160,771**	4,866	13,622	7,219	50,955	33,800	2,926	47,383

Table 6: Total interior floor area of multi-family buildings in each category

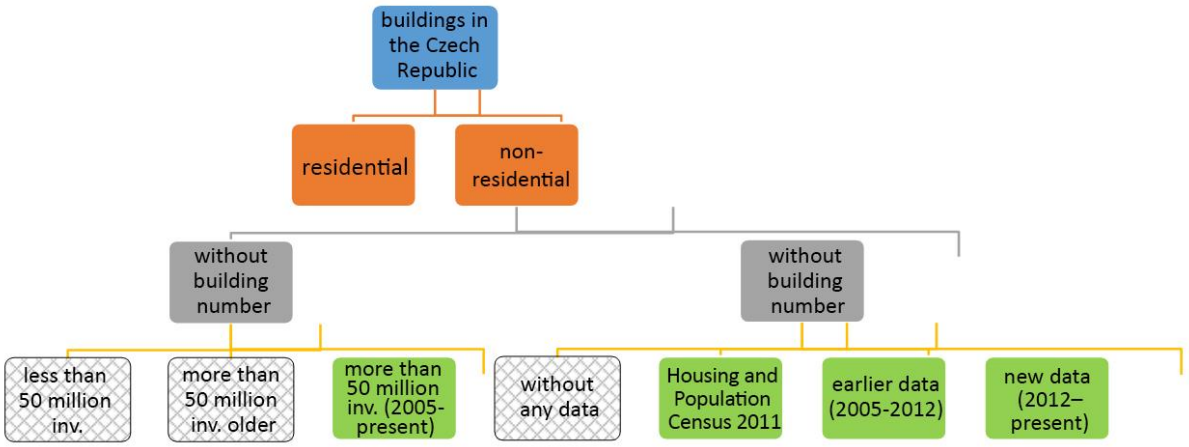
FLOOR AREA [thousand m^2]	construction period							
number of floors	total	1919 and before	1920-1945	1946-1960	1961-1980	1981-2000	2001-2011	not determined
	156,226	**10,161**	**14,202**	**15,657**	**64,518**	**38,943**	**9,435**	**3,310**
1 floor	**869**	227	112	90	159	132	138	11
2 floors	**10,516**	1,904	1,388	1,899	3,009	1,510	759	49
3 floors	**20,365**	2,495	3,080	4,636	5,723	2,639	1,716	76
4 floors	**31,535**	2,356	2,838	4,391	13,393	6,004	2,442	112
5 floors	**20,276**	2,191	3,146	2,649	7,627	2,961	1,613	90
6 floors	**11,691**	521	1,471	977	4,589	3,117	983	33
7 floors	**7,682**	136	1,121	362	3,587	1,940	508	28
8 floors	**24,517**	29	225	114	11,590	11,881	623	56
9 floors	**5,494**	0	17	18	3,046	2,238	161	13
10 floors	**1,534**	0	0	20	1,069	364	81	0
11 or more floors	**11,698**	0	20	62	7,492	3,877	240	8
not determined	**10,051**	303	783	441	3,236	2,282	172	2,834

The total internal floor area for multi-family buildings is determined by adding 15% to the total area of inhabited dwellings in multi-family buildings.

4.3 Other buildings

The scheme for the collection of statistical data on public- and commercial-sector buildings is given in the diagram below.

Figure 1: Scheme for the collection of statistical data on buildings



Buildings can primarily be divided into those with a building number (municipal or registration number) and those without. The municipal number is normally used with buildings for permanent use. The registration number is used for buildings that are not for permanent use. Furthermore, certain data are available in some cases for buildings that do not have a building number. These are data collected since 2005 for new buildings with investment costs exceeding CZK 50 million. Buildings have been identified in building authorities since about 1999-2000. Since 2012, identification has been based on the RÚIAN property register. It has only been for the last 10 years that all buildings that have been assigned a building number have been registered.

For buildings with a building number (that is, buildings that are expected to be used permanently), in the case of the Czech Statistical Office data given below, data are available from the three following sources:

- The 2011 People and Housing Census,
  - performed for every building containing at least one dwelling (in permanent use),
  - contains the following data for example:
    - type of building
    - type of owner:
    - period of construction or reconstruction
    - number of floors above ground.
- ‘Older data’ (for buildings built between 2005 and 2012)

    - contain the following data:
        - total floor space
        - number of floors in the building
        - type of building
- ‘New data’ (for buildings built from 2012 to date)
    - data aggregated from several sources
        - RÚIAN (Register of territorial identification, addresses and real estate)
        - Building authorities (code 3041, state 7-99)
    - contain the following data:
        - built-up area
        - floor area
        - number of floors in the building
        - type of building
    - approximately 20% of non-residential buildings have yet to be registered

The Czech Statistical Office keeps records of buildings in the service sector, in industry and in agriculture only if they have been assigned a building number. The numbers of such buildings are presented in the following table. The percentage of buildings in each category which are heated is also estimated. Based on the average floor area of buildings, where this is known, the total floor area of all buildings and of heated buildings is estimated. This information shows a much higher derogation than the information for the residential sector.

Table 7: Method of use of other buildings, estimated number of heated buildings and floor area

type of building/zone	symbol	total number of records		number of records with known floor area	floor area of buildings with known floor area	average floor area	estimated total floor area	
		[pcs]		[pcs]	[m²]	[m²/build.]	[m²]	
NON-RESIDENTIAL BUILDINGS		**613 134**		**24 816**	**16 639 423**	**671**	**251 195 155**	
administration	ADM	18 922	3%	1 109	2 698 403	2 433	39 399 657	16%
business	TRD	14 999	2%	2 101	3 414 115	1 625	19 885 124	8%
schools	SCH	12 564	2%	259	533 503	2 060	24 733 375	10%
hotels	HTL	8 899	1%	590	512 725	869	6 700 256	3%
culture	CULT	51 668	8%	1 594	1 086 095	681	34 014 464	14%
health care	HLT	1 906	0%	150	211 437	1 410	6 283 691	3%
athletic	SPORT	1 525	0%	262	307 156	1 172	1 621 623	1%
transport	TRA	356	0%	16	33 192	2 075	699 107	0%
industry	IND	19 067	3%	1 530	3 545 138	2 317	41 133 448	16%
warehouses	WRH	5 696	1%	719	1 399 854	1 947	6 518 995	3%
farming	COUNTRY	41 287	7%	1 486	463 734	312	12 960 790	5%
recreation	REC	289 281	47%	9 184	764 851	83	23 180 360	9%
garages	GAR	93 994	15%	3 261	267 673	82	6 062 821	2%
castles and chateaus	CSCHT	229	0%	1	680	680	155 720	0%
not specified	?	51 849	8%	2 468	1 304 083	528	27 247 377	11%
no energy consumption	-	892	0%	86	96 784	1 125	598 348	0%

5 Opportunities for energy savings in the building stock

This chapter reflects the requirement of the Energy Efficiency Directive under Article 4(b).

5.1 Calculation method for residential buildings

A detailed description of the procedure is given in the residential building stock survey[22]. The following steps have been taken:

a) For a matrix of 72 categories of buildings by age and size, the thermal insulation properties of the building envelope were estimated (the thermal transmittance coefficient for the main structures). The baseline document was the Tabula[23] project study, and the values were verified and clarified by reference to information from experts and companies based on experience. The percentage-based distribution of individual structures on the building envelope was estimated based on the author's survey of approximately 50 habitable buildings. The efficiency of heat sources, by fuel, was also considered to a certain degree in the calculations, again on the basis of expert estimates.

[22] Antonín J. 2016. Survey of the residential building stock in the Czech Republic and possibilities for savings in such buildings. Chance for Buildings for the Ministry of Industry and Trade.Available from: http://www.sanceprobudovy.cz/assets/files/Pruzkum%20rezidencnich%20budov%20v%20CR_SPB_13.12.%202016_verze33_final.pdf

[23] STÚ-K. 2011. Guide to the typology of habitable buildings: Tabula project output

b) The share of already renovated buildings was also estimated. For single-family buildings, this is 25%; for multi-family buildings it is 40% (55% of prefabricated multi-family buildings have been reconstructed). This was based on the author's own survey, estimates by consulting companies, the statistics of support programmes, the quantity of ETICS (contact insulation system) sold, and, for multi-family buildings, the PanelScan study[24]. Most of the renovated buildings have been considered in relation to the required values of thermal transmittance coefficients; for a minority, the recommended values under ČSN 730540 (2011) were considered.

c) The next step was to make use of the study author's own unique model[25] based on the stochastic principle. For each of the 72 categories, he creates 1 000 hypothetical buildings differing, within a set range, in their geometry, orientation, size and the thermal insulation properties of the building envelope. This method of modelling reduces the degree of derogation in the result compared to a procedure where there would only be one representative building for each category.

   The model was calibrated for the calculation so that the resultant values of final consumption (or the energy supplied at building level) were consistent with the actual statistics kept by the Ministry of Industry and Trade.

d) Two standards were defined as cost-effective standards for the renovation of buildings. The first is based on the recommended values of the thermal transmittance coefficient for structures under ČSN 730540 (2011) and the slightly improved efficiency of sources. Put simply, this entails a medium energy-saving renovation to a standard approaching the low-energy standard.[26]

   The second is based on the lower threshold of the range of passive values of the thermal transmittance coefficient according to the same standard; it achieves peak efficiency of heat sources and uses mechanical ventilation with waste heat recuperation. Put simply, this entails the thorough general renovation of a building to a standard approaching the passive standard.[27]

   These two defined standards are also based on calculations made by SEVEn for the Ministry of Industry and Trade when setting the cost-optimal level of requirements under the Energy Performance of Buildings Directive.

   For reference purposes, a shallow standard of renovation was also taken into consideration, for required thermal transmittance coefficient values with no improvement in the efficiency of sources.[28]

e) For the calculation of opportunities to save energy on space heating, the above-mentioned model was applied. For calculations of opportunities to save energy on the production of hot water and on lighting, simpler methods of calculation were applied, based on an investigation into opportunities throughout the building stock at the same time (i.e. not stochastically for individual building categories).

[24] CERPAD. 2009 Study of the condition of the housing stock of prefabricated buildings in the Czech Republic
[25] Optimisation of buildings. 2016. http://optimalizacebudovy.fsv.cvut.cz
[26] In English, for example, the corresponding term in Buildings Performance Institute Europe (BPIE) documents is 'moderate renovation'.
[27] The corresponding term in English is 'deep renovation'.
[28] The corresponding English term is 'shallow renovation'.

5.2 Modelling outputs for space heating

The resultant energy consumption and potential savings compared to the current consumption of the residential building stock can be found in the following tables.

Table 8: Model condition of building stock (current and after renovation), heat consumed on space heating

State of buildings	Indoor temperature considered	single-family building	multi-family building	Total
	[°C]	[PJ]	[PJ]	[PJ]
original state of buildings – model	temperature estimate*	138.6	72.1	**210.7**
consumption from heating – statistics from the Ministry of Industry and Trade	N/A			**172.1**
new state/standard of renovation considered:				
shallow renovation, required U values	18	111	49.2	**160.2**
moderate renovation, recommended U values	19	66	29.4	**95.4**
deep renovation, passive U values	20	21.9	10	**32**

For buildings in their original state, a lower average indoor temperature is envisaged during the heating period compared to the standard 20°C. The internal calculation temperature is envisaged differently for each age category and increases according to the growing insulation standard. For buildings in the 'required values' standard, 18°C is envisaged, for buildings in the 'recommended values' standard, 19°C is envisaged, and for buildings in the 'passive' standard, 20°C is envisaged. Therefore, the estimation of energy saving possibilities is rather conservative.

Table 9: Model condition of building stock (current and after renovation), heat consumed on space heating, saving

		Data of the Ministry of Industry and Trade, 2011	Renovation to recommended values	Renovation to passive values
Heat required for space heating	[GWh]	38,189	23,852	8,450
	[PJ]	137.5	85.9	30.4
Total efficiency (production, distribution, sharing)		80%	90%	95%
Heat consumed from heating	[GWh]	47,798	26,502	8,895
	[PJ]	172.1	95.4	32.0
Saving in the heat consumed from heating	[GWh]		**21,296**	**38,903**
	[PJ]		**76.7**	**140.1**
Saving on actual consumption – percentage	[%]		**45 %**	**81**

Therefore, the potential space heating energy savings for residential buildings are 77 PJ for moderate energy-saving renovation (45% of the original consumption) and 140 PJ for the deep renovation of the entire building stock to a passive standard (81% of the original consumption). This is the technical energy-saving potential. The relevant part of this technical potential that can be implemented on buildings that have not yet undergone energy-saving renovation is the economic potential. However, the full harnessing of this potential is hampered by numerous factors (the initial high investment costs, lack of information about suitable measures for the different types of buildings, etc.). In other words, it is not the market potential. The degree to which energy savings are implemented is discussed in chapter 7 together with the various building renovations scenarios.

5.3 Savings of energy on the production of hot water and on lighting

Much less information about the current situation is available for systems designed for the production of hot water and artificial lighting in residential buildings. However, as consumption here is lower in absolute terms than consumption on space heating, we can work with a lower level of accuracy.

Further to expert estimates based on the procedure set out in the background study, the following summary can be put forward:

The estimated potential savings in energy on the production of hot water are 12 PJ, i.e. approximately 30% of current consumption. Nevertheless, we can assume that less of this potential will be exploited if reconstruction is carried out to a poorer quality. In contrast, this potential may actually be exceeded following deep energy-saving renovation. It is then included in the calculation of investment costs together with the cost of replacing the source of heat used for space heating.

The estimated potential savings in energy on artificial lighting are 3.4 PJ, i.e. approximately 60% of current consumption. The whole of this potential is related to electricity consumption. The replacement of lighting is not included in the calculation of investment costs because this is treated as routine maintenance of dwellings and, furthermore, the price of the most efficient lighting is rapidly falling.

5.4 Consumption and total potential energy savings in the residential sector

For 2011, final consumption in households (the residential sector) was between 246 and 252 PJ (depending on the methodology), and approximately 40 PJ of that was energy consumed on domestic appliances.

The total potential energy saving in residential buildings is 92 PJ for moderate energy-saving renovation of the housing stock, and 155 PJ for deep building renovation. This estimate draws on the type of energy consumption included in the calculation of the energy performance of buildings in accordance with the Energy Management Act (Act No 406/2000) and the Implementing Decree on the energy performance of buildings (Implementing Decree No 78/2013). Therefore, this does not include energy consumed on domestic appliances.

It should be noted, again, that this is the economic rather than the market potential and as such it is only the hypothetically achievable potential of energy savings. Requirements to achieve a certain level of such potential and the scenario for the start-up of its implementation are discussed in chapter 7.

5.5 Calculation method for non-residential buildings

A detailed description of the procedure is given in the non-residential building stock survey[29]. The following steps have been taken:

[29] Antonín J. 2016. Survey of the non-residential building stock in the Czech Republic and possibilities for savings in such buildings. Chance for Buildings for the Ministry of Industry and Trade, available from: http://www.sanceprobudovy.cz/assets/files/Pruzkum%20nebytovych%20budov%20v%20CR_SPB_13.12.2016_verze24_final.pdf

a) A detailed analysis of possibilities for energy savings and their investment demands was made on a sample of 100 well-described buildings of varying size, age and type of use. Four variants of savings measures concerning the building envelope and savings measures concerning energy sources were then evaluated on the sample.

b) Also evaluated was a subset of 20 buildings for which actual energy consumption was available (for heating in particular) outside the energy model on the basis of energy invoices. From this, a comparison is then given of the calculation values according to the BEPC and the actual building consumption, and a correction factor is derived between calculated and actual consumption values depending on the building parameters selected. The background study thus provides key information on the future use of the whole BEPC data collection database to determine the real potential for energy savings. This correction is then applied retrospectively to the sample of 100 buildings.

c) Finally, statistical data from the non-residential building stock were collected in cooperation with the Ministry of Industry and Trade and the Czech Statistical Office. Based on data and an analysis of the sample of buildings, corrected to be closer to the real values, the conclusion of the study determined the potential energy savings for the non-residential building sector in the Czech Republic using several different variants of savings measures and scenarios. It also contains an estimate of the investment demands of the implemented measures and the energy savings achieved.

5.6 Modelling outputs for energy savings through envelope renovation

Given the nature of the proposed savings measures concerning, as a first step, building envelopes and the installation of forced ventilation with recuperation, the energy saving options below relate only to the heating component, that is, the supply of energy for heating.

Figure 1: Percentage savings of specific supplied energy for heating with correction – by floor area

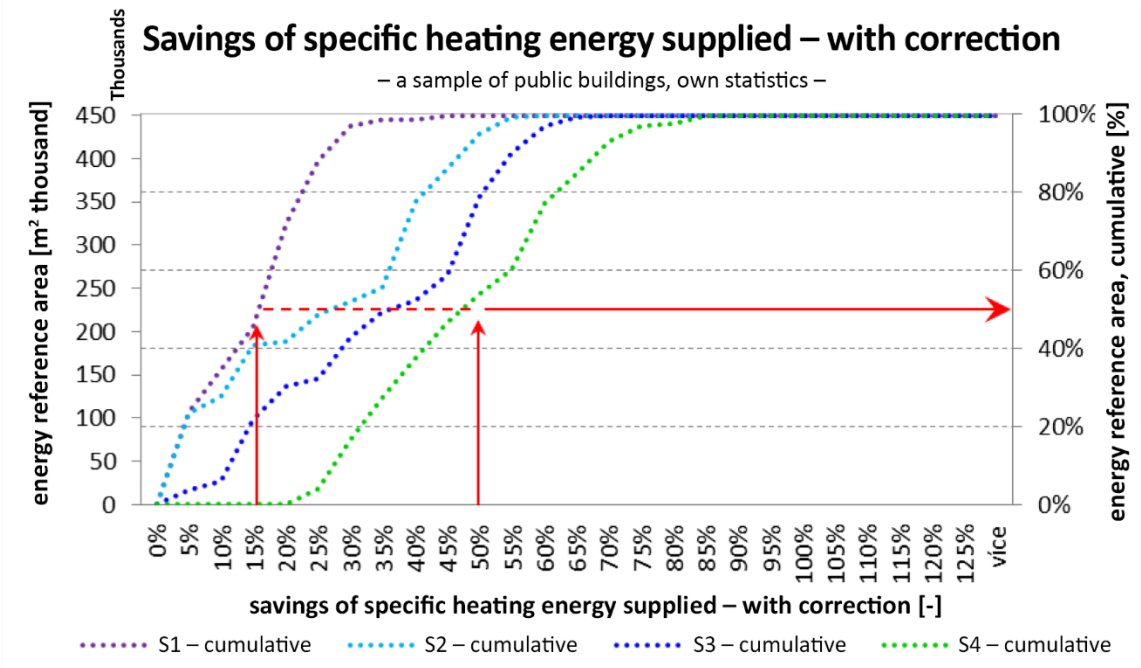


Table 11: Percentage savings of specific supplied energy for heating with correction – by floor area

savings of specific heating energy supplied – with correction						
	[kWh/(m^{2}a)]			[kWh/(m^{2}a)]		
status	min	average	max	min	average	max
1 – partial renovation	0	16	67	0%	15%	43%
2 – required values	2	30	132	1%	28%	56%
3 – recommended values	5	39	166	3%	36%	65%
4 – passive v. + recovery	13	53	189	20%	49%	84%

As stated in the above chapter on statistical data, the estimated total area of supplied records of non-residential buildings ('buildings' is deliberately not stated since it is not clear whether one record can encompass a complex of buildings) is 251.2 million m2. By subtracting categories that can mostly be considered to be unheated (the garages, castles and chateaux category and the 'energy-free' category) and, at the same time, assuming that 50% of the area of buildings in the warehouses, recreation and 'unspecified' categories are heated, we arrive at an estimated floor area of 215.9 million m2. The next step is to take into account the difference between the floor area according to statistical data and the energy reference area of 15%. For the determination of possible savings, the total building area is estimated at **248.3 million m^2**.

If we assume that buildings have the same structure as those in the evaluated sample of 100 buildings, including their initial state (that is, assuming that some of them have already undergone some renovation), savings that are economically interesting can be achieved in 50% of the energy reference area of buildings. The potential for energy savings from heating with complex and high-quality renovations is **32.6 PJ**. Another **10.5 PJ** can be saved through more expensive renovations of a further 30% of the energy reference area.

5.7 Modelling outputs for energy savings through changing source

Using a sample of buildings, an analysis was performed of installed capacities and individual types of heat sources for heating and hot water heating, broken down by to fuel. The analysis is based on the design heat loss of the buildings, with the distribution of heat sources being estimated according to the percentage coverage of energy demand for heating, based on the energy performance certificate. At the same time, the components of the annual energy consumption are determined, with the consumption broken down by fuel type. The decrease in the required output of the sources due to envelope renovation and the installation of ventilation with recuperation is about half (to 53%).

Table 20: Heat source output for a sample of 100 buildings related to floor area

heating source output related to floor area					
measure variant		min	average		max
cs – current state	[W/m^2]	30	81	100%	198
1 – partial renovation	[W/m^2]	24	67	83%	132
2 – required	[W/m^2]	17	51	63%	95
3 – recommended	[W/m^2]	15	45	56%	87
4 – passive	[W/m^2]	13	36	45%	71

Two options for changing source are also considered. In the case of district heating, it is envisaged that the existing source will be kept. In the case of a natural gas boiler room, the replacement of the boilers with new condensing boilers is envisaged, but only where condensing boilers are not already installed, of course. The replacement with new gas boilers will then account for approximately half of the total installed capacity of the existing gas boilers. If the existing source of heat for heating uses electricity (unless it is a heat pump, a therefore in most cases an electric boiler and, in a small number of cases, a direct heating or storage appliance), variant A envisages a transition to a heat pump. Due to limitations of earth-water pumps (especially in urban areas), replacement is envisaged with air-water heat pumps. Variant B then envisages a hypothetical case in which heat pumps replace all types of sources.

The total possible savings in variant A are set at **7.0 PJ** , and in variant B, at **34.3 PJ**.

5.8 Consumption and total potential energy savings in the non-residential sector

For 2011, final consumption was roughly 126 PJ in the service sector and 23 PJ in agriculture. Based on an analysis of consumption statistics, consumption outside buildings (e.g. the internal consumption requirement of heating plants and incinerators, as well as agricultural machinery) was deducted from these values, as were types of consumption not specified in the evaluation of the energy performance of buildings pursuant to the Energy Management Act (e.g. data centres and servers or the technological equipment of shops). **The final consumption on the operation of buildings in both of these sectors is estimated at 124 PJ.**

The potential for energy savings is the sum of the potential for savings using predominantly structural measures in appropriate parts of the building stock (cheaper energy savings, often in still-unrenovated or only partly renovated buildings, making up half of the floor area of existing buildings) of 32.6 PJ, the potential for savings in already-renovated parts of the building stock (another 30% of floor area, more expensive energy savings) of 10.5 PJ, and the potential for savings using technological measures in the range 7.0 PJ (better efficiency of sources while keeping the fuel mix) to 34.3 PJ (better efficiency and a hypothetical transition to heat pumps). **The overall potential for savings can therefore be set at 50.1 PJ to 77.4 PJ.** Note: In the previous version of this document, this was specified in less detail at 55 PJ.

6. Investment costs required for renovation

6.1 Investment in the renovation of the building envelopes of residential stock

The estimate of investment costs of renovating buildings to the various standards is based on the total cost per unit area of structure (perimeter walls, flat/sloping roof, windows and doors, flooring underground and/or above ground). In the model applied, the areas of the individual parts of the envelope are known for the entire building stock (indicated in the table separately for single-family and for multi-family buildings).

Costs are total costs including not only materials and labour, but also design work, the erection of scaffolding, the disposal of waste, etc. Some of these costs would have to be expended even in the absence of energy-saving renovation; this is neglected maintenance, which is subtracted from the estimate.

Table 10: Total investment in the renovation of the envelopes of single-family and multi-family buildings (recommended values), exclusive of VAT

RECOMMENDED STANDARD						
		PERIMETER WALLS	ROOFS	FLOORS	DOORS AND WINDOWS	ENVELOPE + PROJECT
area	[mil. m²]	279.0	217.4	192.8	84.9	774.1
specific cost of single-family buildings	[CZK/m²]	1,145	1,110	824	5,800	-
specific cost of multi-family buildings	[czk/m2]	1,278	1,026	824	5,800	-
cost of single-family buildings	[CZK million]	222.3	200.7	128.7	281.6	833
cost of multi-family buildings	[CZK million]	108.5	37.6	30.2	211.1	387
cost of single-family + multi-family buildings	[CZK million]	330.8	238.2	158.8	492.6	1,221
cannot be insulated – single-family buildings	[%]	5%	0%	60%	0%	-
cannot be insulated – multi-family buildings	[%]	10%	0%	20%	0%	-
essential investment – single-family buildings	[CZK million]	211.2	200.7	51.5	281.6	**776.0**
essential investment – multi-family buildings	[CZK million]	97.6	37.6	24.1	211.1	**385.2**
essential investment – single-family + multi-family buildings	[CZK million]	308.8	238.2	75.6	492.6	**1,161.2**
single-family building renovation share	[%]	25%				
multi-family building renovation share	[%]	40%				
investment after the deduction of single-family buildings	[CZK million]	158.4	150.5	38.6	211.2	582.0
investment after the deduction of multi-family buildings	[CZK million]	58.6	22.5	14.5	126.6	231.1
investment after the deduction of single-family + multi-family buildings	[CZK million]	217.0	173.1	53.1	337.8	813.1

Table 11: Total investment in the renovation of the envelopes of single-family and multi-family buildings (passive values), exclusive of VAT

PASSIVE STANDARD						
		PERIMETER WALLS	ROOFS	FLOORS	DOORS AND WINDOWS	ENVELOPE +PROJECT
area	[mil. m²]	279.0	217.4	192.8	84.9	774.1
specific cost of single-family buildings	[CZK/m²]	1,285	1,410	982	6,500	-
specific cost of multi-family buildings	[CZK/m²]	1,483	1,376	982	6,500	-
cost of single-family buildings	[CZK million]	249.4	254.9	153.4	315.6	973
cost of multi-family buildings	[CZK million]	125.9	50.4	35.9	236.5	449
cost of single-family + multi-family buildings	[CZK million]	375.3	305.3	189.3	552.1	1,422
cannot be insulated – single-family buildings	[%]	5%	0%	60%	0%	-
cannot be insulated – multi-family buildings	[%]	10%	0%	20%	0%	-
essential investment – single-family buildings	[CZK million]	237.0	254.9	61.3	315.6	**899.9**
essential investment – multi-family buildings	[CZK million]	113.3	50.4	28.8	236.5	**443.7**
essential investment – single-family + multi-family buildings	[CZK million]	350.3	305.3	90.1	552.1	**1,343.7**
single-family building renovation share	[%]	25%				
multi-family building renovation share	[%]	40%				
investment after the deduction of single-family buildings	[CZK million]	177.7	191.2	46.0	236.7	675.0
investment after the deduction of multi-family buildings	[CZK million]	68.0	30.2	17.3	141.9	266.2
investment after the deduction of single-family + multi-family buildings	[CZK million]	245.7	221.4	63.3	378.6	941.2

Total investment required in the renovation of the envelopes of single-family buildings is estimated at CZK 776 billion for the recommended standard and CZK 900 billion for the passive million.

Total investment required in the renovation of the envelopes of multi-family buildings is estimated at CZK 385 billion for the recommended standard and CZK 444 billion for the passive million.

These costs are less energy-saving renovations (put simply, insulation work) already carried out on single-family and multi-family buildings. Nevertheless, presumably even those buildings already insulated will need new renovation in the longer term (up to 2050). Although the investment costs of renovation are the same (or very similar) as for the renovation of a building that has not been insulated, the energy saving would be much lower. It is debatable whether such renovation would be cost-effective. This is discussed in chapter 7 concerning modelling scenarios.

The average cost of renovation of a building envelope is between **2,465 CZK/m2** and **4,616 CZK/m2**, depending on the type of building and quality of renovation: see the following table.

Table 12: The resulting specific investment for the renovation of the envelopes of single-family and multi-family buildings (by floor area)

		TOTAL INDOOR FLOOR AREA - AFTER DEDUCTING THE SHARE OF BUILDINGS THAT HAVE ALREADY BEEN RENOVATED				
floor area of the single-family building	[mil. m²]	146.22				
floor area of the multi-family building	[mil. m²]	93.74				
		RECOMMENDED STANDARD				
		PERIMETER	ROOFS	FLOORS	DOORS AND WINDOWS	ENVELOPE
specific cost of single-family buildings	[CZK/m²]	1,083	1,029	264	1,444	3,980
specific cost of multi-family buildings	[CZK/m²]	625	240	154	1,351	2,465
		PASSIVE STANDARD				
specific cost of single-family buildings	[CZK/m²]	1,215	1,308	315	1,619	4,616
specific cost of multi-family buildings	[CZK/m²]	725	322	184	1,514	2,840

6.2 Investment in the replacement of technology in the residential stock

The estimate of the investment cost required to renovate the technological facilities of buildings up to the recommended or passive standard is also based on unit costs. These include variable costs depending on the installed capacity of the technology, and fixed costs of the single-family or multi-family building. Again, the estimated costs are exclusive of VAT, but overall include all necessary action.

A certain mix of fuels and, hence, types of sources is also anticipated for each level of renovation. Considering that the financial cost of the different technologies varies, this is a major factor influencing the overall cost. It should therefore be treated merely as an estimate and as approximate.

Table 13: Determination of the total investment cost of renovating the technological facilities of a building, exclusive of VAT

Investment in the renovation of the technological facilities of a building (only the source of heat)								
type of heat source	recommended standard				passive standard			
	single-family building		multi-family building		single-family building		multi-family building	
	share	investment	share	investment	share	investment	share	investment
		[CZK million]		[CZK million]		[CZK million]		[CZK million]
Oil & Petroleum Products	0%	0.0	0%	0.0	0%	0.0	0%	0.0
Natural Gas	45 %	136.0	35%	84.7	40%	152.4	30%	83.6
Coal & Coal Products	5%	244.0	0%	0.0	0%	0.0	0%	0.0
Biomass	30%	244.0	5%	108.8	30%	231.7	10%	103.8
Heat*	5%	0.0	55%	0.0	5%	0.0	50%	0.0
Electricity*	5%	0.0	0%	0.0	5%	0.0	0%	0.0
Other (solar; heat pumps)	10%	305.0	5%	122.8	20%	280.4	10%	121.3
total	100	**177.10**	100	**41.23**	100	**186.56**	100	**47.57**
*Floor area [mil. m²]	194.96		156.23		194.96		156.23	
Specific investment [CZK/m2]	**908**		**264**		**957**		**304**	
total [CZK million]	**218.33**				**234.13**			
*Floor area [mil. m²]	351.18				351.18			
Specific investment [CZK/m²]	**622**				**667**			

Investment in the renovation of the technological facilities of a building (sources including forced ventilation in the case of the passive standard)					
		single-family building		multi-family building	
Investment in forced ventilation with recuperation			**200.30**		**157.00**
total		100	**386.85**	100	**204.61**
specific investment [CZK/m^2]		**1,984**		**1,310**	
total [CZK million]		**591.46**			
specific investment [CZK/m^2]		**1,684**			

The total investment required in the replacement of the technology of single-family is estimated at CZK 177 billion for the recommended standard and CZK 387 billion for the passive standard (including forced ventilation with recuperation).

Total investment required in the replacement of the technology of multi-family buildings is estimated at CZK 41 billion for the recommended standard and CZK 205 billion for the passive standard (including forced ventilation with recuperation).

6.3 Investments in non-residential sector buildings

The investment needed to achieve the theoretical potential for energy savings in public and commercial buildings can be estimated at CZK 764-1,156 billion when switching to heat pumps However, this estimate shows a relatively high error because the non-residential building stock sector is very heterogeneous. In addition to buildings similar to residential buildings (schools, offices) there are also buildings such as shopping centres and logistic halls.

7. Scenarios for the renovation of the residential building stock

This chapter reflects the requirement of the Energy Efficiency Directive under Article 4(d) and (e).

Scenarios for the renovation of the building stock in the Czech Republic were drawn up on the basis of outputs under the preceding chapters of this report by Buildings Performance Institute Europe (BPIE) using its own model. This chapter aims to assess the energy and economic impacts of the different scenarios for the renovation of the building stock in the Czech Republic.

7.1 Definition of scenarios

Five scenarios have been defined:

Scenario 1: Business as usual, with no new policy measures

Scenario 2: Fast but shallow renovation of the building stock

Scenario 3: Slow but, for energy purposes, deep renovation of the building stock

Scenario 4: Fast and deep renovation of the building stock

Scenario 5: Ideal hypothetical (3% deeply renovated buildings from 2017)

A description of the parameters of individual scenarios can be found in the following table.

Table 14: Description of the modelled scenarios

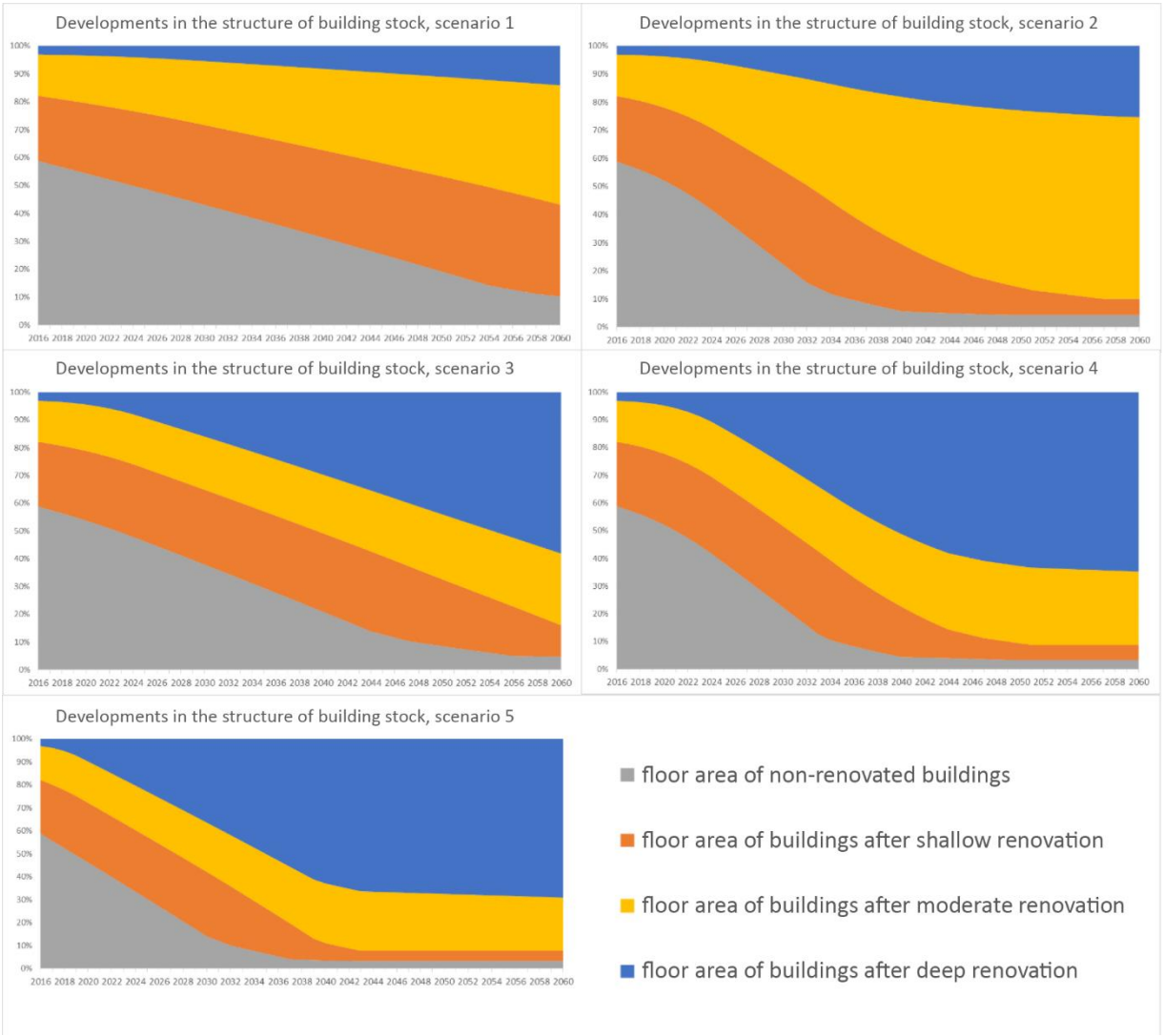
Description of the scenario	2016-2025	2025-2035	2035-2050
Scenario 1: Business as usual			
with no new policy measures			
percentage of buildings renovated per year	1%	1%	1%
share of shallow renovation	45 %	20%	20%
share of moderate energy-saving renovation	50%	55%	55%
share of deep renovation	5%	25%	25%
Scenario 2: Fast but shallow renovation of the building stock			
a higher percentage of renovated buildings, without progressive energy criteria			
percentage of buildings renovated per year	1->3%	3%	3->1.5%
share of shallow renovation	45 %	20%	20%
share of moderate energy-saving renovation	50%	55%	55%
share of deep renovation	5%	25%	25%
Scenario 3: Slow but, for energy purposes, deep renovation of the building stock			
the existing percentage of renovated buildings, criteria of energy-related deep renovation			
percentage of buildings renovated per year	1->1.5%	1.5%	1.5%
share of shallow renovation	45 %	5%	5%
share of moderate energy-saving renovation	50%	10%	10%
share of deep renovation	5%	85%	85%
Scenario 4: Fast and deep renovation of the building stock			
higher percentage of renovated buildings, criteria of energy-related deep renovation			
percentage of buildings renovated per year	1->3%	3%	3->1.5%
share of shallow renovation	45 %	5%	5%
share of moderate energy-saving renovation	50%	10%	10%
share of deep renovation	5%	85%	85%
Scenario 5: Ideal hypothetical			
3% deeply renovated buildings from tomorrow			
percentage of buildings renovated per year	3%	3%	3->1.5%
share of shallow renovation	5%	5%	5%
share of moderate energy-saving renovation	10%	10%	10%
share of deep renovation	85%	85%	85%

The scenarios are modelled for residential and office buildings. The above table presents a simplified view of the individual scenarios. These differ in the percentage of buildings renovated per year, as well as in the depth of renovation.

The fast scenarios 2 and 4 count towards 2025 with a gradual increase in the annual renovation rate to 3% (the ideal fast scenario 5 counts on this increase incrementally from 2017). With the slow scenario 3, the annual renovation rate would increase to only 1.5% over the same period, with the baseline scenario remaining at 1% for all periods. In all scenarios then, with the exception of scenario 1, the last period would see a drop in the percentage of renovated buildings per year because the renovation would have been completed of all buildings that entered the initial phase unrenovated (see below).

The scenarios with deep renovations of buildings (3 and 4) would increase the share of deep renovations to 85% in the first period, while scenario 5 counts on somewhat faster increase. The shallow renovation scenarios (1 and 2) would increase the shares of moderate and deep renovations to 55% and 25% respectively.

The different development, depending on the scenario, of the total building stock structure over time is illustrated in the following figure.



All scenarios anticipate an increase in the floor area of new buildings by 0.85% and the demolition of buildings accounting for 0.20% of the floor area per year. Therefore, over the period up to 2050, there will be an increase in floor area in all scenarios by approximately 16% compared to the situation today.

Up to 2020, new buildings are considered in the cost-optimal standard (with energy consumption of 125 kWh/m2.year for single-family buildings, or 100 kWh/m2.year for multi-family buildings); after 2021, they are considered in the nearly-zero consumption standard (55 kWh/m2.year for single-family buildings and 40 kWh/m2.year for multi-family buildings). Both levels are consistent with the requirements of the Energy Management Act (Act No 406/2000) and are in line with the definitions laid down in the Implementing Decree on the energy performance of buildings (Implementing Decree No 78/2013).

For existing buildings, all scenarios expect at least some level of renovation in approximately 94 % of the total floor area. The rest are considered to be unable to be reconstructed either for technical reasons or due to the owner's wishes. The renovation of historical buildings is factored in by the fact that, in the progressive scenarios 4 and 5, a certain percentage of shallow and moderate energy-saving renovation is being considered.

The scenarios envisage that buildings that have yet to undergo energy-saving renovation (75% of single-family buildings, 60% of multi-family buildings and 50% of public and commercial buildings, see chapter 5) will be renovated first. Once this area of renovation (always moderate or deep) has been exhausted, attention turns to buildings that have already been renovated (for example, for single-family buildings, this will be in about 2070 in scenario 1, and about 2040 in scenarios 4 and 5). The background study assumes that 65% have undergone shallow innovation in the last two decades, 30% moderate and 5% deep renovation, and for non-residential buildings, the shares are 50%, 40% and 10%. Based on the same investment costs, the energy savings are roughly half of those achieved in the renovation of buildings not previously renovated.

The essential investment costs of renovation are taken from the results of chapter 6. A learning curve is factored in overtime, i.e. a gradual reduction in investment costs at current prices due to falling prices in certain technologies, the refinement of procedures, routine work and improvements in the quality thereof, and consequently lower repair requirements. This outweighs the trend of a gradual rise in labour force costs in construction and the growth in prices of ordinary building materials. Annual decreases are considered to be 0.3% for shallow innovation, 0.6% for moderate energy-saving renovation and 4.9% for deeper innovation.

In the evaluation of economic costs, the discounting of future investments and savings, on the one hand, or a rise in energy prices and construction works, on the other, is not factored in. Trying to establish such trends would be speculation. For the purposes of further analysis, a 3% discount rate could be taken into account (for households, alternative investment has a return of approximately 1% to 2% in a savings account, or from a government bond, and interest rates on mortgages are 3%, and even lower for multi-family buildings). Energy prices for final customers have risen by between 3% and 6% per year, net of any tax changes, over the past few decades. In contrast, the crisis has pushed down construction work prices in the past five years.

7.2 Modelling outputs

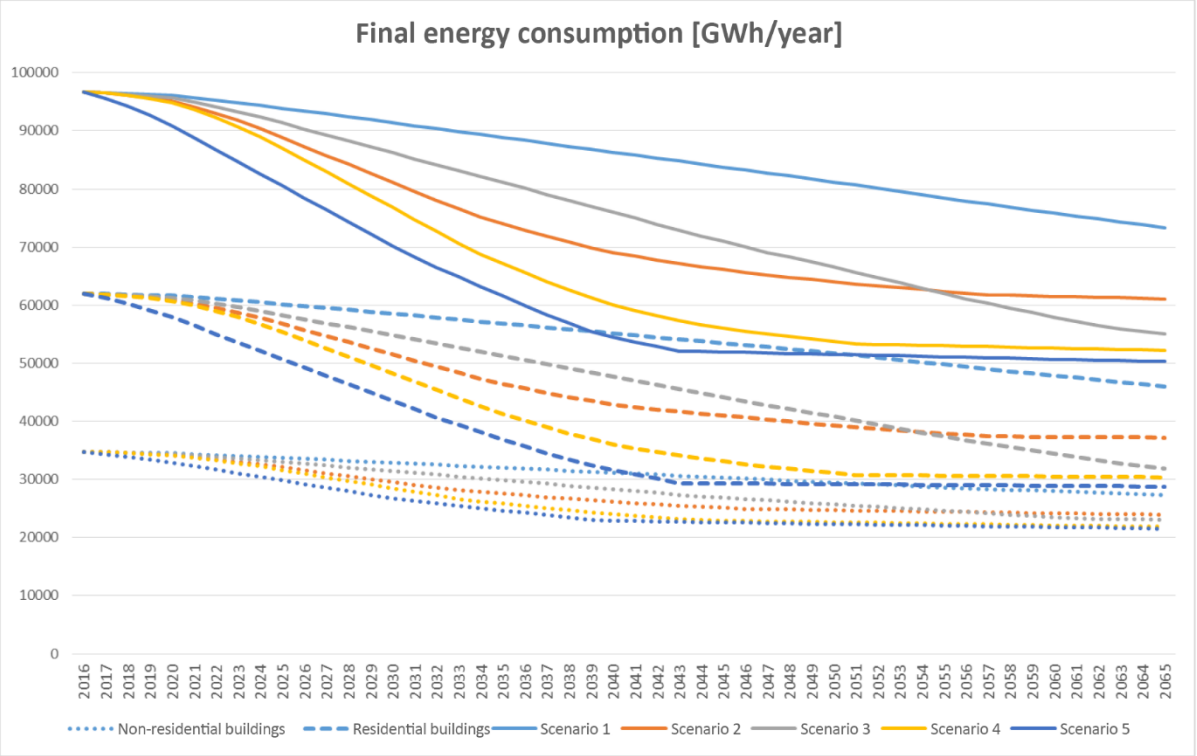
The outputs of the modelling are presented in four graphs. These describe:

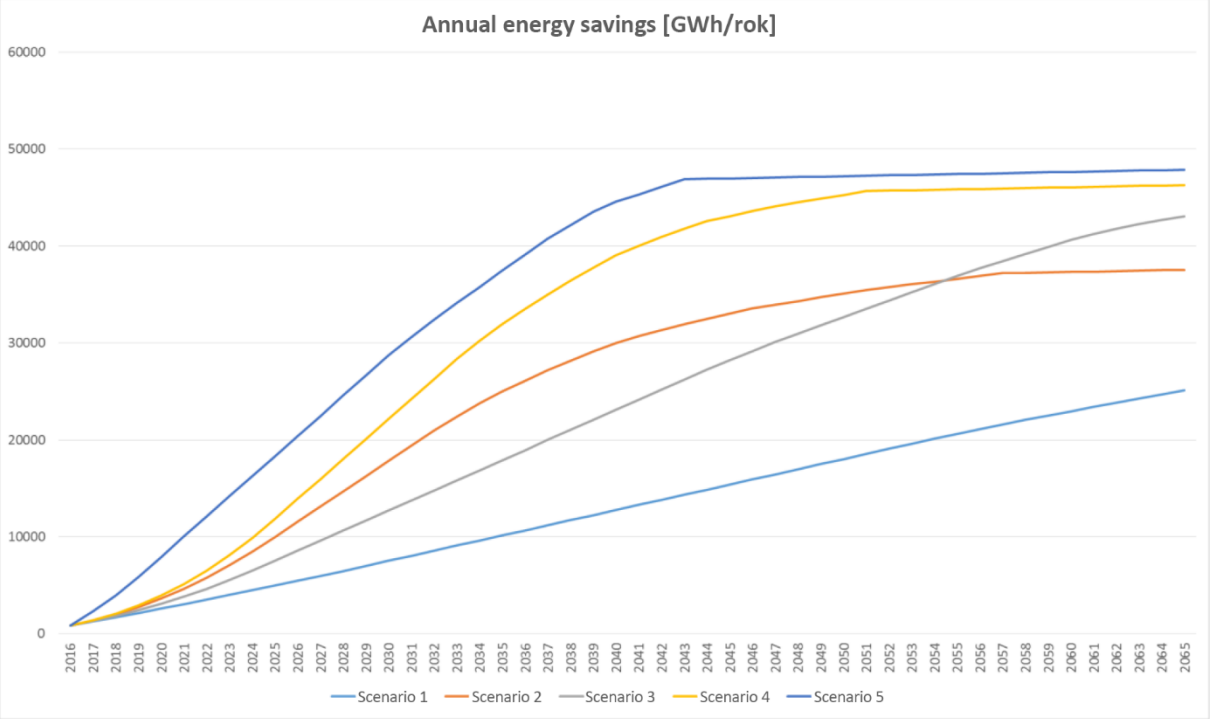
a) Trends in energy consumption in the buildings sector for the types of consumption being considered in the evaluation of the energy performance of buildings in accordance with the Energy Management Act (i.e. excluding appliances). The starting point is 349 PJ (96,905 GWh). The residential sector accounts for 224 PJ (62,158 GWh), and the non-residential sector 125 PJ (34,747 GWh).

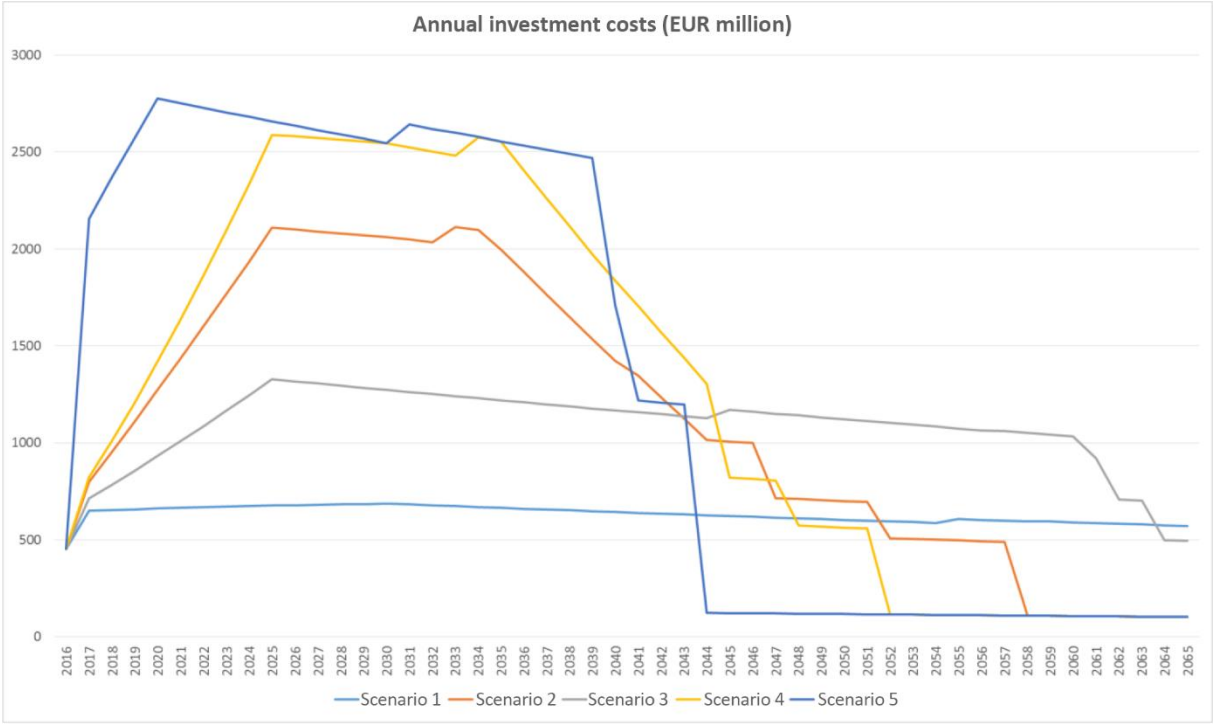
b) The overall development of energy savings compared to a situation without the energy-saving renovation of buildings, but including an increase in the number of new buildings and demolition of old ones.

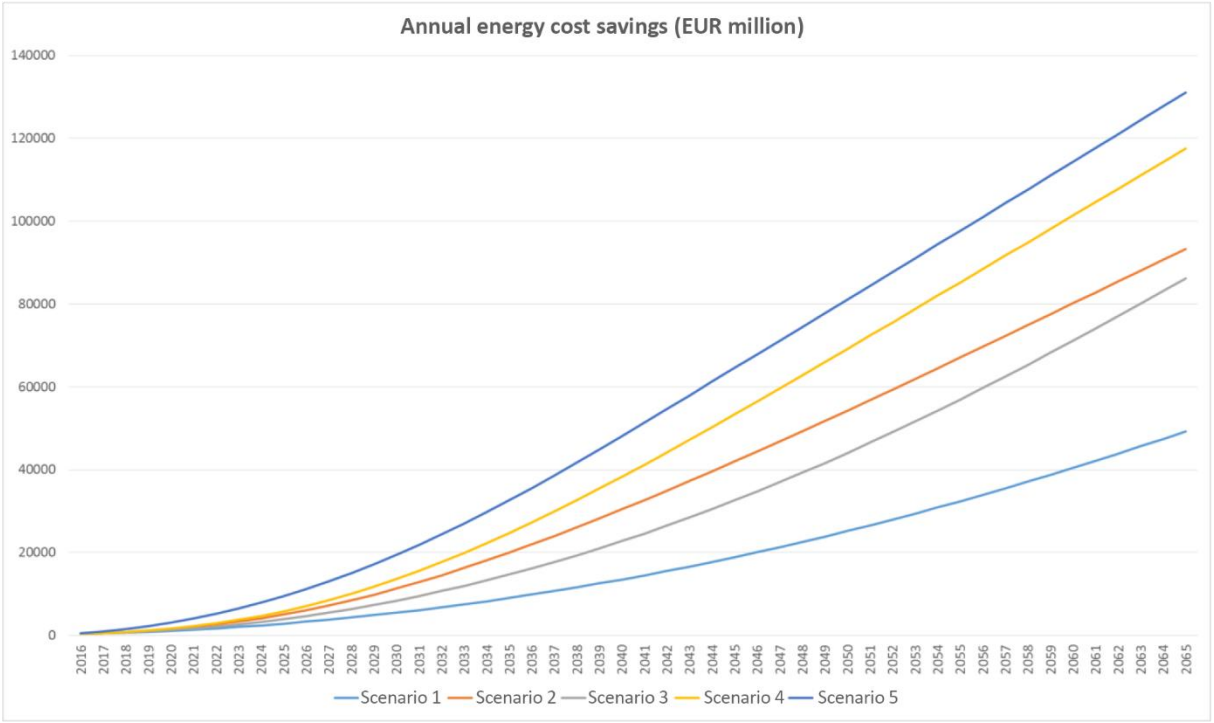
c) The overall development of annual investment costs required to implement the individual renovation scenarios. These include all necessary costs, including the preparation of design documentation, arrangements for building supervision, the removal and disposal of waste, and, for example, the erection of scaffolding. These costs are presented net of VAT. For values in EUR, a fixed conversion rate of CZK 27 per EUR has been considered for the duration of the modelling.

d) Trends in annual energy cost savings in the operation of buildings as a result of the measures taken. To determine this indicator, an average price of saved energy of EUR 70 per MWh is applied. The value is again net of VAT.


Final energy consumption [GWh/year]
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065
Non-residential buildings
Residential buildings
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5


Annual energy savings [GWh/rok]
60000
50000
40000
30000
20000
10000
0
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5





7.3 Evaluation and comparison of individual scenarios

The business-as-usual scenario (1), not counting on state intervention, will see the renovation of 94% of those buildings not yet renovated by 2070 (single-family buildings), 2058 (multi-family buildings) and 2054 (public and commercial buildings), with a cut in energy consumption by roughly 56.5 PJ by

2050 compared to the current situation. Buildings renovated since the 1990s will not be renovated again until the second half of this century. Cumulative essential investment costs up to 2050 stand at EUR 22.2 billion for the implementation of this scenario.

The hypothetical scenario (5), on the other hand, envisaging major state intervention leading to the use of the full absorption capacity of energy-saving construction, will cover the renovation of all non-renovated building stock and the high-quality renovation of buildings that in the past have only undergone shallow renovation (have only had their windows replaced, or insulation installed to the required values, etc.) by 2040. This will prevent buildings from becoming dilapidated and will ensure that much of the energy-saving potential is harnessed. By 2050, it will reduce energy consumption in multi-family buildings by roughly 163 PJ. Cumulative essential investment costs up to 2050 stand at EUR 65.5 billion for the implementation of this scenario.

Scenarios 2, 3 and 4 are situated between the two extremes above. Their influence on energy consumption reductions in residential buildings, and their economic costs and benefits, are set out in the graphs. The achievement of different levels of energy savings depends mainly on the effectiveness of regulatory measures, the volume of public funds allocated, and the ability to excite additional private investment (the 'financial leverage' amount).

The setting of energy criteria, such as the terms and conditions of support schemes, is equally important. A comparison of scenarios 2 (fast but shallow) and 3 (slow but deep) shows that, in the initial stage of the scenario it is possible to obtain larger energy savings through faster, shallow renovation, but in the longer term the shallow renovation blocks part of the economically effective potential of the savings, and then deep renovation that is slower to take effect records, in absolute terms, a lower possible achievable level of energy consumption. The outputs of the background study also show that deep renovation has a slightly shorter period of return than moderate energy-saving building renovation (by two or three years). It could be recommended that moderate energy-saving building renovation be the minimum requirement of support schemes, with building owners receiving a bonus, in the form of higher aid intensity, if they opt for deep renovation.

The various scenarios naturally make different contributions to the pursuit of the Czech objective up to 2020 in accordance with the Energy Efficiency Directive. The starting year for modelling is 2016, and the model up to 2020 does not therefore envisage substantial savings due to faster and deeper renovations that are just getting under way (see above). Scenario 5 shows potential savings of 22 PJ with costs of EUR 9.9 billion. Without intervention, on the other hand, the business-as-usual scenario 1 would contribute only minimally to the achievement of the Czech target, with costs of EUR 2.6 billion.

A summary of information for all scenarios is provided in the following table:

Table 15: Selected outputs of scenarios as at 2020, 2030 and 2050

Scenario 1: Business as usual	**2020**	**2030**	**2050**
Final energy consumption in the given year [PJ]	346	329	292
single-family buildings	*143*	*136*	*119*
multi-family buildings	*79*	*75*	*67*
public and commercial buildings	*124*	*118*	*106*
Energy savings compared to initial situation 349 PJ [PJ]	3	20	56
Investment costs in the given year [EUR millions]	661	687	603
Cumulative investment costs [EUR millions]	2,623	9,393	22,235

single-family buildings	*1,245*	*4,447*	*10,508*
multi-family buildings	*591*	*2,111*	*4,989*
public and commercial buildings	*787*	*2,835*	*6,738*
Cumulative energy cost savings [EUR million]	656	4,326	22,571
single-family buildings	*354*	*2,067*	*10,385*
multi-family buildings	*199*	*1,139*	*5,569*
public and commercial buildings	*103*	*1,120*	*6,617*
Total induced GDP [EUR million]	3,790	10,280	22,636
Average induced employment	12,585	12,928	12,636
Total state budget income [EUR million]	874	3,146	7,470
Total social security insurance premiums [EUR million]	100	360	855
Scenario 2: Fast but shallow renovation of the building stock	**2020**	**2030**	**2050**
Final energy consumption in the given year [PJ]	343	292	230
single-family buildings	*141*	*119*	*87*
multi-family buildings	*78*	*67*	*55*
public and commercial buildings	*123*	*106*	*89*
Energy savings compared to initial situation 349 PJ [PJ]	6	57	118
Investment costs in the given year [EUR millions]	1273	2061	700
Cumulative investment costs [EUR millions]	4137	23,394	51,494
single-family buildings	*1,969*	*11,115*	*24,464*
multi-family buildings	*920*	*5,148*	*11,547*
public and commercial buildings	*1,248*	*7,132*	*15,483*
Cumulative energy cost savings [EUR million]	800	8,455	49,289
single-family buildings	*418*	*3,944*	*23,507*
multi-family buildings	*232*	*2,054*	*11,181*
public and commercial buildings	*151*	*2,457*	*14,602*
Total induced GDP [EUR million]	5,238	23,736	50,679
Average induced employment	19,874	32,272	29,231
Total state budget income [EUR million]	1,381	7,855	17,285
Total social security insurance premiums [EUR million]	158	899	1,977
Scenario 3: Slow but, for energy purposes, deep renovation of the building stock	**2020**	**2030**	**2050**
Final energy consumption in the given year [PJ]	344	310	240
single-family buildings	*142*	*126*	*91*
multi-family buildings	*79*	*71*	*56*
public and commercial buildings	*124*	*113*	*93*
Energy savings compared to initial situation 349 PJ [PJ]	4	38	109
Investment costs in the given year [EUR millions]	932	1273	1,122
Cumulative investment costs [EUR millions]	3,288	15,600	39,193
single-family buildings	*1,544*	*7,222*	*17,935*
multi-family buildings	*748*	*3,582*	*8,952*
public and commercial buildings	*996*	*4,797*	*12,306*
Cumulative energy cost savings [EUR million]	727	6,409	39,301
single-family buildings	*389*	*3,118*	*18,925*
multi-family buildings	*215*	*1,595*	*9,220*
public and commercial buildings	*123*	*1,696*	*11,156*
Total induced GDP [EUR million]	4,462	16,686	40,220

Average induced employment	15,940	22,049	22,938
Total state budget income [EUR million]	1,109	5,388	13,625
Total social security insurance premiums [EUR million]	127	614	1,551
Scenario 4: Fast and deep renovation of the building stock	**2020**	**2030**	**2050**
Final energy consumption in the given year [PJ]	341	276	194
single-family buildings	*141*	*110*	*63*
multi-family buildings	*78*	*64*	*49*
public and commercial buildings	*123*	*103*	*82*
Energy savings compared to initial situation 349 PJ [PJ]	7	72	155
Investment costs in the given year [EUR millions]	1,419	2,546	563
Cumulative investment costs [EUR millions]	4,464	27,807	61,200
single-family buildings	*2,118*	*13,054*	*29,120*
multi-family buildings	*979*	*6,061*	*13,439*
public and commercial buildings	*1,367*	*8,692*	*18,641*
Cumulative energy cost savings [EUR million]	838	10,038	62,779
single-family buildings	*440*	*4,892*	*31,612*
multi-family buildings	*237*	*2,291*	*13,461*
public and commercial buildings	*161*	*2,855*	*17,706*
Total induced GDP [EUR million]	5,594	28,732	61,741
Average induced employment	21,635	39,303	35,627
Total state budget income [EUR million]	1,506	9,604	21,157
Total social security insurance premiums [EUR million]	172	1,094	2,409
Scenario 5: Ideal hypothetical	**2020**	**2030**	**2050**
Final energy consumption in the given year [PJ]	327	253	185
single-family buildings	*134*	*99*	*58*
multi-family buildings	*75*	*58*	*47*
public and commercial buildings	*119*	*96*	*80*
Energy savings compared to initial situation 349 PJ [PJ]	22	96	163
Investment costs in the given year [EUR millions]	2,776	2,546	117
Cumulative investment costs [EUR millions]	9,879	36,355	65,524
single-family buildings	*4,588*	*16,766*	*31,510*
multi-family buildings	*2,263*	*8,367*	*14,341*
public and commercial buildings	*3,028*	*11,222*	*19,674*
Cumulative energy cost savings [EUR million]	1,521	15,070	74,454
single-family buildings	*757*	*7,241*	*37,899*
multi-family buildings	*397*	*3,555*	*16,347*
public and commercial buildings	*367*	*4,275*	*20,208*
Total induced GDP [EUR million]	10,984	37,392	65,248
Average induced employment	48,626	51,662	37,685
Total state budget income [EUR million]	3,392	12,635	22,385
Total social security insurance premiums [EUR million]	387	1,439	2,549

The above table, with its time specifications, does not reflect the locking-in of shallow renovation savings, and according to the table shallow and fast renovations seem to be more suitable. That would be an inaccurate conclusion. Looking back at the above graphs shows that slow but deep renovation will 'catch up' with the fast-scenario consumption level in 2055 and, unlike the faster

scenario, it then drops further. It is therefore important to consider this long-term viewpoint when selecting a scenario and, in particular, setting policies. All the more so in view of the expected effects of climate change (see below).

Long-term effects also need to be monitored with regard to return on investment. Even in 2030, the cumulative investment costs would be significantly higher than the energy cost savings achieved in that year. Around 2050, on the other hand, savings would be slightly higher in most scenarios. Also, the cumulated state budget revenues generated by investments in energy renovations would account for more than a third of the total investment in 2050 in all scenarios.

From modelling, scenario 4 (quick and deep) may seem the most appropriate. If its funding could be secured, this scenario would make a major contribution to overall savings on final energy consumption by 2030. Compared the scenario where renovation is just as quick but shallow (scenario 2), scenario 4 brings 26% more savings at a cost that is higher by about 19%. A shift to the implementation of scenario 4 is therefore considered cost effective and ensures a higher contribution to the fulfilment of the Czech target. This shift, however, is hindered by the investment amounts necessary and other barriers reducing the absorption capacity for implementation by property owners. To overcome them, a long-term strategy is needed, together with targeted efforts by state and the coordination of all stakeholders.

Experience shows that the implementation of scenarios 2 to 5 depends on the volume of public funds that can be earmarked for building renovation. At present, those funds can only be predicted up to 2020, or 2023 in the case of operational programmes financed by the ESIF. At present, those funds can only be predicted up to 2020, or 2023 in the case of operational programmes financed by the ESIF. In the longer term, therefore, there is considerable uncertainty about the availability of a disproportionately larger volume of public funds, which is due also to the fact that the revised EU ETS Directive has yet to be finally approved, and the fact that it has not been decided how potential funds from the Modernisation Fund and other resources available to the Czech Republic under the EU ETS will be allocated. The basic framework for using EU funds after 2020 is also not known.

The amount of investment costs needed will require further examination and will be verified by reference to practical experience (e.g. the difference between the standard price of work and the price ultimately implemented by the company with the best bid should be taken into account).

8. Primary energy savings

This strategy envisages energy savings in final consumption and sold energy sold heating and hot water heating (solar thermal collectors and heat pumps). This is in keeping with the Czech Republic's proposed objectives under Article 3 and Article 7 of the Energy Efficiency Directive.

However, a reduction in final consumption in buildings will also be reflected in a reduction in primary energy consumption (both in terms of total and non-renewable energy). This is a consequence of the fall in the actual need for energy and an increase in technological efficiency. This is achieved by using new technology of better quality, in particular photovoltaic panels, or, potentially in the future, micro-cogeneration units.

Some technologies of local renewable sources in/on buildings or in the vicinity thereof also directly reduce the consumption of non-renewable primary energy, even though such use will not appear in the balance of final consumption and total primary energy, or will be not be manifested much, because of the high efficiency thereof. These technologies are heat pumps, biomass installations, solar thermic collectors, photovoltaic installations, and high-potential geothermal sources and mini wind turbines.

An important role in reducing primary energy consumption in buildings is also played by the shift of non-renewable energy factors towards lower values among energy carriers which, as a result of energy transformation, are outside buildings, i.e. electricity from the grid and district heat. In response to gradual increases in the share of renewable sources and increases in the efficiency of production and distribution (heating industry modernisation), the primary energy consumption needed to ensure the good use of buildings will gradually decrease.

Although these factors have not been discussed in this document, they merit attention because, as a result, primary energy consumption will better reflect the load placed by building use on the environment.

9. Adapting buildings to climate change

To make the modelling of the development of future consumption in the building sector even more precise, a study was drawn up as part of the preparation project for the National Strategy for Adapting Buildings to Climate Change that mapped the likely effects of climate change in the Czech Republic.[30] The results of this study then formed the basis for the elaboration of an appropriate set of measures that will respond in the building area to the expected climate change and thus help buildings adapt.

According to this study, the Czech Republic will be among the areas less affected by climate change Nevertheless, its effects will bring about a variety of problems that will have a direct impact on the construction sector and human settlements. The study considered two scenarios for future emission development – the gentler RCP4.5 and a scenario predicting greater temperature rise, RCP8.5, according to IPCC methodology (hereinafter referred to as the 'S4.5' and 'S8.5' scenarios). The results of their impacts are summarised in the points below.

1. By 2040, the average air temperature in our country will increase by about 1°C per year, and by 2060 the average air temperature in the Czech Republic will increase by as much as 2.5°C.

2. The probability of occurrence, intensity and duration of continuous waves of extremely high temperatures will increase up to twice that before 2000.

3. The number of tropical days (over 30°C) and nights (above 20°C) will increase up to double in some areas.

4. There will be a drop in the number of arctic (the maximum temperature during the day does not exceed -10°C), icy (the temperature remains below freezing throughout the day) and frosty (the minimum daytime temperature drops below freezing) days.

[30] Belda M., Pišoft P., Žák M. 2015. Outputs of regional climate models in the Czech Republic for the 2015-2060 period. Department of Atmospheric Physics, Faculty of Mathematics and Physics, Charles University in Prague.

5. Winter rainfall will increase while summer rainfall will decrease, the number of days without rainfall and the risk of drought will rise significantly, and the fire risk will also rise.

6. The risk of torrential rains and subsequent local floods will rise, as will maximum flows, but the average and minimum river flows will probably drop, or flows will dry out completely.

7. There will be a greater risk of the creation of urban thermal islands, that is, urban areas with a significantly higher temperature than in the surrounding area.

8. The frequency of extreme weather phenomena (windstorms, tornadoes) will increase.

The effects of the expected temperature rises for the period up to 2060, which, on the one hand, will reduce the consumption of heat for heating, but on the other will also increase energy consumption for cooling, were introduced into the model of building renovation scenarios. For the sake of simplicity, the scenarios assumed the temperature rises to be linear, up to 2060 in the case of the S4,5 scenario. All five building renovation scenarios were therefore modified to include two variants of future climate development.

Adaptation measures in the form of shielding and cooling, including modifications to the investment costs of the renovation concerned and operating costs, were also introduced into the models. For the shallow renovation, a variant was chosen that prioritises the installation of inefficient cooling in addition to the installation of shielding. Conversely, deep renovation preferred shielding and, if necessary, the installation of efficient cooling only subsequently. Macroeconomic data were calculated assuming impacts reducing the economic efficiency of work due to the increased number of tropical days. Overall, then, the output is 10 scenarios of possible future development.

9.1 Modelling outputs with the inclusion of climate scenarios

For scenarios S4.5 and S8.5, the overall energy consumption decreases compared to the baseline since the effect of decreasing consumption due to the rise in temperature in both cases exceeds the increase in energy consumption for cooling. The fact that the rise in consumption for cooling is only slight is caused by the fact that a relatively conservative estimate of the share of cooled buildings is envisaged and that in scenario 1 and, in part, scenario 3 in our models see a relatively rapid increase in such renovations, in which we assume a preference for the installation of shielding elements. Thanks to the installation of cooling and shielding, the proportion of buildings that may be affected by overheating has been steadily decreasing, resulting in a drop in labour productivity and a fall in gross value added.

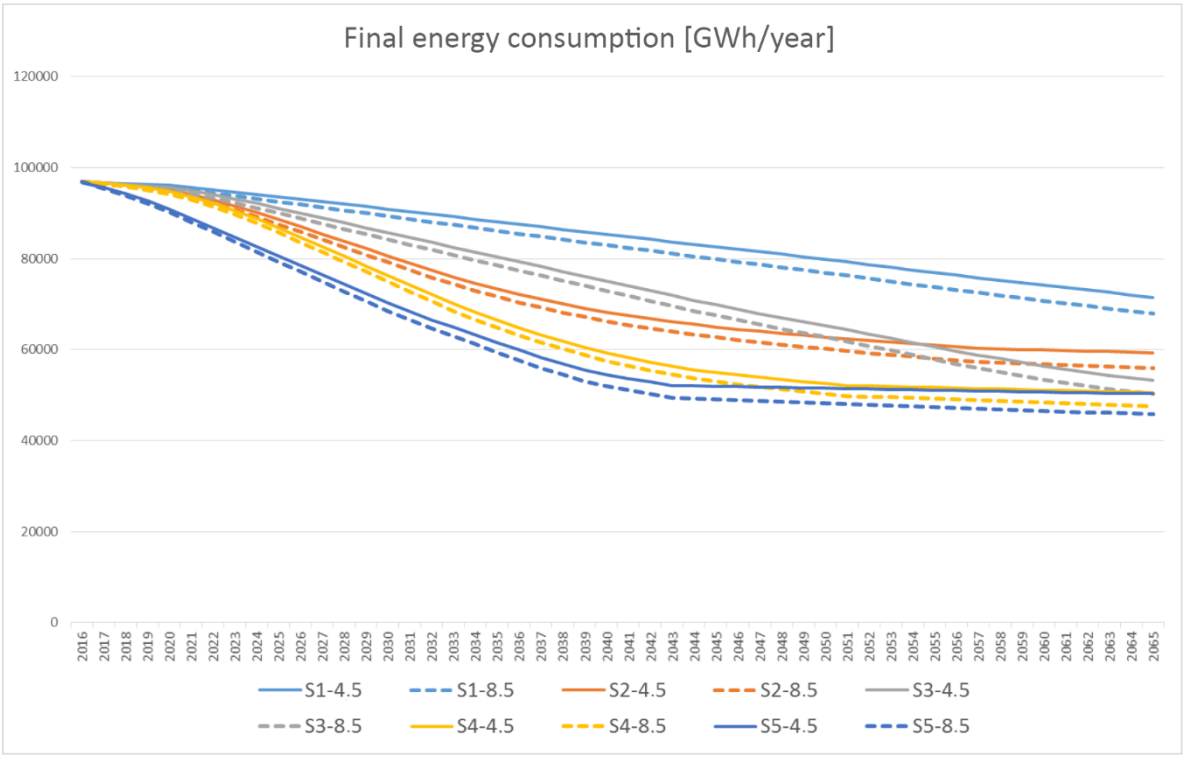
The above is illustrated in the following graphs. For the sake of clarity, only one of the two climate scenarios is shown in some of the graphs.

a) Development of final energy consumption in climate scenarios S4.5 and S8.5
b) Floor area of buildings that are neither shielded nor cooled in the S8.5 scenario
c) Increase in consumption for cooling in the S8.5 scenario
d) Decrease in energy consumption for heating in the S4.5 and S8.5 scenarios
e) Resulting effect of falling energy consumption for heating and rising consumption for cooling

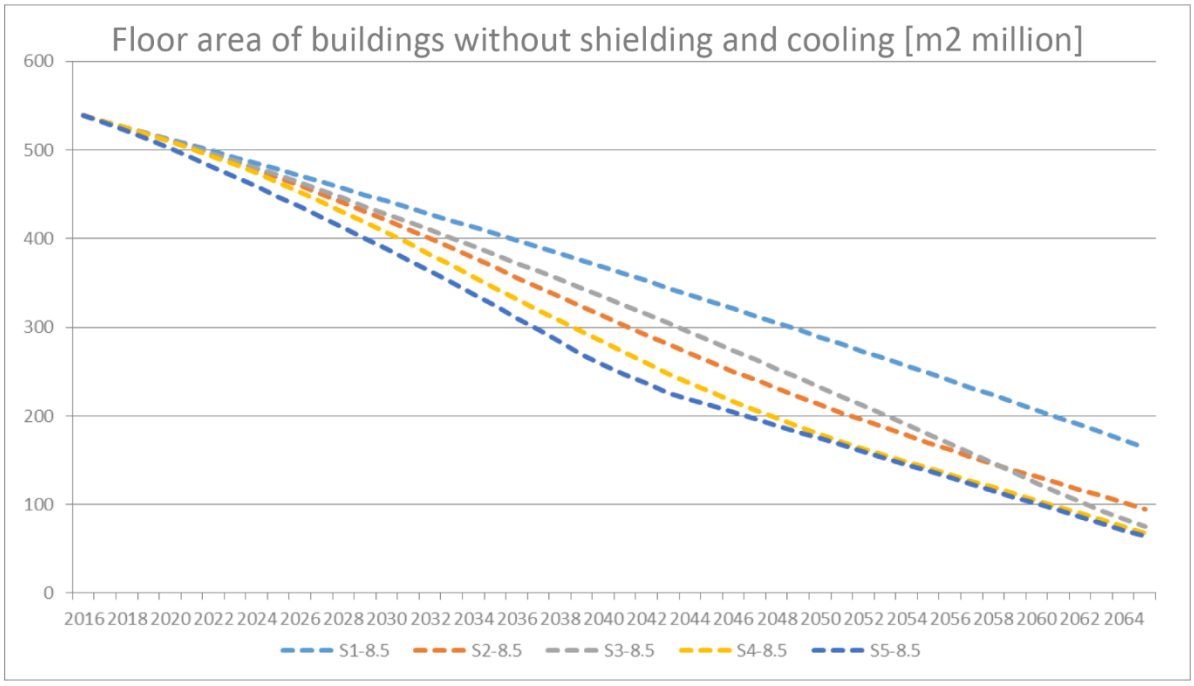
f) Decrease in GVA due to the effect of tropical days in the S4.5 scenario

g) Decrease in GVA due to the effect of tropical days in the S8.5 scenario

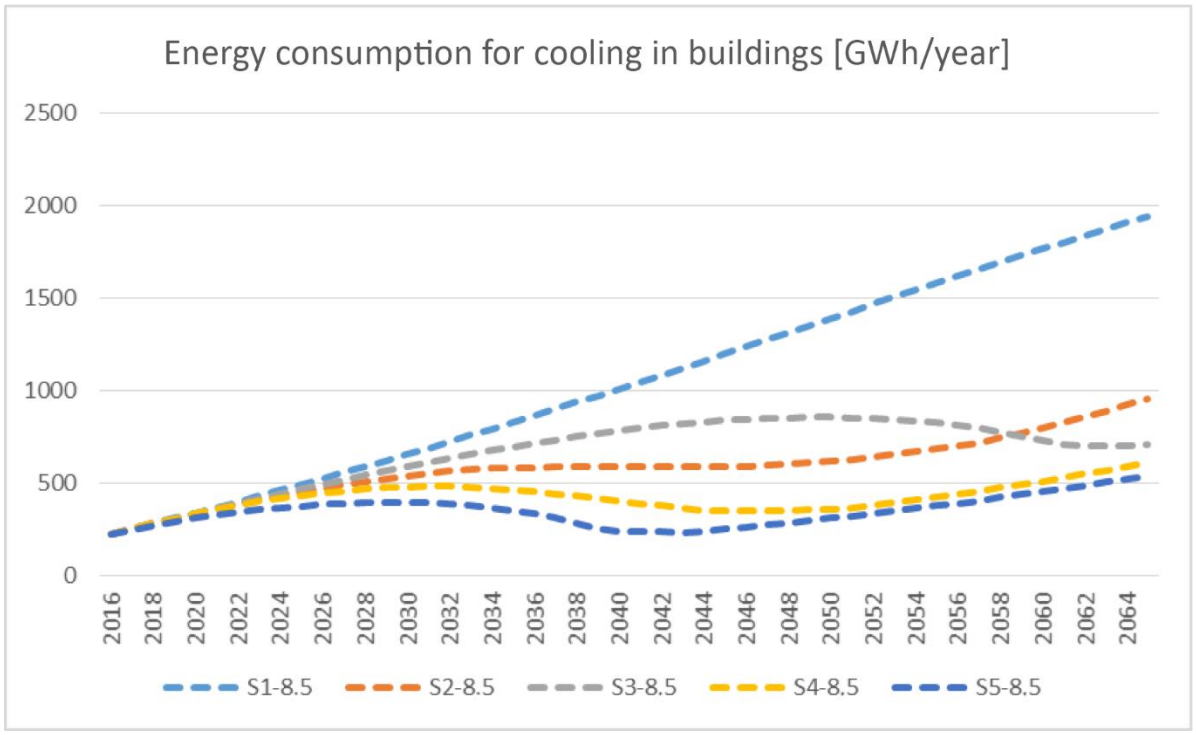
Final energy consumption for the S4.5 and S8.5 climate scenarios



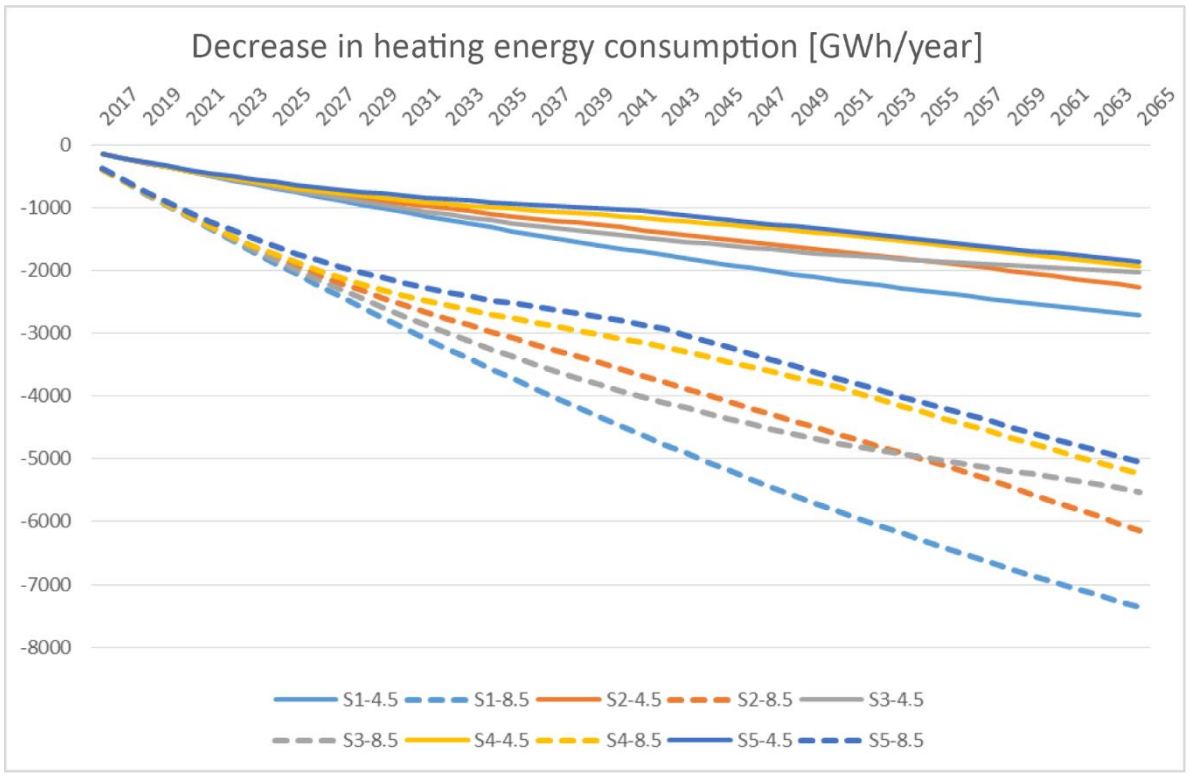
Floor area of buildings that are neither shielded nor cooled in the S8.5 climate scenario



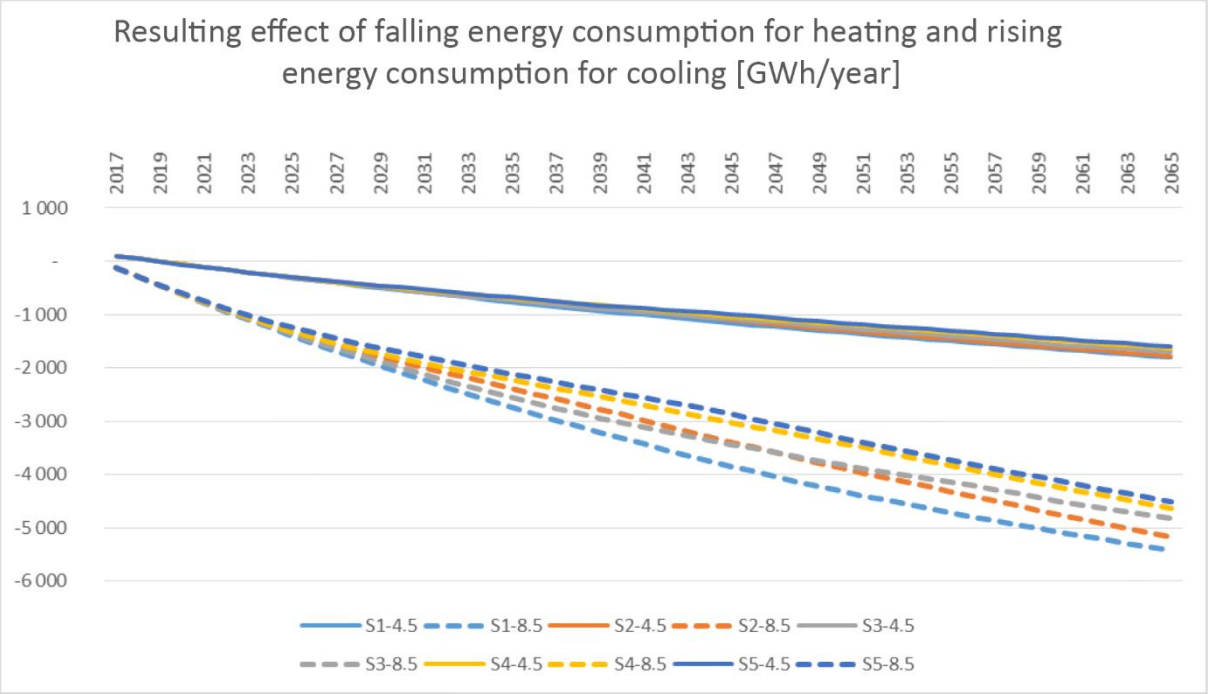
Increase in consumption for cooling in the S8.5 climate scenario



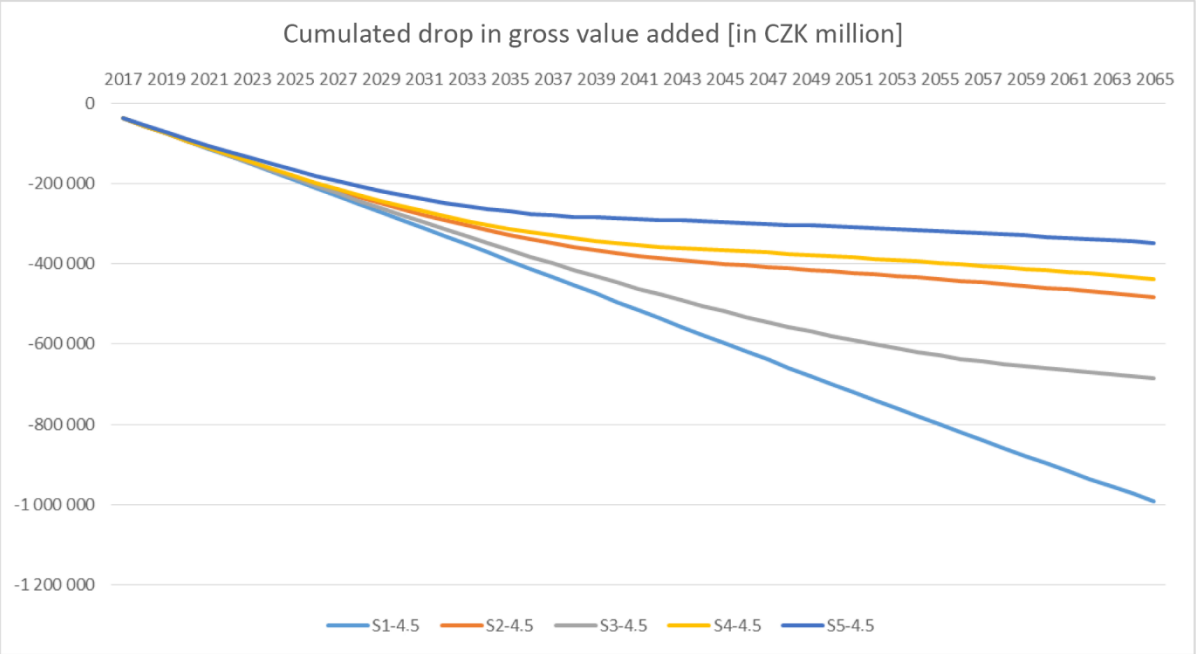
Decrease in energy consumption for heating in climate and renovation scenarios



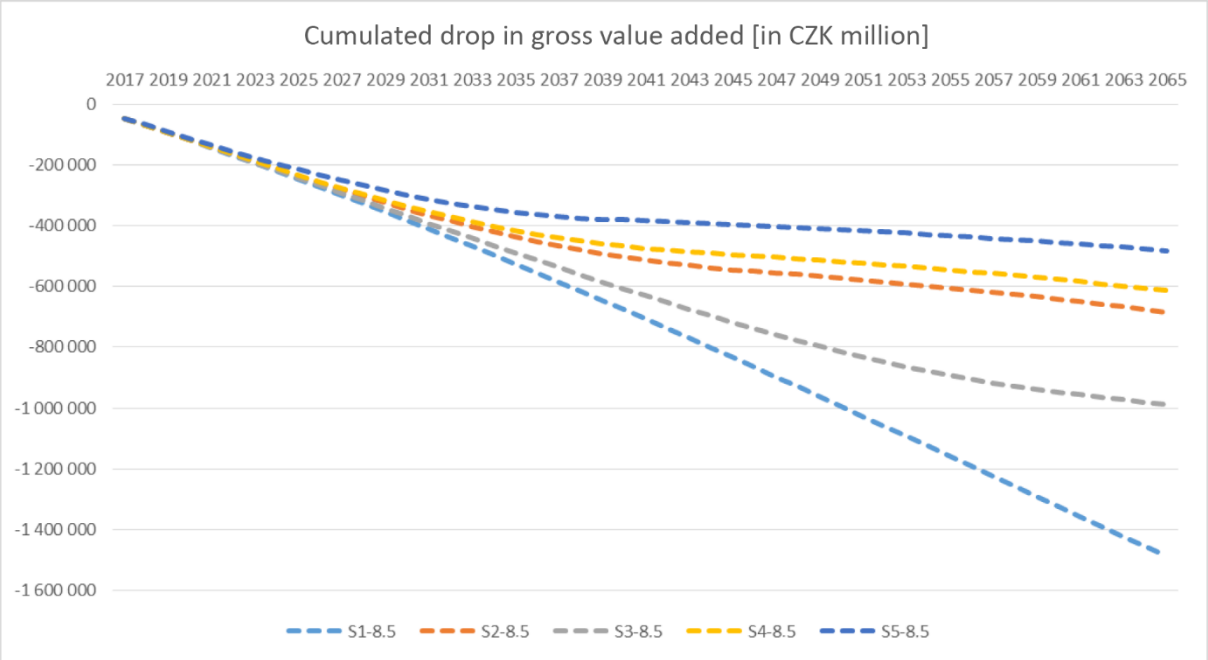
Resulting effect of falling energy consumption for heating and rising consumption for cooling



Decrease in GVA due to the effect of tropical days in the S4.5 scenario



Decrease in GVA due to the effect of tropical days in the S8.5 scenario



9.2 Evaluation and comparison of individual scenarios

Climate scenarios and the associated results of modelling provide certain boundaries, within which the monitored values are likely to move. What is of particular interest about the results, which are summarised in the following tables, is the slightly higher induced GDP, employment, state budget revenues and social security contributions in the worse climate scenario, S8.5. This is mainly due to the fact that the higher installation rate of cooling systems, as well as shielding, which we assume in this scenario, contributes more to the national economy. Much more significant, however, is the effect of the decline in gross value added, which is the result of lower labour productivity due to overheating. Here, the difference climate scenarios as at 2050 ranges from CZK 106 billion for renovation scenario 5 to CZK 294 billion for scenario 1. But even more significant are the differences between the different renovation scenarios. Considering the S8.5 climate scenario, the difference between renovation scenarios 1 and 5 is CZK 581 million.

Scenario 1: Business as usual	2020 (S4.5)	2020 (S8.5)	2030 (S4.5)	2030 (S8.5)	2050 (S4.5)	2050 (S8.5)
Final energy consumption in the given year [PJ]	346	344	327	322	288	277
Energy savings compared to initial situation 349 PJ [PJ]	3	5	22	27	61	72
Investment costs in the given year [EUR millions]	878	952	902	972	805	867
Cumulative investment costs [EUR millions]	3,491	3,790	12,417	13,438	29,410	31,757
Energy cost savings – no price rises or discounts [EUR millions]	681	724	4,397	4,519	22,718	22,970
Total induced GDP [EUR millions]	4,431	4,650	12,514	13,264	27,954	29,680
Average induced employment	12,712	12,755	13,055	13,097	12,760	12,801
Total state budget income [EUR millions]	1,099	1,175	3,928	4,190	9,332	9,936
Total social security insurance [EUR millions]	127	137	455	487	1,082	1,155
Scenario 2: Fast but shallow renovation of the building stock						
Final energy consumption in the given year [PJ]	342	340	290	285	226	217
Energy savings compared to initial situation 349 PJ [PJ]	7	9	59	64	123	132
Investment costs in the given year [EUR millions]	1,498	1,572	2,296	2,363	871	918
Cumulative investment costs [EUR millions]	5,025	5,323	26,638	27,639	58,808	60,927
Energy cost savings – no price rises or discounts [EUR millions]	620	867	8,518	8,626	49,406	49,604
Total induced GDP [EUR millions]	5,894	6,113	26,147	26,884	56,147	57,714
Average induced employment	20,005	20,048	32,410	32,451	29,360	29,396
Total state budget income [EUR millions]	1,611	1,687	8,699	8,957	19,199	19,748
Total social security insurance [EUR millions]	186	195	1,002	1,033	2,212	2,278
Scenario 3: Slow but, for energy purposes, deep renovation of the building stock						
Final energy consumption in the given year [PJ]	344	342	308	303	235	226
Energy savings compared to initial situation 349 PJ [PJ]	5	7	40	46	114	123
Investment costs in the given year [EUR millions]	1,155	1,229	1,155	1,229	1,314	1,363
Cumulative investment costs [EUR millions]	4,171	4,469	1,8763	1,9761	46,535	48,674
Energy cost savings – no price rises or discounts [EUR millions]	752	794	6,476	6,591	39,422	39,629
Total induced GDP [EUR millions]	5,164	5,401	19,195	19,990	46,029	47,728
Average induced employment	16,077	16,124	22,190	22,234	23,073	23,112
Total state budget income [EUR millions]	1,355	1,438	6,266	6,544	15,658	16,253
Total social security insurance [EUR millions]	156	166	720	753	1,798	1,869

Scenario 4: Fast and deep renovation of the building stock						
Final energy consumption in the given year [PJ]	341	339	275	270	189	181
Energy savings compared to initial situation 349 PJ [PJ]	8	10	74	79	160	168
Investment costs in the given year [EUR millions]	1,650	1,724	2,794	2,855	722	758
Cumulative investment costs [EUR millions]	5,366	5,663	31,224	32,197	68,490	70,361
Energy cost savings – no price rises or discounts [EUR millions]	863	905	10,097	10,200	62,877	63,044
Total induced GDP [EUR millions]	6,310	6,547	31,437	32,211	67,490	68,974
Average induced employment	21,775	21,821	39,456	39,499	35,761	35,795
Total state budget income [EUR millions]	1,756	1,839	10,551	10,822	23,169	23,689
Total social security insurance [EUR millions]	202	212	1,209	1,242	2,655	2,718
Scenario 5: Ideal hypothetical						
Final energy consumption in the given year [PJ]	327	325	253	247	185	174
Energy savings compared to initial situation 349 PJ [PJ]	22	24	96	102	163	175
Investment costs in the given year [EUR millions]	3,035	3,105	2,780	2,835	236	267
Cumulative investment costs [EUR millions]	10,873	11,164	39,805	40,715	72,472	74,166
Energy cost savings – no price rises or discounts [EUR millions]	1,545	1,585	15,125	15,219	74,547	74,707
Total induced GDP [EUR millions]	11,772	12,003	40,118	40,842	70,721	72,064
Average induced employment	48,781	48,826	51,816	51,857	37,814	37,845
Total state budget income [EUR millions]	3,668	3,749	13,589	13,842	24,300	24,770
Total social security insurance [EUR millions]	420	430	1,555	1,585	2,783	2,840

Cumulated drop in gross value added [in CZK million]	**2020 (S4.5)**	**2020 (S8.5)**	**2030 (S4.5)**	**2030 (S8.5)**	**2050 (S4.5)**	**2050 (S8.5)**
Scenario 1: Business as usual	93,622	118,560	290,510	382,095	700,112	994,385
Scenario 2: Fast but shallow renovation of the building stock	92,846	117,567	263,057	344,993	418,236	572,350
Scenario 3: Slow but, for energy purposes, deep renovation of the building stock	93,289	118,134	278,964	366,495	579,990	813,917
Scenario 4: Fast and deep renovation of the building stock	92,709	117,392	256,457	336,059	380,925	517,991
Scenario 5: Ideal hypothetical	89,259	112,990	228,363	298,607	306,679	412,808

10. Contribution to cutting greenhouse gas emissions

Alongside the adaptation measure, energy renovation of buildings is also a mitigation measure, that is, a measure that reduces greenhouse gas emissions. These are generated by the operation of buildings, and their share of total anthropogenic emissions is not at all negligible.

A study, 'Potential for greenhouse gas emissions savings through the reconstruction of buildings'[31], was therefore drawn up as part of the project for the preparation of the National Strategy for Adapting Buildings to Climate Change to quantify this potential. The following text is based on this study unless otherwise stated.

According to the National Greenhouse Gas Inventory[32], , which was prepared for the Ministry of the Environment by the Czech Hydrometeorological Institute in June 2016, 101.15 Mt of CO_2 was generated in the Czech Republic in 2014.

The input values were obtained from the table of outputs from the complex model created by the Chance for Buildings in the final version of 16 November 2016. The table contains data series for the five renovation scenarios above. Each renovation scenario is modelled in two variants for the S4.5 climate scenario and the S8.5 scenario, giving rise to ten variants. Each of the ten variants consists of two components: (1) residential buildings and (2) public and commercial buildings.

For each of these two components, final energy consumption figures are calculated for individual years on the basis of forecast for Czech building stock trends, as well as final energy consumption savings for heating and the increase in final energy consumption for cooling. It was also necessary to assign an energy mix to these final consumption values. Its development has been modelled for individual years, separately for residential buildings and for non-residential buildings. Current energy mixes were taken as the starting point, and energy mixes were predicted for 2060; both are based on studies of residential building[33] and non-residential building stocks[34]. Simplifications were made for the sake of clarity, where current values and those for 2060 were linearly interpolated by discrete values for each year. Due to the large uncertainties, further forecasts remain constant for the purpose of this study of the energy mix in 2060.

[31] Lupíšek A. 2016. Potential for greenhouse gas emissions savings in the Czech Republic through the reconstruction of buildings. University Centre for Energy Efficient Buildings of Czech Technical University.

[32] Krtková E., D. Troeva Grozeva and M. Beck, 2016. National Greenhouse Gas Inventory Report of the Czech Republic (reported inventories 1990-2014), available from: http://portal.chmi.cz/files/portal/docs/uoco/oez/nis/NIR/CZE_NIR-2016-2014_UNFCCC.pdf

[33] Antonín J. 2016. Survey of the residential building stock in the Czech Republic and possibilities for savings in such buildings. Chance for Buildings for the Ministry of Industry and Trade, available from: http://www.sanceprobudovy.cz/assets/files/Pruzkum%20rezidencnich%20budov%20v%20CR_SPB_13.12.%202016_verze33_final.pdf

[34] Antonín J. 2016. Survey of the non-residential building stock in the Czech Republic and possibilities for savings in such buildings. Chance for Buildings for the Ministry of Industry and Trade, available from: http://www.sanceprobudovy.cz/assets/files/Pruzkum%20nebytovych%20budov%20v%20CR_SPB_13.12.2016_verze24_final.pdf

Table 16: Energy mixes considered for residential buildings (according to final energy consumption)

Energy carrier	Initial state (according to Ministry of Industry and Trade data for 2011)	2060		
		Scenario 1 (identical to the initial state)	*Scenarios 2 and 3*	*Scenarios 4 and 5*
Fuel oils	0.07%	0.07%	0%	0%
Natural gas	33.17%	33.17%	36.2%	24.9%
Coal	10.54%	10.54%	2.7%	0%
Biomass	18.34%	18.34%	18.6%	17.6%
District heating	17.46%	17.46%	24.6%	24.0%
Electricity	20.28%	20.28%	7.0%	6.3%
Other (solar, heat pumps)	0.13%	0.13%	10.9%	27.1%

Table 17: Energy mixes considered for non-residential buildings (according to final energy consumption)

Energy carrier	Initial state	2060	
		Scenarios 1 and 2 (identical to the initial state)	*Scenarios 3, 4 and 5*
Electricity	42.1%	42.1%	34.9%
District heating	28.7%	28.7%	31.3%
Natural gas	27.1%	27.1%	27.0%
Gas cogeneration unit	1.5%	1.5%	1.6%
Other (solar, heat pumps)	0.4%	0.4%	4.8%
Solid fuels	0.2%	0.2%	0.2%

To calculate energy savings from CO_2 emissions, the emission factors were then used from Implementing Regulation No 425/2004 or Implementing Regulation No 480/2012, which are used for energy audits:

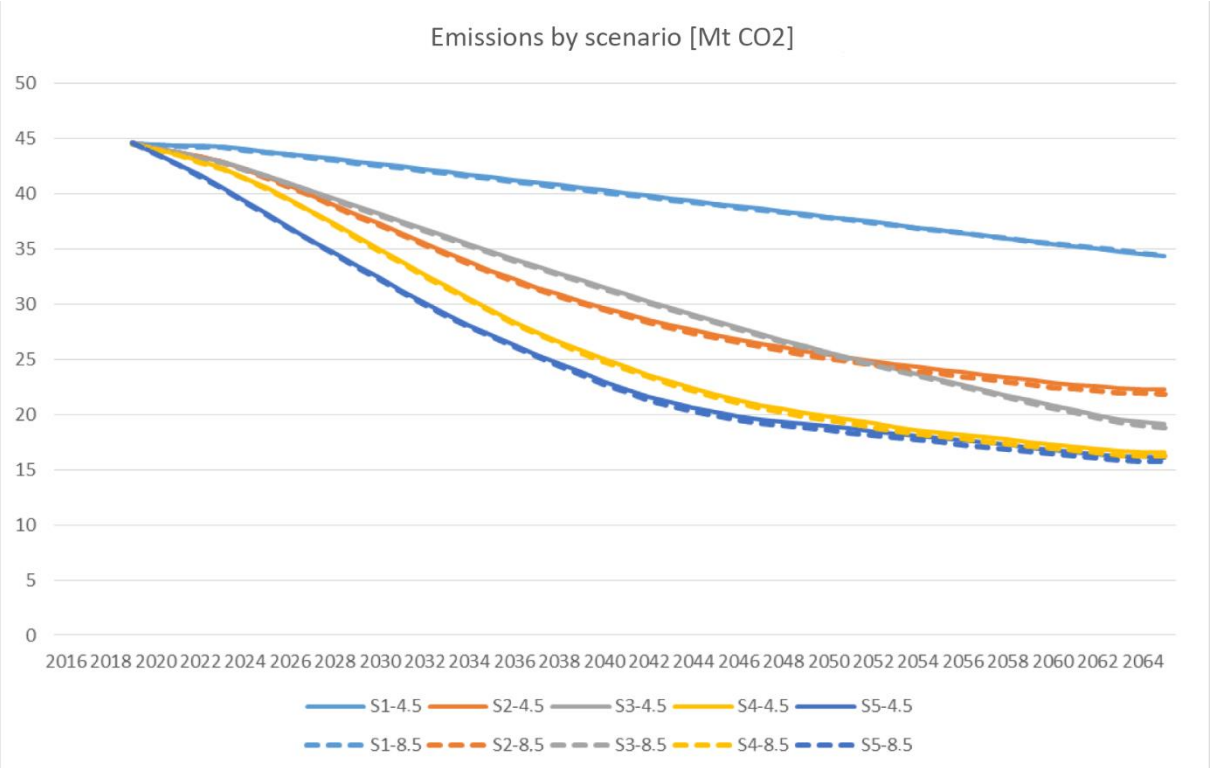
Table 18: Emission factors according to Implementing Regulation No 480/2012

Type of fuel	**Emission factor t CO_2/MWh fuel efficiency**
Lignite	0.36
Coal	0.33
Heavy fuel oil	0.27
Light fuel oil	0.26
Natural gas	0.20
Biomass	0
Electricity	1.17

***** the district heating emission factor was considered to be the same as that for natural gas, 0.2 t CO_2/MWh of fuel efficiency; for gas cogeneration units the emission factor was considered to be half that for natural gas, i.e. 0.1 t CO_2/MWh of fuel efficiency; if the type of coal is not differentiated, the mean value of 0.345 t CO_2/MWh of fuel efficiency was used; for other fuels (solar energy, heat pumps), an emission factor of 0 was used for this study

For the sake of clarity, as no forecast of the future development of emission factors is available in the Czech Republic, they were considered to be constant over the whole evaluated period, which is erring on the side of caution (it is expected that the emission factors of individual fuels will decrease with the advent of new technologies and a significant reduction in the emission factor of electricity with an increasing share of renewables, cogeneration or nuclear power in the distribution network). This simplification assumes that more emissions are generated than in reality. Electricity was considered as a source of energy for changing the consumption of energy for cooling.

Options for reducing CO_2 emissions in individual scenarios



The results of the calculation of CO_2 emissions from residential and non-residential structures in the individual scenarios are summarised in the previous graph. Based on the calculations made, it can be stated that the **operation of buildings with their 44,57 Mt of CO_2 contributes about 44% to the total production of emissions in the Czech Republic**. It also can also be seen from the graph that **emissions of CO_2 from the operation of buildings can be reduced from the current 44.6 Mt to 17.9 Mt per year by 2050, that is, by roughly 60%,** which would represent a **reduction in total annual CO_2 emissions in the Czech Republic of 26.4% (compared to 2014).** Buildings can therefore make a significant contribution to the emission reduction targets in the Czech Republic.

11. Measures for the implementation of the renovation scenarios

This chapter reflects the requirement of the Energy Efficiency Directive under Article 4(c).

11.1 General description of the measures being considered

12. Policy measures

In the implementation of energy savings and adaptation measures in buildings, policy support is important to foster trust in a predictable and stable approach by the state. It is a sign to property owners and to the implementing companies and their subcontractors, as well as for manufacturers of materials and technologies.

For private property owners, a stable environment is important in the planning of their investments and the timing thereof, based on the availability of financial resources and the exploitation of synergy in the implementation of energy-saving renovation at the time the building needs to be renovated.

For energy-saving construction, a stable environment is important in the planning of business, whether this takes the form of investment in the construction of new production capacities, or in the training of existing and newly recruited workers.

MEASURE 1: INCORPORATION OF ENERGY SAVINGS SCENARIOS IN BUILDINGS INTO THE STATE ENERGY POLICY

The State Energy Policy is a high-level strategy document of the state covering energy management. Its role is to communicate medium-term and long-term plans of the state in this area to the public and businesses. Therefore, it should include scenarios for the renovation of the building stock (and a discussion thereof), or, if appropriate, incorporate a single preferred scenario, with an explanation of the reasons for its inclusion.

MEASURE 2: INCORPORATION OF THE POINTS OF THIS STRATEGY INTO OTHER STATE POLICY DOCUMENTS

Building renovation has an effect on many areas of the economy and society. This includes energy security, air protection, climate protection and adaption to climate change, housing development, the health of the population of employees, social cohesion, regional and local development, the business of small and medium-sized enterprises, and, in general, the economic policy of state. To ensure that the state adopts a consistent approach in all areas, the building renovation scenarios will be discussed and the relevant points of this strategy will be incorporated into sectoral policies. This is also important for good interdepartmental coordination. For now, this is problematic in the Czech Republic

13. Economic measures

The high initial investment costs of the energy-saving renovation of buildings are one of the main barriers to the implementation thereof. The Czech Republic has roughly 10 years' experience of offering support schemes, which help various groups of property owners to achieve energy savings in the operation of their properties. It is worth mentioning the Panel and the New Panel programmes, controlled and administered by the Ministry of Regional Development, the Green Savings and New Green Savings programmes at the Ministry of the Environment, the Efekt Programme at the Ministry

of Industry and Trade, and the operational programmes in the 2007-2013 programming period (the Operational Programme Enterprise and Innovation, the Operational Programme Environment, the Integrated Operational Programme and the Regional Operational Programme).

To cultivate the trust of property owners and to prevent fluctuations in the construction market, the programmes should be conceived as long-term schemes with an outlook at least to 2020, should have stable financing, and should maintain stable conditions of support. As it sets up its new operational programmes, the Czech Republic will also reduce the administrative burden on applicants and beneficiaries of support to the minimum possible level. On the other hand, requirements for the energy performance of buildings after renovation should be at a high level (although still cost effective).

MEASURE 3: NEW GREEN SAVINGS

The New Green Savings Programme, managed by the Ministry of the Environment and administered by the State Environmental Fund, is financed from revenues generated by auctions of emission allowances within the EU ETS. Section 4 of the Act on the Conditions of Trading in Greenhouse Gas Emission Allowances (Act No 383/2012) purposefully links at least half of the revenue from auctions to measures reducing emissions of greenhouse gases (or more, if the annual revenue from their sale is less than CZK 12 billion). Of that amount, half will now be channelled into the budgetary heading of the Ministry of the Environment and half into the Ministry of Industry and Trade heading in the period between 2013 and 2020.

Revenue for the Ministry of the Environment heading to 2020 is estimated at CZK 20 billion. These resources have been declared for use in the New Green Savings Programme. It is good that the programme has announced continuous acceptance of applications, which will create trust between it and applicants.

The New Green Savings Programme focuses on single-family buildings (energy-saving renovation and construction to the passive energy standard) because this area cannot be covered with European Structural and Investment Funds. Nor can they be used to finance the construction of multi-family buildings to the passive standard or energy-saving renovations of multi-family buildings in the City of Prague.

MEASURE 4: EUROPEAN STRUCTURAL AND INVESTMENT FUNDS 2014-2020

The new European Structural and Investment Funds in the 2014-2020 programming period are a major opportunity for the financing of energy savings in buildings. The new regulations on the European Structural and Investment Funds promote the use of resources to improve the energy performance of buildings. In fact, for the European Regional Development Fund, they demand a minimum allocation for the thematic objective of the transition to a low-carbon economy (which includes building renovations).

In the 2014-2020 programming period, support for energy savings in buildings is included in four operational programs: OP Enterprise and Innovation for Competitiveness (support for energy savings in industry and commercial buildings), OP Environment (support for energy savings in public buildings, construction of new public buildings to the passive standard), Integrated Regional Operational Programme (support for energy savings in multi-family buildings outside Prague) and OP Prague – Growth Pole (additional support for exemplary projects relating to energy-saving public buildings in Prague).

The drawing and effectiveness of use of funds from these programmes vary, but it can be said in general that they are gradually improving. A detailed analysis and recommendations are contained the Government's Report on the state of achievement of energy efficiency targets, which was approved by the Government in Resolution No 158 of 27 February 2017.

Measure 5: Energy Performance Contracting method

Energy Performance Contracting (EPC or 'guaranteed energy services') can be used to commercially finance energy savings with a short period of return (up to 8-10 years in the public sector or 5-7 years in the commercial sector, with lighting replacement possible even under three years), and may be applied in those situations where it is possible to guarantee a certain method of building use (in particular, administrative buildings, whether public or commercial, schools, hospitals, etc.). This method is typically appropriate for technological measures, but may also be used in combination with the renovation of building envelopes, if this is financed in another way. A combination of state aid and the EPC method guarantees the efficient use of public resources with additional effect.

In order to develop this method, it is necessary to ensure its possible practical concurrence with the awarding of a public contract for the renovation of public buildings under OP E and to legally ensure that it can be used so as to formally avoid increasing state or public debt.

Measure 6: Other financial instruments

An analysis of potential energy savings and essential investment resources indicates that the overall renovation of buildings is a measure that takes a long time to pay for itself (typically about 20 years), but this also means that the return on the investment is roughly 4-6% per year. Considering other comparable investment opportunities, this is an attractive proposition (perhaps not for the business sphere, institutions or households, but definitely for investment funds and banks).

We will have to analyse which of the barriers preventing massive investment in building renovation are pivotal and which can be removed. It is necessary to analyse market failures deriving, among other things, from the structure of building ownership, the necessary co-financing by owners, the expected benefits of renovation, the high diversity and relatively small (financial) size of projects, and the high transaction costs of implementation. This will serve as a platform for a discussion on the possible use of innovative financial instruments to make energy savings in buildings.

At present, the possibility should be verified of directly assigning the task to the Czech-Moravian Guarantee and Development Bank by the Ministry of the Environment, which does not exercise shareholder rights in it.

Measure 7: Building renovation in accordance with Article 5 of the Energy Efficiency Directive

The Energy Efficiency Directive requires Member States to make the energy-saving renovation of at least 3% of the floor area of buildings used by the central state administration. In the Czech Republic, roughly 500-600 structures fall within this category, according to statistics. During 2014, the Government decided how selected structures would be renovated (essentially it will proceed by starting with those that report the lowest energy performance) and how to finance such renovation. From 2017, up to 90% funding will be possible in combination with support from the OP E and NGS.

MEASURE 8: OBLIGATION OF ENERGY COMPANIES TO SAVE ENERGY AT THEIR CUSTOMERS

A discussion has started on what form the introduction of an obligation of energy suppliers or distributors to make savings among end customers should take. In line with Government Resolution No 923/2013, mandatory measures on an alternative scheme will be added if it becomes clear that the Czech Republic will not achieve its target for energy efficiency by 2020 by alternative measures alone. It might be viable to introduce the scheme during the voluntary stage, from 2018 at the earliest. The preference of energy companies is not to introduce this obligation.

14. Legislative and administrative measures

MEASURE 9: REQUIREMENTS REGARDING MINIMUM ENERGY STANDARDS FOR RENOVATION AND NEW CONSTRUCTION

Measures that have already been implemented include an amendment to Act No 406/2000 on energy management in order to transpose the Directive on the Energy Performance of Buildings (the amendment was approved as Act No 318/2012). This law, in line with the Directive, defines the minimum requirements concerning the energy performance of new buildings, major changes to completed buildings, and non-major changes to completed buildings. These requirements are defined at a cost-optimal level. For the purposes of publicly financed support schemes, the criteria should be more progressive, but should still be defined at a cost-optimal level.

In the second step, the Energy Management Act requires the construction of buildings with almost zero consumption (gradually for new buildings for which building permission is requested between 1 January 2016 and 1 January 2020). However, this standard is defined very vaguely and inadequately in the Implementing Decree on the energy performance of buildings. Based on a recommendation of the European Commission, it is necessary to revise this definition so it does not jeopardise the foreseeability of the business environment for builders, and to introduce the second step towards nearly-zero energy buildings that will be at the passive standard and use renewable energy sources, which will be mandatory from, for example, 2022.

MEASURE 10: BUILDING ENERGY PERFORMANCE CERTIFICATES

With a view to the clear measurability of the energy performance of buildings, the above-mentioned amendment to the Energy Management Act established clear methodology for this calculation and for the issuance of building energy performance certificates. The use of building energy performance certificates as proof of compliance with conditions concerning energy intensity has been established in every day practices. The use of building energy performance certificates to compare the energy quality of properties on the property market is still in its infancy. The inspection body for compliance with the quality of building energy performance certificates and compliance with other obligations under the Energy Management Act is the State Energy Inspectorate. The role of the inspection body will be strengthened so that these certificates consolidate their reliability as an instrument of certified quality.

The Ministry of Industry and Trade supported the preparation of the information portal www.prukaznadum.cz, which contains all important facts about building energy performance certificates. An information campaign was also conducted to explain the meaning of the building energy performance certificate.

In the next step it is necessary to amend Implementing Decree No 78/2013 on the energy

performance of buildings in order to better specify the boundary conditions (input values) for the calculation of the energy performance and to make it impossible for processors to choose their own values. This will also result in improved controllability of certificates by the State Energy Inspectorate.

MEASURE 11: TAX ADVANTAGE

The possibility of a tax advantage for energy-saving buildings should be examined. There is discussion of the possible amendment of legislation on property transfer tax that would stratify the rate according to the energy class of the building and enable tax relief to be used to take account of whether the person acquiring the real estate has invested in energy savings within a certain time limit (two years, say) after acquisition of the real estate.

It is also necessary to examine possible real estate, value-added or natural- or legal-person income tax advantages for energy savings.

MEASURE 12: COHERENT REQUIREMENTS OF BUILDING LEGISLATION

The Energy Management Act is a special piece of legislation linked to the Building Act (Act No 183/2006). At present, however, the building authorities do not always have a sufficient insight into the requirements of the Energy Management Act. The Building Act also empowers the Ministry of Regional Development to issue an implementing decree on the technical requirements of construction (268/2009) and Prague City Hall to issue a regulation with similar content (this institution is preparing 'Prague Construction Regulations').

It would be advisable to harmonise requirements in the Czech Republic as a whole and in Prague (either by removing structural technical requirements from the Prague Construction Regulations or by introducing the same requirements in both pieces of secondary legislation). Building authorities also require methodological guidance to ensure that the same administrative requirements apply throughout the country.

A specific requirement associated with energy savings in buildings (in particular the installation of new airtight windows) is the safeguarding of sufficient ventilation. Here, the requirements under the aforementioned regulations are inadequate, and it would be advisable, after expert debate, to finalise them so that hygiene standards and the quality of the indoor climate are respected at all times.

MEASURE 13: INTRODUCTION OF A SYSTEM FOR THE REPORTING AND EVALUATION OF ENERGY SAVINGS

It is important to reinforce the system for the reporting of the energy savings made in order to evaluate the effectiveness of the individual measures. This could then form a basis for the ongoing revision of the parameters of auxiliary measures and support schemes. It should also provide a coherent picture of the state of the energy performance of buildings and improvements in these conditions.

In addition to evaluations of the applications supported under programmes, data will be collected via the reporting of energy audits, energy performance certificates and direct reporting by public institutions.

This activity is partly performed by launching the ENEX electronic database of energy documents. It is also necessary to discuss with the Czech Statistical Office their methodology for collecting data so that developments in energy-saving construction (building statistics) and the achievement of energy saving targets (energy statistics) can be monitored directly.

15. Measures in the field of training and consultancy

MEASURE 14: REINFORCEMENT OF THE ROLE OF STATE-GUARANTEED CONSULTANCY

Ignorance of specific appropriate measures to improve the energy performance of a particular building, the investment demands thereof, and potential savings, increases the transaction cost of renovating buildings. This barrier can be tackled to a certain extent by reinforcing the role of state-guaranteed consultancy at Energy Consulting and Information Centres. It is also important, for common types of buildings, to prepare model projects quantifying the investment costs and the savings achieved.

It is important to raise awareness among property owners that the preparation of renovation is a complex activity, and that they will need contributions from an energy specialist, a designer or an architect, and a civil engineer. They should have realistic expectations about how long the process will take, and about the benefits of managing it to a high standard. It is also necessary to highlight the role played by the structural and technical supervisor of the client in order to ensure that the work and details are executed to a good quality. Special attention should be paid to awareness in ensuring sufficient quality of the indoor climate by means of a supply of fresh air.

MEASURE 15: TRAINING AT ALL LEVELS

Energy-saving construction requires major advances in the quality of work. There needs to be an emphasis on quality throughout the chain, encompassing the designer, the energy specialist, the construction company, any subcontractors, and the client's structural and technical supervisor.

To ensure that the construction work is prepared and executed to the necessary quality, the existing levels of training in energy-saving construction will be evaluated, and proposals may be made to reinforce certain areas. The analysis will encompass the training and lifelong learning of chartered engineers and technicians active in construction, architects, and energy specialists, as well as apprenticeships and secondary vocational education and, not least, higher-education institutions and research centres.

Sectoral unions and professional chambers will play a major role in this task. Work will be coordinated with them.

MEASURE 16: RESEARCH AND DEVELOPMENT

Barriers hampering reductions in energy consumption in buildings tend to be of a nature that is not technical or structural. Nevertheless, the development of new materials, technologies and procedures could significantly reduce the cost of implementing energy-saving measures. With this in mind, opportunities will be sought for the targeted support of research and development in energy-saving construction.

16. Measures for adapting buildings for climate change

MEASURE 17: PREVENTION OF THE OVERHEATING AND COOLING OF BUILDINGS

It is necessary to ensure the enforcement of requirements by the state administration (building authorities) and the professional public through the amendment of Implementing Decree No 499/2006 on building documentation (documentation for building permission must contain information on full compliance with Section 8(1)(f) energy savings and thermal protection –

overheating), as amended by Implementing Decree No 268/2009 on technical requirements for construction (specification of requirements for overheating and mandatory passive protection of buildings (shielding elements)), amend and update the methodology for evaluating summer stability, and ensure the incorporation of indoor temperature hygiene requirements.

MEASURE 18: MEASURE 18: ENSURING HYGIENIC CONCENTRATIONS OF CO_2 AND BUILDING VENTILATION

In order to maintain a healthy internal environment in buildings, the relevant legislation must require mechanical ventilation and lay down requirements for the indoor environment, including hygiene requirements, and ensure that they can be inspected. Furthermore, the enforcement of these requirements by the state administration (building authorities) and the professional public should be ensured. The legislative requirements for a maximum concentration of CO_2 of 1,500 ppm should be made uniform, and the guidelines for the Ministry of Regional Development and authorities should be amended as necessary. A proposed methodology for CO_2 measurement should be drawn up and then transferred to the Czech standards. A proposed methodology for CO2 measurement should be drawn up and then transferred to the Czech standards. Consideration may also be given to a requirement for heat recovery.

MEASURE 19: INTRODUCTION OF SUPPORT FOR VEGETATION AREAS

The creation of vegetation areas should be supported on roofs, facades and in the immediate vicinity of buildings, especially in the urban environment. Consideration may also be given to the introduction of such a requirement for certain types of buildings, for example, through the requirement to reduce the impact of urban thermal islands, for example by setting the maximum average surface temperature emitted into the surroundings. Examples of a motivation option could include support for vegetation areas under grant headings (see New Green Savings), and enabling a higher degree of construction in an area if it includes a certain amount of vegetation.

MEASURE 20: WATER MANAGEMENT

As part of the fight against drought and the prevention of the squandering of drinking water, consideration can be given to the introduction of support for efficient water management under grant headings or by setting legislative requirements. Support can be given for, say, direct water savings, the use of rainwater (in a structure or for irrigation), the use of grey water in buildings, and the use of energy from hot water or waste water.

16.1 Selection and calibration of measures for the implementation of individual scenarios

Two conclusions in particular follow from the outputs from the modelling of scenarios:

- to ensure an adequate contribution to the Czech energy efficiency target under the Energy Efficiency Directive, measures need to be implemented to achieve scenario 4 or, even better, scenario 5, which will then prevent the building stock from deteriorating and will use a desirable renovation cycle of 30 years,
- the implementation of shallow and moderate energy-saving renovations blocks part of the cost-effective potential, and although it leads to greater energy savings in the short term, it makes it more difficult to reach the level of energy consumption achieved by deep renovation.

In the case of grants, an effective support rate appears to be about 25% for single-family buildings and multi-family buildings, and about 50% for public buildings. With these rates, the public funds required would be approximately CZK 100 billion by 2020. However, the possibility should be examined of using financial instruments that leverage public funds not at the beneficiary level but at the level of the support provider.

When implementing measures leading to a relatively robust (but necessary) increase in the percentage of buildings renovated for energy savings every year, other policy, administrative and information measures as described in chapter 9.1 must be involved. This must lead to an increase in the absorption capacity of support programmes on the part of applicants and an increase in the capacity of the construction sector for high-quality energy-saving renovations. This requires political support, an active and systematic approach by the state, and coordination between stakeholders such as research and education institutions, professional chambers and trade unions.

To manage the risk of blocking part of the cost-effective potential of energy savings, it is also necessary to set support programme criteria correctly, or to tighten up the legislative requirements for the energy performance of renovated buildings. The acceptability criterion for support programmes would be at the recommended/low-energy standard (medium energy-efficient renovation) described above, but building owners would have a strong motivation to carry out renovations approaching the passive standard (deep renovation for energy purposes).

17 Conclusion

This is a background document for the Ministry of Industry and Trade in the fulfilment of the obligations under Article 4 of the Energy Efficiency Directive and for updating the State Energy Policy. It should also serve as a basis for any amendments to conditions for support programmes or the preparation of financial instruments to support energy savings after 2020. It also complements other documents that show that large-scale energy-efficient renovations of buildings, as mentioned in the Government's programme statement, are feasible and bring many benefits to society. They are an opportunity for both the construction sector and energy security, and for the Czech economy in general.

The study is based on a statistical and construction-technical analysis of the building stock and the possibilities of energy savings in buildings. Furthermore, in collaboration with the Buildings Performance Institute Europe, it models scenarios of possible ways to renovate the building stock in the Czech Republic and suggests measures that are necessary to realise the scenarios. Part of this measure also deals with quantification and calibration in order to realise the scenarios.

To complement this strategy, however, there must be consensus among politicians, the state administration, trade unions, professional chambers, educational institutions and other stakeholders to ensure the most efficient implementation of energy savings, preferably directly in the selected building renovation scenario. This must be followed by the elaboration of individual measures in specific steps with specific responsibilities of all designated entities, especially the state administration. Only in this way will this opportunity and challenge benefit of the citizens of the Czech Republic.

Annex 5

MINISTRY OF
INDUSTRY AND TRADE

Assessment of the potential for high-efficiency cogeneration and efficient district heating and cooling for the Czech Republic

December 2015

CONTENTS

LIST OF ABBREVIATIONS

BAT	Best available techniques
BAU	Business as usual
BGI	Biogas installation
CAPEX	Investment costs
CBA	Cost benefit analysis
CGU	Co-generation unit (a term used in the Czech Republic for a CHP installation with a combustion engine)
CHMI	Czech Hydrometeorological Institute
CHP	Combined heat and power
CNB	Czech National Bank
CR	Czech Republic
CSO	Czech Statistical Office
DS	Distribution system
EEX	European Energy Exchange
EMA	Act No 406/2000 on energy management
ERDF	European Regional Development Fund
ERI	Energy recovery installations
ERO	Energy Regulatory Office
EU ETS	EU Emissions trading system
EUA	EU emission allowances
GCC	Gas combined cycle
HA CR	Heating Association of the Czech Republic
HC	hard coal
HSS	Heat supply system
HW	Hot water
IEA	International Energy Agency
IHS	Individual heat supply
LIG	Lignite
MIT	Ministry of Industry and Trade
NAPERS	National Action Plan for Energy from Renewable Sources of the Czech Republic

NPV.....Net present value

OP E .....Operational Programme Environment 2014-2020

OP EIC .....Operational Programme ‘Entrepreneurship and Innovation for Competitiveness’

OPEX .....Other operating costs

ORC .....Organic Rankine cycles

PES .....Primary energy savings

PM .....Particulate matter

RES .....Renewable energies

REZZO .....Register of Emissions and Air Pollution Sources

SR .....Secondary resources

TA CR .....Technology Agency of the Czech Republic

WWTP .....Waste water treatment

EXECUTIVE SUMMARY

The energy sector of the Czech Republic has seen gradual changes in the fuel base and technologies in the last two decades. There is a decrease in the use of solid and liquid fuels (coal and heating oils from national sources), while the use of nuclear energy (for electricity production), natural gas (for individual heat production and smaller cogeneration sources) and renewable energy sources is increasing. These trends can be realistically expected to continue.

There has also been a significant reduction in heat consumption due to the streamlining of production, distribution and, in particular, heat consumption. Although there is still space for heat savings on the consumption side, the declining trend has noticeably slowed down.

Consumption of heat for heating, hot water and for technological purposes (excluding process heat) reached 445 PJ in 2013. The heat demand outlook given in this report reflects, on the one hand, the projected economic growth of the Czech Republic in services and industry and the increase in the number of households, and, on the other hand, the continuing trend of energy savings, which should offset the increased demand for heat. Forecasts predict a relative stagnation due to the combination of economic development / the number of households, and energy savings in all these sectors.

In terms of production, two-thirds of heat is produced at individual level and the remaining heat is produced centrally. Concerning central heat production, approximately three-quarters of heat is from combined heat and power generation (CHP), and one-quarter is from heat plants. The dominant fuel in individual heat production and heat generation is natural gas. Conversely, the dominant fuel in combined heat production is black and brown coal of predominantly national origin. In the combined cycle, about 11 to 12 TWh of electricity are currently being produced. Most of this production is in older coal-fired steam turbine plants. In terms of operating support, in 2014, 53% of the total CHP electricity produced was identified as high-efficiency CHP electricity.

The current situation in the Czech Republic is favourable in terms of the extent of the use of cogeneration. CHP sources and heat supply systems have a long tradition in the Czech Republic; the relevant technologies are available, and there is sufficient operating experience and know-how for the preparation and implementation of new high-efficiency CHP projects.

The potential for the development of high-efficiency CHP has been identified especially with smaller sources with power output of up to 10 MW_e. It will probably consist of an increase in the number of micro-cogeneration units[35], small[36] and medium-scale CHP sources based on natural gas. Growth of sources with high-efficiency cogeneration can also be expected in the area of biomass utilization, biogas installations (including heat transfer from existing sources) and the development of energy recovery of waste. However, the development of these high-efficiency CHP areas is conditional on maintaining stable economic incentives for investors and resource providers.

In relation to large sources, only limited potential for the development of high-efficiency CHP was identified. Heat from large sources such as cogeneration plants, factory energy installations and most power plants is currently being used at the place of production, or transferred to the consumer through a heat supply system (HSS). In HSS with large sources, it will rather involve a change in the fuel base (co-firing of renewable energy sources (RES))

[35] Under Directive 2012/27/EU, 'micro-cogeneration unit' means a cogeneration unit with a maximum capacity below 50 kW_e.
[36] Under Directive 2012/27/EU, 'small-scale cogeneration unit' means a cogeneration unit with installed capacity below 1 MW_e.

or alternative fuels, or improvement (increase) of CHP parameters (achieving higher efficiency or primary energy savings) as a result of resource reconstruction. However, concerning large sources, the risk of a possible reduction of electricity production from high-efficiency CHP cannot be overlooked. Current developments in the energy markets (and their consequences in the form of a reduction in wholesale electricity prices) can cause a downturn in electricity generation from high-efficiency CHP at large sources and a switch to a partially heat-plant operating regime. Most of the major heating sources in the Czech Republic use solid fossil fuels. Maintaining the current level of electricity generation from high-efficiency CHP is therefore also threatened by the tightening of environmental requirements and the expected increase in CO_2 allowance costs.

The general objectives of national energy policy and territorial energy policies proclaim support for the maintenance and development of high-efficiency CHP. Concrete measures in the form of setting primary legislation and implementing regulations provide a basis for the application of the energy and environmental effects of high-efficiency CHP. With regard to creating an appropriate economic and legislative environment for the further development of high-efficiency CHP and efficient district heating systems in the Czech Republic, this report recommends other appropriate measures, which should be implemented as soon as possible.

The analyses of savings in primary energy consumption and the society-wide benefits demonstrate the benefits of maintaining existing sources and developing new sources of high-efficiency CHP. In terms of the scope of new sources with high-efficiency CHP, it is recommended, on the basis of a cost-benefit analysis, to maintain the development within the CHP scenario, whose assumptions by 2025 include:

- Maintaining the current range of efficient SFAs and efficient sources with high-efficiency cogeneration
- The development of medium-scale and small gas fuel sources, complemented by the development of RES or alternative fuel sources (a total of 350 MW_e of electrical output of new sources by 2025).

The positive results of the CHP scenario represent a society-wide perspective of the operation of the existing and the development of new high-efficiency CHP sources. The market price of electricity does not provide operators of high-efficiency CHP sources with compensation for extra costs associated with energy savings and emission savings from the combined production of power and heat. In order to achieve the development of high-efficiency CHP according to the CHP scenario, which has been assessed as the most advantageous from the society-wide perspective by the cost-benefit analysis (CBA), it is necessary to ensure that the system of support of high-efficiency CHP electricity is maintained and to further develop a system of measures that will ensure the stability of the business environment in this segment of the energy sector.

1. Introduction

Article 14 of Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (hereinafter the 'Directive 2012/27/EU') provides the following:

- Section 1(1) By 31 December 2015, Member States shall carry out and notify to the Commission a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling, containing the information set out in Annex VIII.
- Section 3(3) For the purpose of the assessment referred to in paragraph 1, Member States shall carry out a cost-benefit analysis covering their territory based on climate conditions, economic feasibility and technical suitability in accordance with Part 1 of Annex IX.

The report 'Assessment of the potential for high-efficiency cogeneration and efficient district heating and cooling for the Czech Republic' contributes towards the above requirements for the Czech Republic.

In terms of its content and methodology, the report meets the requirements of Directive 2012/27/EU and was prepared in accordance with 'Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EC, and repealing Directives 2004/8/EC and 2006/32/EC; Article 14: Promotion of efficiency in heating and cooling' (SWD(2013) 449 final, of 6 November 2013).

The report is divided as follows:

- Chapter 2 contains the information under point (a) of Annex VIII to Directive 2012/27/EU, i.e. a description of heating and cooling demand
- Chapter3 contains the information under point (b) of Annex VIII to Directive 2012/27/EU, i.e. a forecast of how this demand will change in the next 10 years, taking into account in particular the evolution of demand in buildings and the different sectors of industry
- Chapter 4 contains map data according to point (c) of Annex VIII to Directive 2012/27/EU
- Chapter5 contains the information according to points (d) and (e) of Annex VIII to Directive 2012/27/EU, i.e.:
    - identification of the heating and cooling demand that could be satisfied by high-efficiency cogeneration, including residential micro-cogeneration, and by district heating and cooling;
    - identification of the potential for additional high-efficiency cogeneration, including from the refurbishment of existing and the construction of new generation and industrial installations or other installations generating waste heat;
- Chapter 6 contains the information under point (f) of Annex VIII to Directive 2012/27/EU, i.e. the identification of energy efficiency potentials of district heating and cooling infrastructure
- Chapter 7 contains the information under point (g) of Annex VIII to Directive 2012/27/EU, i.e. a description of the strategies, policies and measures that may be adopted up to 2020 and up to 2030 to realise the potential in chapter 5

- Chapter 8 contains the information under point (h) of Annex VIII to Directive 2012/27/EU, i.e. share of high-efficiency cogeneration and the potential established and progress achieved under Directive 2004/8/EC
- Chapter9 contains the information under point (i) of Annex VIII to Directive 2012/27/EU, i.e. an estimate of the primary energy to be saved
- Chapter 10 represents compliance with the requirement under point (j) of Annex VIII to Directive 2012/27/EU, i.e. to estimate public support measures to heating and cooling
- Chapter 11 represents compliance with the requirement under Article 14(3) to carry out a cost-benefit analysis covering their territory in accordance with Part 1 of Annex IX to Directive 2012/27/EU.

The report has been prepared on the basis of statistical data of the Ministry of Industry and Trade of the Czech Republic supplemented by the data of the Energy Regulatory Office (hereinafter referred to as 'ERO'), the Czech Statistical Office (hereinafter referred to as 'CSO'), the Czech Hydrometeorological Institute (hereinafter referred to as 'CHMI'), the IEA/Eurostat data and forecasts from strategic documents of the Czech Republic (State Energy Policy of the Czech Republic, National Action Plan for Energy from Renewable Sources of the Czech Republic[37], National Action Plan for Energy Efficiency of the Czech Republic, and others).

[37] Unless otherwise stated, the Report relies on the 2015 update to the NAP RES submitted to the inter-ministerial comment process.

2. Heating and cooling demand and the method to meet it

This part of the document aims to provide the information under point (a) of Annex VIII to Directive 2012/27/EU, i.e. a description of heating and cooling demand.

The following data sources were, among others, used to analyse the current heat demand and the methods to meet it:

- Ministry of Industry and Trade data from reports submitted by approximately 1,500 companies
- Ministry of Industry and Trade data on household consumption
- SCO data on energy balances of approximately 25,000 companies
- CHMI data on approximately 12,000 sources / 6,500 companies
- ERO data on approximately 2,400 price areas / 500 companies
- Natural gas distribution data for approximately 220,000 household supply and transfer points / 110,000 companies

Given the extent of the data to be processed, it is impossible to provide data on long-term trends. Therefore, information for 2013, for which comprehensive data is available for all analysed consumption segments, was processed for this document.

Complementary data from ERO, CSO, CHMI, IEA/Eurostat and other supplementary documents[38] were used to supplement the data. The methodologies of data collection and their evaluation used to report production and consumption of heat / CHP varies between entities, which should be respected in particular when comparing the results presented in this document with other documents.

2.1 Heat consumption

Heat consumption in the Czech Republic in 2013 amounted to approximately 583 PJ[39]. A large portion of this heat (124 PJ) was consumed in the form of process heat (fuel and energy consumption directly in process line furnaces and burners).

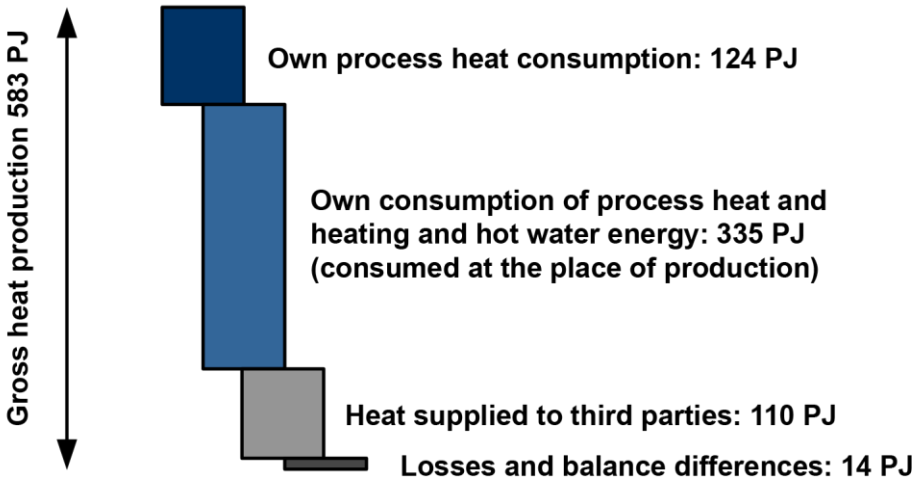
The remaining heat consumption can be divided into:

- own consumption of technological heat and heat for heating and hot water, that is, consumption directly at the location of generation without delivery to third parties,
- heat supplied to third parties, which includes all sales (not including own-consumption producers), that is,
    - supply to heat supply systems – district heating (licensed entities),
    - sales of heat as a licensed activity,
    - the supply of heat to a housing cooperative etc.,
    - supply at the generation site to foreign entities (unlicensed entities, unlicensed activity); heat supplied by a foreign entity during boiler room maintenance etc.,
- losses and balance differences.

The structure of the total heat energy consumption in the Czech Republic in 2013, broken down by the above categories, is shown in the figure below.

[38] Unless otherwise stated, the data used in this document are from the Ministry of Industry and Trade of the Czech Republic.
[39] Temperatures in 2013 were slightly above average - the deviation from the normal temperature was +0.4°C (Source: CHMI)

Figure 1 Heat energy balance in 2013



Source: Ministry of Industry and Trade

In terms of breakdown of heat consumption by sector (without considering own heat consumption), the largest consumption in 2013 was in the household scheme and amount to approximately 189 PJ[40]. The industrial sector[41] consumed roughly 176 PJ of heat energy. The remaining 80 PJ of heat consumption was recorded in the service sector, transport and other unspecified consumption.

Centrally generated and supplied heat accounts for about 150 PJ of the total annual heat consumption (445 PJ). Approximately 110 PJ is made up of centrally generated heat supplied to third parties. The residual 40 PJ of heat consists of the consumption by a self-producer (e.g. own consumption in technological facilities within factory energy installations which also supplies heat centrally outside the company; the supply of heat from the boiler room to the building of the boiler room owner, except heat sales to other buildings, etc.). This heat is not further included in the individual heat production statistics or forecasts, and remains in the category of centrally produced heat (see Table 1).

Summarised heat consumption data broken down by sector and by means of heat generation and supply (centrally or individually produced heat) in 2013 are presented in the table below.

[40] The value does not include process heat (heat not produced for heating or preparation of hot water).
[41] The industry sector involves mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste management, remediation activities and construction, and also includes agriculture and forestry.

Table 19 Consumption of heat energy in 2013 by sector and means of supply

Sector	Consumption of centrally produced heat [PJ]	Consumption of individually produced heat [PJ][42]	Total heat consumption [PJ]
Industry, agriculture and forestry	69	107	176
Households	54	135	189
Services, transport and others	27	53	80
Total	**150**	**295**	**445**

Source: Ministry of Industry and Trade, Czech Statistical Office

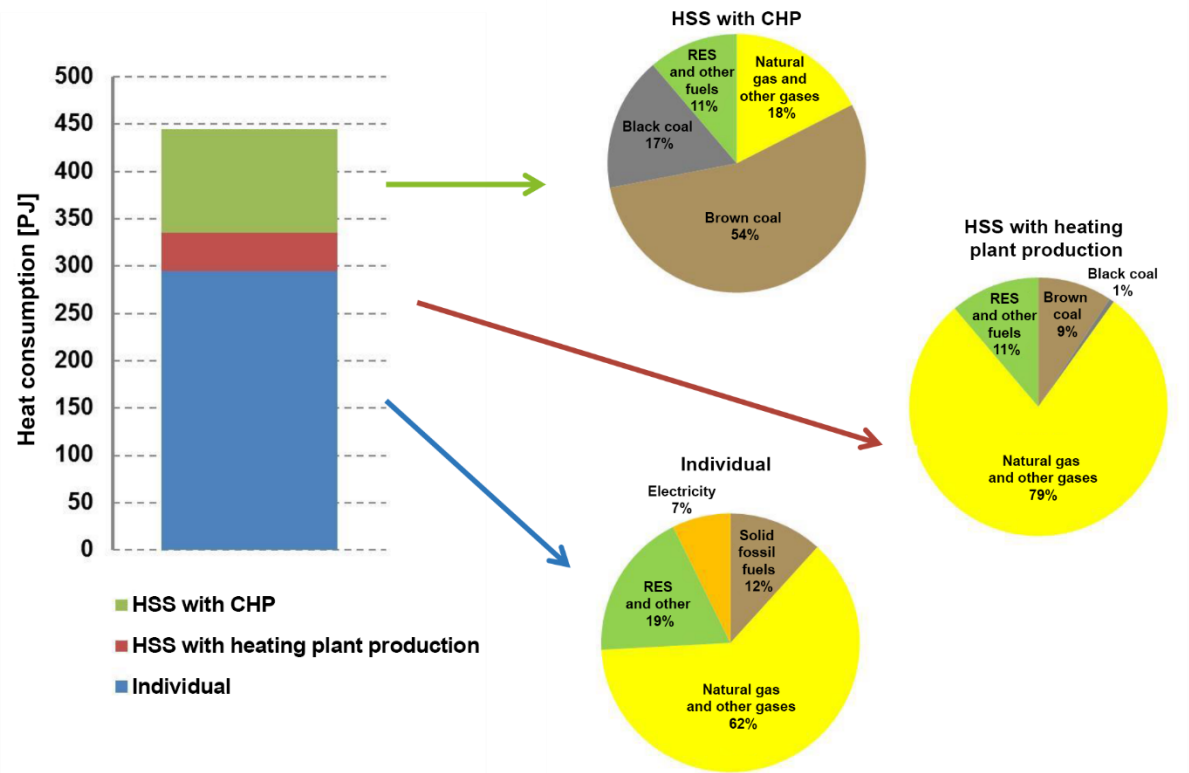
2.2 Heat production

Excluding process heat and heat to cover losses,[43] approximately 445 PJ of heat is produced annually in the Czech Republic for heating, hot water preparation and technological heat (heat energy used for technological purposes in industry).

Heat is generated centrally in heat supply sources to go to heat supply systems, and at the same time for consumption at the generation location or in individual sources for individual heat supply (hereinafter referred to as 'IHS'). The share of heat production in HSS and IHS is approximately 1:2. The converted shares of the components of the heat production are illustrated in the following chart.

[42] More detailed information on the structure of individual production and consumption of heat is provided in chapter 5.
[43] The total annual gross production of heat is approximately 580 PJ, of which about 120 PJ is produced and consumed in the form of process heat, and 15 PJ is loss and balance. Process heat includes a direct charge of fuel or energy into metallurgical processes, cement and lime production processes, production of glass, ceramics, etc. It is the consumption of fuel and energy directly in furnaces and at the burners of technology lines.

Graph 1 Structure of heat production in 2013



Source: Ministry of Industry and Trade, Czech Statistical Office, Heating Association of the Czech Republic

2.2.1 Centralised heat production

At present, approximately 2,000 sources centrally producing heat are registered. These are, on the one hand, heating plants supplying only heat and, on the other hand, power plants and cogeneration plants that supply CHP heat. The share of CHP heat accounts for approximately 75% of the total centrally produced heat.

Approximately 150 PJ of heat is produced centrally per year in the Czech Republic. Of this, approximately 110 PJ is delivered to third parties. The residual heat consists of the consumption by a self-producer (e.g. own consumption in technological facilities within factory energy installations which also supplies heat outside the company; the supply of heat from the boiler room to the building of the boiler room owner, except heat sales to other buildings, etc.).

This document breaks down centrally produced and supplied heat to CHP heat and separately produced heat. While the amount of CHP heat has correlated in recent years with the temperatures and reflects the effect of energy savings (according to the CSO, a 17% decrease in CHP heat in the period 2000–2013), a more significant decrease in heat production is seen in the case of heating plants (according to the CSO, in the period 2000–2013 heat produced in heating plants decreased by 37%).

As for the fuel mix of CHP heat, the dominant fuel is brown coal, which accounts for more than half of the fuel consumption. Concerning heat produced separately, natural gas is the dominant fuel, which covers 79% of fuel consumption in this production. The percentages of consumption of individual types of fuels in the production of heat in CHP plants and heating

plants are shown in the table below.

Table 20 Fuel shares in central production of heat in CHP plants and heating plants

Fuel	Share with CHP [%]	Share with heat plant production
Lignite	54	9
Coal	17	1
Natural gas and other gases	18	79
RES and other fuels	11	11

Source: Ministry of Industry and Trade, Czech Statistical Office

The following table shows the structure of CHP plants as at 31 December 2014. It can be seen from the table that most of the installed capacity is attributable to thermal power plants with an installed capacity of more than 5 MW_e-9,915.6 MW_e. The thermal installed capacity of these sources accounts for more than 88% of the total installed heat capacity of CHP plants. As mentioned in Chapter 10.2.1, almost 75% of CHP electricity comes from sources with an installed capacity of more than 5 MW_e.

Table 21 Structure of CHP plants (December 2014)

Plant capacity	Technology	Total installed capacity, electricity [MW_e]	Total installed capacity, heat [MW_t]
Up to 1 MW_e (inclusive)	Steam power plants	13	537.4
	Steam-gas plants	0.0	0.0
	Gas firing plants	296.6	341.9
	Total	**309.6**	**879.4**
1 MW_e up to 5 MW_e (inclusive)	Steam power plants	82.8	1266.9
	Steam-gas plants	0.0	0.0
	Gas firing plants	239.0	283.4
	Total	**321.8**	**1550.3**
Over 5 MW_e	Steam power plants	9,792.2	18,080.0
	Steam-gas plants	118.0	119.9
	Gas firing plants	5.4	7.9
	Total	**9,915.6**	**18,207.8**
Total	Steam power plants	9,888.0	19,884.4
	Steam-gas plants	118.0	119.9
	Gas firing plants	541.0	633.1
	Total	**10,547.0**	**20,637.4**

Source: Energy Regulatory Office

2.2.2 Individual production of heat

Individual heat production takes place in individual sources, such as boilers using solid, liquid or gas fuels, heat pumps, solar collectors, etc. In the Czech Republic, approximately 295 PJ of heat is produced per year individually, of which approximately 45% represents individual heat production and subsequent consumption in households. The remaining amount of

individual heat production is then produced in industry and services. Only a small part of individually produced heat is CHP.

As far as household fuels are concerned, natural gas (60% of households) is the most used, followed by a group of households burning coal, coke or briquettes with a share of less than 15%. Approximately 13% of households burn biomass as the primary fuel for the production of heat. Electricity accounts for 12%.

Similarly to households, natural gas is the most used fuel in individual heat production also in industry and services sectors, where it accounts for about 63%. An overview of the share of individual types of fuels is given in the following table.

Table 22 Share of fuels in individual heat production

Fuel	Fuel share in households [%]	Fuel share in industry and services [%]
Natural gas	60	63
Other fossil fuels	15	9
Electricity	12	2
Biomass and others	13	26

Source: Ministry of Industry and Trade, Czech Statistical Office, Heating Association of the Czech Republic

2.3 Consumption of cooling

Cooling is not particularly developed in the Czech Republic due to local climatic conditions. It is usually used in administrative and service buildings, and in industrial applications where constant temperature conditions are to be maintained.

Neither producers nor consumers of cold are currently under any reporting obligation, and the precise volume of supply/consumption of cold is not therefore known. Although in the Czech Republic there exists the individual production of cold and a cooling supply system, the demand for cooling has not been statistically evaluated.

In most cases, these are individual sources of cold for consumption in the structure in which the heat-carrying medium is produced. Applications of ‘trigeneration’, that is, the combined production of electricity, heat and cold (usually based on combustion engine technology) also make an appearance.

As far as heat supply systems are concerned, these are mostly a combination of hot water/steam distribution and absorption cooling, where heat is used as the driving energy for the production of cold. Cold is delivered in this way to industrial companies, service users and, for example, mining companies. With regard to technology, the supply of cold is included in heat production. It is estimated that the central supply of cold in the Czech Republic reach levels of approximately 300 to 400 TJ/year.

3. Forecast of demand for heating and cooling

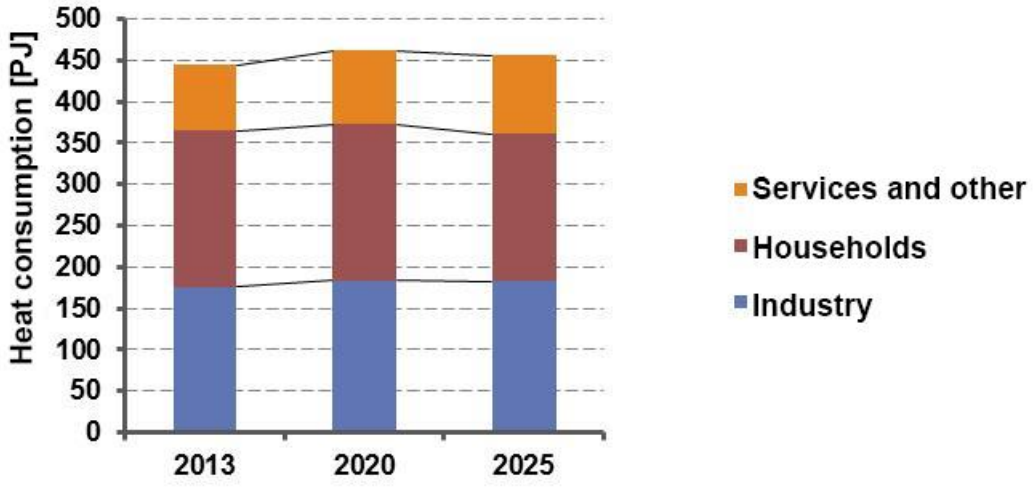
The aim of this part of the document is to provide the information under point (b) of Annex VIII to Directive 2012/27/EU, that is, a forecast of the demand for heat in the next 10 years, with particular regard to the consumption of heat in buildings and in individual branches of industry.

The heat demand forecast reflects the expected economic growth in individual sectors. The Czech Republic expects continued economic growth and gradual convergence towards developed European countries. In some sectors, however, there may be structural changes with a gradual slowdown in favour of the service sector in particular. In the area of industrial production, the most significant growth is expected in the processing industry. Conversely, a decline is envisaged in the mining and extraction of raw materials. In aggregate, industrial sectors are projected to increase production by as much as 40% by 2025 (at constant prices compared to the reference year 2013). In services, production is expected to grow in virtually all sectors (in aggregate across the sectors, by more than 50% compared to 2013). In addition, the forecast predicts the continuation of the upward trend in the number of households. In line with economic growth, there should be a gradual increase in demand for heat, in technological processes, industrial consumption and final consumption.

The forecasts assume, however, a continuing trend of energy savings that should offset pressure on the rise in demand for heat. For industry, this represents an average 25% reduction in specific heat consumption per unit of production, and up to 27% for service sectors (comparison of the 2013 reference year and the forecast for 2025). For the population, the continuing trend of savings measures is expected to reduce consumption in the case of existing buildings by 10%. The resulting relative stagnation is a combination of relative growth pressures due to growth in natural production in the industrial sectors and in purchasing power, household appliances and the number of households, and energy savings in all these sectors.

For all sectors, heat consumption is stated without process heat (process heat is described in chapter 2) or losses.

Graph 2 Heat consumption forecast



An overview of the consumption of heat by sector and means of supply is given in the following Table[39].

Graph 23 Heat consumption forecast [PJ]

Sector	2013	2020	2025
Industry, agriculture and forestry	176	184	183
Households	189	189	179
Services, transport and others	80	89	94
Total	**445**	**462**	**456**

4. National maps of heating and cooling

The purpose of this part of the document is to provide the information according to point (c) of Annex VIII of Directive 2012/27/EU, that is, to draw up maps of the Czech Republic which, while maintaining the confidentiality of commercially sensitive information, show:

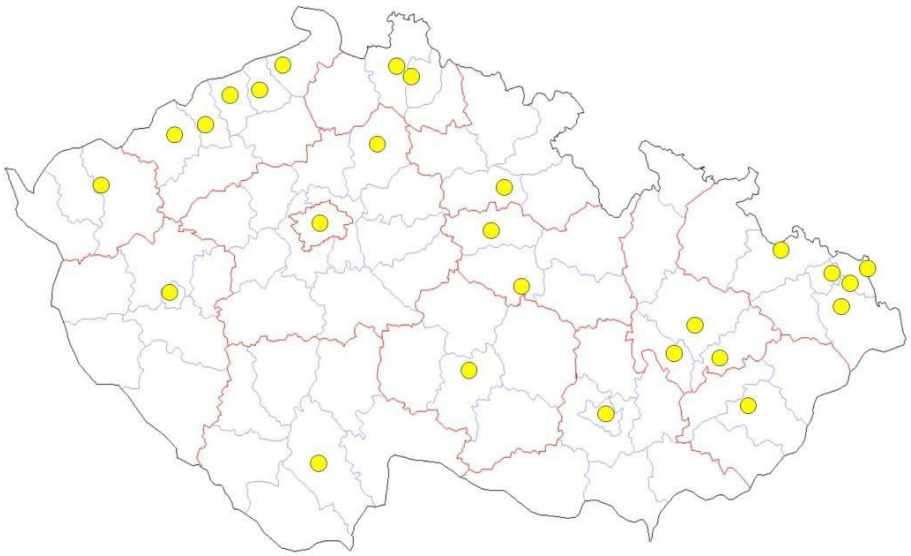
- areas of demand for heating and cooling
  - towns and suburban areas
  - industrial zones
- existing and planned district heating and cooling infrastructure,
- possible areas offering heating and cooling
  - electricity generation installations
  - waste incinerators
  - existing and planned installations with CHP and district heating installations;

4.1 Areas of demand for heating and cooling

4.1.1 Towns and suburban areas

The breakdown of towns and suburban areas the indicator ‘plot ratio > 0.3’ is not available in the Czech Republic. The following map therefore shows the most significant municipalities in the Czech Republic – statutory cities (Prague, Plzeň, Liberec, Brno, Ostrava, České Budějovice, Havířov, Hradec Králové, Karlovy Vary, Olomouc, Opava, Pardubice, Ústí nad Labem, Zlín, Jihlava, Kladno, Most, Karviná, Mladá Boleslav, Teplice, Děčín, Frýdek-Místek, Chomutov, Přerov, Jablonec nad Nisou and Prostějov).

Figure 2 Map of statutory cities in the Czech Republic

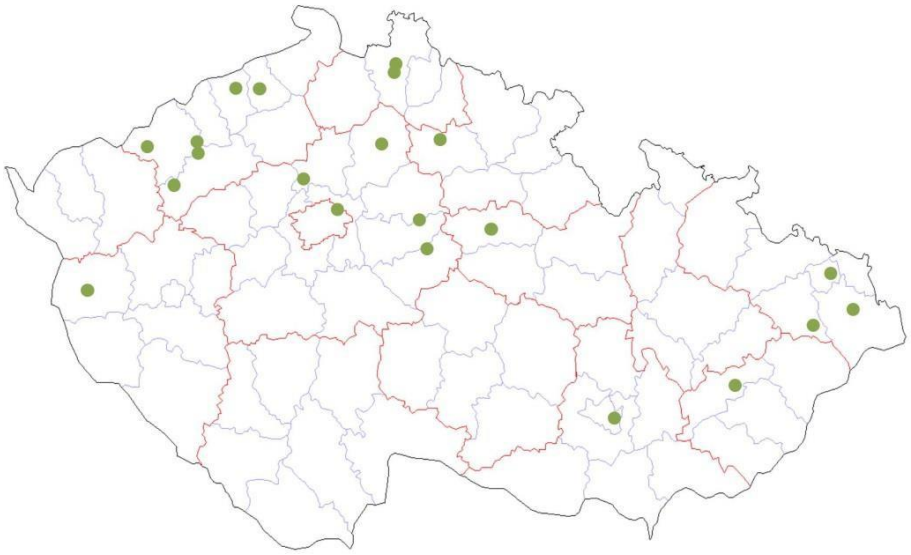


4.1.2 Industrial zones

The classification of industrial zones by heat consumption is not recorded in the Czech Republic. The following map shows industrial zones with an area used of more than 50 ha (Kolín-Ovčáry, Ostrava - Mošnov, Most Joseph, Holešov, Žatec - Triangle, Nošovice, Kutná Hora - Na Rovinách, Liberec South-Doubí, Bor Logistics Park, Mladá Boleslav-East, Kozomín-Úžice, Klášterec n.O. Industrial Park VERNE, Jičín-Industrial Zones I, II, III,

Černovická terasa, Krupka Industrial Park, Liberec North-Růžodol Business and Industrial Zone, Ostrava-Hrabová, Pardubice-Free Zone + Staré Čívice, Podbořany-Alpka, Business Area, Vlčovice, Ústí nad Labem-North Předlice, VGP Park Horní Počernice).

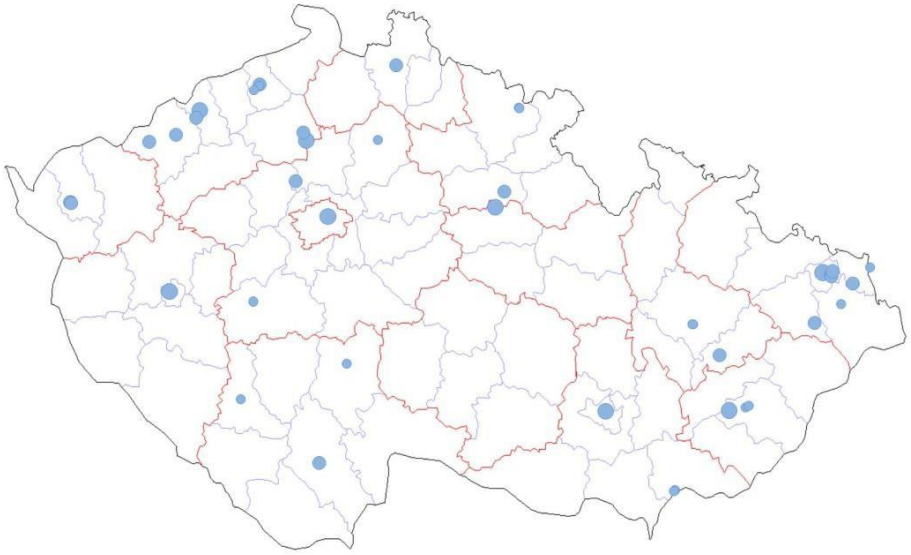
Figure 3 Map of industrial zones



4.2 Infrastructure for district heating and cooling

The following map shows the most important heat supply systems in the Czech Republic; systems with a transmission capacity of 200 MW_t were selected for inclusion (Hodonín, Trutnov, Tisová, Prunéřov, Ostrava Vítkovice, Plzeň, České Budějovice, power line from Mělník and distribution systems in Prague, Strakonice, Ústí nad Labem, Ostrava, Karviná, Havířov, Olomouc, Přerov, Frýdek Místek, Ústí nad Labem, Zlín, Liberec, Brno, Hradec Králové, Mladá Boleslav, Příbram, Ostrava, Tábor, Olomouc, Štětí, Chomutov, Hodonín, Vítkovice, Ústí nad Labem, Litvínov, Zlín, Plzeň, Opatovice, Kralupy nad Vltavou, Most-Komořany, Kopřivnice, Otrokovice). The heat transfer system from the Temelín Power Plant is the only planned district heating infrastructure that can currently be considered to be extensive. Given that the development of high-efficiency CHP is predominantly planned for smaller generators, there will be no need to embark on extensive infrastructure projects for district heating.

Figure 4 Infrastructure map for district heating

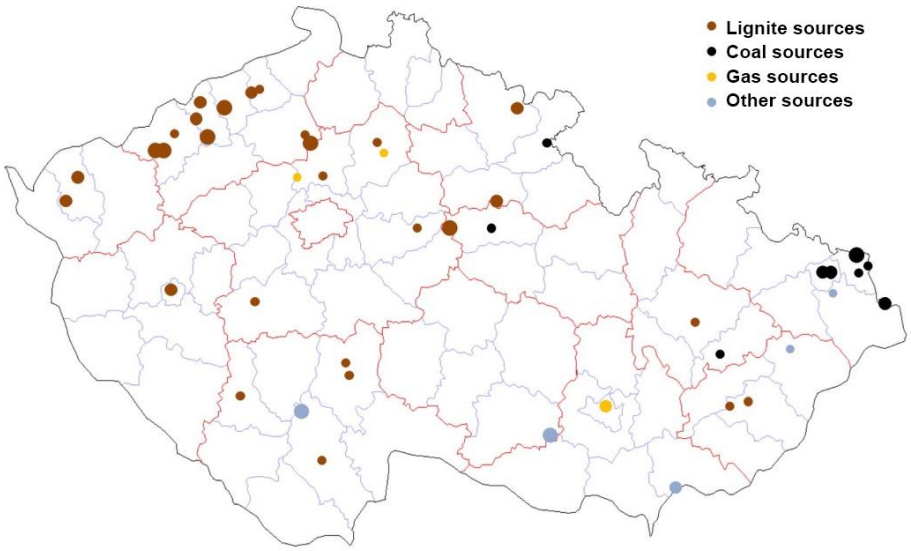


4.3 Heating and cooling supply locations

4.3.1 Electricity generators

The following map shows the largest existing sources in the Czech Republic with production of more than 20 GWh/year where CHP technology is already used, or where the sources are suitable for the use of CHP technologies (Ledvice, Mělník, Chvaletice, Tušimice, Počerady, Poříčí, Prunéřov, Tisová, Trmice, Kladno, Zlín, Opatovice, Vřesová, Chomutov, Plzeňská energetika, Plzeňská teplárenská, České Budějovice, Olomouc, Kolín, Komořany, Příbram, Strakonice, Tábor, Ústí nad Labem, Štětí, Otrokovice, Planá n.L., Neratovice, Mladá Boleslav, Litvínov, Dětmarovice, Třebovice, Karviná, ČSA-Karviná, Přerov, Ostrava-Přívoz, Náchod, Třinec, Synthesia Pardubice, ArcelorMittal Ostrava, Vítkovice, Brno, Kralupy nad Vltavou, Dobrovice, Hodonín, Biocel Paskov, Valašské Meziříčí, Temelín, Dukovany).

Figure 5 Electricity generators with technologies enabling CHP



Most of the thermal power plants in the Czech Republic that generate more than 20 GWh/year allow the supply of heat in the CHP mode, or have a certificate of origin of electricity from a high-efficiency CHP plant (with the exception of Počerady, Mělník III, PPC Vřesová and Dukovany). At another 19 sources with production above 20 GWh/year, CHP is not feasible (these are hydro, photovoltaic and wind power plants). Other sources include nuclear power plants and biomass and secondary sources.

4.3.2 Waste incinerators

The following map lists the three existing municipal waste incinerators in the Czech Republic (Prague, Brno, Liberec with a total annual consumption of about 650,000 tonnes of waste) and the most important incinerator of industrial waste in Ostrava (consumption of about 20,000 tonnes of waste).

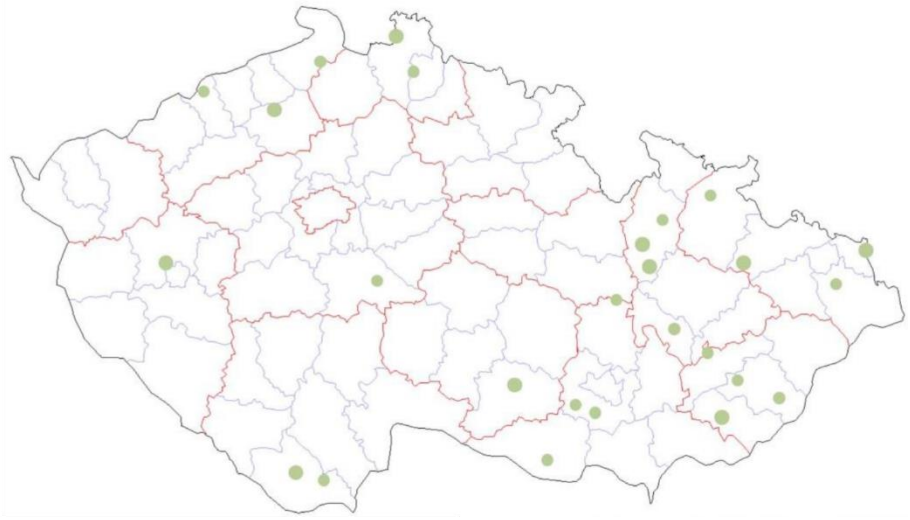
Figure 6 Map of waste incinerators

In the Czech Republic another 23 smaller incinerators for industrial/hazardous/medical waste are in operation with minimal potential for energy recovery. An incinerator with a capacity of 100,000 tonnes is currently under construction in Chotíkov near Plzeň.

4.3.3 Planned installations with CHP and heating plants

The following map is based on authorisations issued for the construction of electricity generators and shows planned electricity generators with technologies enabling CHP (selected for illustration were sources with planned electrical capacity of more than 2 MW_e).

Figure 7 Planned installations with CHP



Plans to construct heating plants are not centrally recorded in the Czech Republic

5. Potential for CHP development and district heating installations

The purpose of this part of the document is to provide information under points (d) and (e) of Annex VIII to Directive 2012/27/EU, that is:

- identification of the heating and cooling demand that could be satisfied by high-efficiency cogeneration, including residential micro-cogeneration, and by district heating and cooling;
- determination of the potential for other highly efficient CHP, including through the reconstruction of existing and the construction of new generating installations and industrial installations or other plants generating heat from waste

From the point of view of the methodology, the current state and the expected development of the individual types of heat production are commented on in order to determine the potential for the development of high efficiency CHP and district heating, or the potential to cover demand using such installations.

With regard to the types of production and supply of heat, the chapter is divided into:

- central and individual heat sources,
- cogeneration sources and separate heat production sources.

In the field of centralised heat production, cogeneration sources are mostly used in the Czech Republic, while in the field of individual heating, the sources are mostly with separate heat generation.

The main objective of this chapter is to determine the potential of individual heat generation technologies and district heating, taking into account the overall demand for heat referred to in chapter 3.

5.1 Sources in centralised heating systems

Sources of heat supply to district heating systems in the Czech Republic can be divided into several groups:

- Large sources with CHP using solid fossil fuels – lignite and coke, or a combination with other fuels (sources with steam boilers and backpressure or condensing collection turbines),
- Large sources with CHP using gas or liquid fossil fuels – natural gas and technological gases or heating fuel (sources with steam boilers and backpressure or condensing collection turbines or GOGAS sources with heat supply)
- Smaller sources with CHP using natural gas (cogeneration units with combustion engines)
- Smaller sources with CHP using biomass and alternative fuels (biomass sources
- with steam turbines or the ORC cycle, biogas installations with combustion engines, waste incinerators with steam turbines)
- Nuclear power plants
- Sources using chemical and waste heat
- District heating sources using fossil or other fuels

Central sources supply to the district heating system around 110 PJ of heat per year in the form of hot and very hot water or steam. In the case of central sources, part of the heat is consumed directly at the place of generation. In the long term, a ratio of approximately 3:1 between heat from CHP and heat from heat plants (with a slightly increasing trend in favour of CHP) is maintained at central sources.

5.1.1 Large sources with CHP using lignite

In the Czech Republic, the generation of electricity and heat developed in the second half of the 20th century with the availability of high-quality domestic lignite in the North Bohemian and Sokolov lignite basin. Lignite is therefore also the dominant fuel in the Czech Republic in the area of CHP and represents approximately half of the district heating supply. This fuel is used in particular in sources in areas at a favourable distance from lignite basins, that is, especially in northern, western, southern and central Bohemian regions.

District heat from CHP at the level of about 50 PJ/year is supplied by more than 45 sources with a total installed electrical capacity of approximately 9 GWe (40% installed electrical power in the Czech Republic). Lignite is burned in some sources together with other fuels – biomass, coal or alternative fuels. These sources are of the heating plant and factory energy installation type, but most electricity power plants also supply heat. Sources with CHP using lignite therefore make a significant contribution to the reliable operation of the power system.

The potential for the supply of heat from lignite sources with CHP has largely been exhausted in the Czech Republic. No further significant development of new sources or increased heat supply can be expected (district heating systems have already been introduced in place of lignite CHP plants). Operators of existing resources will have to face pollutant emissions reduction requirements and increased production costs due to the purchase of $CO2_2$ emission allowances. Another risk for sources of this type is the falling wholesale electricity prices, which reduce the economic efficiency of CHP and, in the extreme case, can cause a transition from cogeneration plant to heating plant heat generation. One of the aims of the Czech Republic's energy policy is therefore to maintain the highest level of district heating systems connected to sources with high-efficiency CHP making efficient use of domestic lignite.

Heat generation in sources of this type will correspond to increasing energy efficiency on the consumption side in the future. Excluding the reduction of heat consumption, there is also potential for increasing energy efficiency both on the source side and on the heat supply system side. For sources, this usually involves the reconstruction of boilers or turbines with parameters better suited to the current level of heat supply. On the system side, it involves the transition from steam distribution systems to hot water distribution systems. Achieving this potential is nevertheless difficult in view of the financial and technical complexity of the related measures. Looking ahead to 2025, a decline in lignite production and increase in consumption of other fuels are expected. The trend in heat production from lignite sources with CHP is slightly downward in view of the assumptions above.

5.1.2 Large sources with CHP using coal

Coal is another major source in the area of CHP and district heating supply. It accounts for about 15% of the supply of district heating from CHP. All large sources using coal operate in CHP mode (cogeneration plants, factory power installations and one power plant). This fuel is mainly used in northern Moravia, Silesia and eastern Bohemia.

Most sources are currently undergoing greening related to the requirements of Directive 2010/75/EU. It is also expected that sources of this type will be maintained to maintain due to an expected reduction in heat generation in connection with reduced heat consumption. Coal sources are also threatened by the decreasing economic efficiency of CHP, and face similar risks of transition to heating plant production as in the case of lignite. Further significant

development in the use of coal for CHP relating to the district heat supply cannot be assumed because district heating systems are already in production areas.

The expected trend until 2025 in heat production from coal sources with CHP is slightly downwards.

5.1.3 Large sources with CHP using gas or liquid fuels

CHP sources using gas and liquid fuels account for approximately 15-20% of CHP district heat supply. Regarding fuels, other than natural gas, technological gases from metallurgical and chemical production are used; the trend in the use of liquid fuels is declining.

From the point of view of the types of source, they are cogeneration plants or factory power installations predominantly using turbine steam boiler technology (steam-gas cycles have not expanded significantly in the Czech Republic so far).

The development of sources of this type cannot be expected in the future (the use of natural gas in large CHP sources is not economically efficient in the Czech Republic and the use of natural gas will developed at the level of smaller CHP plants). Looking ahead to 2025, stagnation or a slight decline in heat generation using this technology can be expected.

5.1.4 Biomass sources with CHP

Biomass is used in large CHP sources for co-firing with solid fossil fuels (but the use rate is limited by the technical possibilities of the combustion plant on the one hand, and support for the use of biomass on the other) and separately.

Except for large sources co-firing biomass, around 25 small cogeneration biomass sources with a total capacity of 80 MW_e supply heat in the Czech Republic. There is potential for the development of this technology at locations with existing central heat generation. Limiting conditions for development are the availability of biomass at the site of future production and the possibility of receiving support for new sources.

Within the framework of the NAP RES, an increase is expected of heat production from biomass outside households by 2020 of 4.5 PJ (through the co-firing of renewable and non-renewable sources and separate combustion). Beside the potential increase in the co-firing of biomass in a large sources, it can be expected that a number of smaller plants with CHP will be launched into operation, separately using biomass (installed capacity of 10-15 MW_e, or 20-30 MW_t. Assuming the use of heat output of 3,000 hours/year, this would mean a potential increase in the annual heat supply from new biomass sources of 0.3 PJ by 2025).

5.1.5 Biogas installations with CHP

Biogas installations were mainly developed in the Czech Republic between 2008 and 2013. Currently in the Czech Republic, more than 570 biogas installations are in operation with a total installed capacity of approximately 370 MW_e. Of this number, 70% of biogas installations are agricultural, and the rest are units located at waste water treatment plants (WWTP), amounting to approximately 20%, and waste dumps (10%).

The heat produced during the operation of the combustion engine is partly used to maintain fermentation (about 20%). In most cases, however, the rest of the heat produced is not wholly available for sale due to the relatively large distance of the cogeneration unit from the potential heat consumption. One of the supported activities under the operational programmes until 2020 is therefore support for the transfer of heat from biogas installations.

Under the NAP RES, biogas installation output is expected to increase by 36 MW_e and the generation of heat by 1.3 PJ by 2020. In 5-10% of existing biogas installations, however, there is potential for heat transfer, usually as a substitute for existing smaller heating sources. Assuming the use of heat output of 3,000 hours/year, a potential increase by 2025 in newly supplied heat from existing and new biogas installations can be estimated at 2 PJ.

5.1.6 Waste incinerators with CHP

In the Czech Republic, three municipal waste incinerators are in operation with a total annual capacity of about 650,000 tonnes of municipal waste. All sources are equipped with CHP facilities:

- ERI Malešice (heat supplied for distribution and consumption in City of Prague)
- SAKO Brno (heat supplied for distribution and consumption in the City of Brno)
- Termizo (heat supplied for distribution and consumption in the City of Liberec)

At present, another municipal waste incinerator – ERI Chotíkov, is under construction, again with high-efficiency CHP technology and heat transfer for distribution and consumption in the City of Plzeň.

In addition, there are five cement plants in the Czech Republic that enable co-incineration of waste in their furnaces (Králův Dvůr, Čížkovice, Prachovice, Mokrá, Hranice). Approximately 340,000 tonnes of usually hazardous/ industrial waste is used here. Self-produced heat is used for energy in these cases as process heat.

Furthermore, there are 24 smaller incinerators for industrial/hazardous/medical waste in the Czech Republic with an annual consumption of approximately 80,000 tonnes.

In the Czech Republic, according to data from the Ministry of the Environment, approximately 5 million tonnes of municipal waste is generated annually. In line with waste management plans, landfilling of mixed municipal waste should be restricted by 2024, which is also an opportunity to develop incinerators. At present, however, projects under development are running into economic feasibility problems resulting from very low fees for the landfilling of mixed municipal waste and lengthy authorisation processes. The new Waste Act, which the Ministry of the Environment is currently working, should bring a significant increase in landfill fees for mixed municipal waste.

In the case of the development of the use of waste for energy, this will mainly involve CHP installations – for larger sources with a pass-out condensation turbine set, for smaller sources, the development of pyrolytic or plasma gasification.

Within the framework of the NAP RES, heat generation from the biodegradable fraction of municipal waste is expected to increase by 0.3 PJ by 2020. In the Czech Republic, there is the potential to use is about 1.4 million tonnes of municipal waste for energy. Assuming the energy use of all available fuel, the growth potential of electric power incinerators is estimated to be 30 MW_e with annual heat supply of 3 PJ/year during the 2016-2030 period.

5.1.7 Nuclear power plants

For both nuclear power plants in the Czech Republic there are plans to transfer heat for heating purposes. The situation is relatively complicated, due in particular to the considerable distances from larger settlements where the heat could be used.

Temelín Power Plant

At present, the heat from Temelín Power Plant is supplied to the municipality of Týn nad Vltavou in the amount of about 0.2 PJ/year. A major plan is under consideration to construct a hot water supply from the power plant to České Budějovice. The length of the power supply from the power plant to the point of delivery to the district heating system would be approximately 25 km, and the assumed quantity of heat supplied would be approximately 1.0-1.5 PJ/year. Thus, approximately half of household consumption could be covered by the power supply. The plan reached the stage when a land-use decision was issued.

For the current heat producer and distributor for České Budějovice, this plan is relatively complicated. On the production side, a potential reduction in supply would reduce CHP efficiency and it would also be necessary to leave sufficient power backup in case of an unplanned shutdown of the Temelin Power Plant blocks or a defect in the power supply. At the same time, the transfer of heat to hot water would require the reconstruction of the heat distribution system.

Dukovany Power Plant

The heat from the Dukovany Power Plant is currently used only in the area of the plant. There is a plan to transfer heat to the City of Brno, about 40 km away, which would include supplying several smaller municipalities along the power supply route. Construction would be complicated: along the route it would be necessary to cross two rivers and build several tunnels. These conditions require a higher level of specific investment and, in terms of economic efficiency, the project would only be feasible provided that heat consumption is approximately 4 PJ/year.

The requirement for the quantity supplied would essentially mean the replacement of the whole district heating source base in Brno (including the municipal waste incinerator and other existing gas sources with CHP). At the same time, sufficient power backup would have to be maintained in case of a malfunction. At present, the renovation of Dukovany Power Station, which will reach the end of its original design lifetime in 2015-2017, is far from certain.

The possibility of building a supply line from Dukovany Power Plant can therefore be considered theoretical and the potential of this possible source will probably not be exploited.

5.1.8 Waste and chemical heat

The use of waste or chemical heat is currently recorded at a level of 5-7 PJ/year and is used for consumption at the point of origin and for the supply of heat to district heating systems. It can be assumed that there is potential in the manufacturing industry to increase the share of process heat use (heat consumption is up to 100 PJ/year). Therefore, the supported activities within the operational programmes include the use of waste energy in the production processes and increasing the energy efficiency of production and technological processes.

5.1.9 Small and medium-sized CHP sources using natural gas

At present in the Czech Republic, approximately 300 machines operate with CHP with an output of 50 kW_e to 5 MW_e using natural gas, with a total installed capacity of about 220 MW_e. In this area of high-efficiency CHP, there is the possibility of significant growth by 2025, mainly as a result of the transition from the existing heating plant generation, accompanied by sources in new structures. A prerequisite for the development of this technology the maintenance of existing support schemes.

The starting point for estimating the development potential of high-efficiency CHP in existing heating plant production is the REZZO (Register of Emissions and Air Pollution Sources) database. From this database, sources were selected that burn natural gas (in areas where the fuel is available) without installed CHP that produces process heat. The development potential was determined using those values:

- micro-cogeneration (see chapter 5.2.5)
- small and medium sources with high-efficiency CHP (see the following table).

Table 24 Technical potential development of small and medium cogeneration up to 2025

Category [kW_e]	50÷200	200÷1,000	>1,000	Total
Estimated potential – el. output [MW_e]	210	360	260	830
Estimated potential – heat production [PJ]	2.5	6.8	4.3	13.7

Except for the standard supply of heat from cogeneration units in the form of water or steam, demand is emerging for cogeneration units supplying process heat for industrial applications (e.g. for drying various materials and raw materials).

5.1.10 Centralised heating plant sources

The dominant fuel in centralised heating plant production is natural gas supplemented with solid fuels (especially biomass and fossil fuels). Production by heating plant sources is approximately 40 PJ/year. This area of heat generation has significant potential for the development of cogeneration, in particular through the installation of cogeneration units with piston engines (see chapters 5.1.9 and 5.2.5) as a replacement for or complementary to existing heating plant production (in this area there is likely to be a decline in the use of solid fossil fuels due to environmental requirements for those combustion sources).

5.2 Individual heating

5.2.1 Gas boilers

Natural gas is the most important fuel in individual heating and also occupies the largest share of total heat consumption in the Czech Republic. Natural gas is used for heating around 1.4 million households (approximately 35% of the total number of households, or 60% of individually heated households). It also accounts for almost two-thirds the dominant individual heat production technology in the industrial and service sectors. At present, it is a possible substitute for the supply of heat from heat supply systems. In the future, the dominant position is likely to remain unchanged. Only a small number of self-producers of heat are expected to make the transition from the use of natural gas burned in boilers to micro-cogeneration/small cogeneration or gas heat pumps.

5.2.2 Solid fossil fuel boilers

Solid fossil fuels (lignite and coal, coke and briquettes) are the cheapest means of individual heating, and at present they are used in approximately 0.35 million households. In the industrial and services sectors, they account for about one-tenth of individual heat production. Due to the promotion of the replacement of individual fossil fuel boilers in households (with boilers with lower emissions), this heat generation technology can be expected to decline This fuel is mainly due to its low price. Substitutes include the use of biomass or other modern technologies (heat pumps, solar collectors etc., and larger sources can also be replaced by cogeneration units).

5.2.3 Biomass boilers

Biomass (wood, wood briquettes or pellets) is used in individual heating systems mainly in locations where natural gas is not available or it is cost-effective for users to use this fuel. Biomass is used as a primary heat source in about 0.3 million households (and as a supplementary heat source in a further 0.5 million households). In the future, a small growth in the use of biomass for individual heating may be expected. Under the NAP RES, an increase in the household generation of heat from biomass of 4.5 PJ is expected by 2020.

5.2.4 Electric boilers and heat pumps

Electricity is typically used in heating in family houses in locations where natural gas is not available. At present, electricity is used in approximately 0.3 million households. In the future, an increase in the use of electric heat pumps can be expected, both in new buildings and in cases of transition from the original use of electric boilers or other fuels with less comfortable logistics (coal, biomass). Under the NAP RES, the heat pump heat generation is expected to increase by 8.3 PJ by 2020.

5.2.5 Micro-cogeneration

Micro-cogeneration with outputs of the order of units of kW or several tens of kW is still not particularly widely used (of the order of 200 units with a total electric output of 5 MW_e). In the future, moderate development of this technology (predominantly based on the combustion of natural gas) may be expected in places where there has only been mono-production of heat and in areas with new heat consumption.

The installation of high-efficiency CHP can be expected in particular in service structures, multifamily buildings with higher outputs of heat from gas sources and, in smaller quantities, in single-family buildings. Installation of high-efficiency CHP in dwellings (probably a combination of a gas boiler with a Stirling engine of about 1 kWe_e) will be minimal.

In terms of the development of micro-cogeneration, the potential development up to 2025 was estimated, on the basis of analyses of a database of small sources of pollution and the household consumption of natural gas, to be up to 150 MW_e with an expected supply of heat from CHP of up to 5.0 PJ.

5.3 Summary of the potential for individual heat generation technologies

The following table summarises the expected development or decline of individual heat generation technologies. A trend for the period up to 2025 in the area of centralised heat production is expected to be a decline in the heating plant generation of heat, to be replaced by small and medium cogeneration units, supplemented by the transfer of heat from appropriately located biogas installations. Although no other major development of large sources with high-efficiency CHP is foreseen, there may be a change of fuels used for CHP (e.g. municipal waste, nuclear fuel and biomass instead of fossil fuels). For large, high-efficiency CHP sources, there is also a risk of a decrease in the production of electricity from CHP due to the accumulation of economically unfavourable impacts (reductions in electricity price, allowance burdens, environmental requirements etc.). In the area of individual sources, it is expected that there will be developments in the application of modern technologies (e.g. heat pumps and solar collectors) and in micro-cogeneration (up to 50 kW_e) and small cogeneration (up to 1 MW_e), particularly in office buildings, service buildings and industrial applications.

Table 25 Trends in the development of individual heat generation technologies

Technology	Concomitance	Trend	Potential development of the generation of heat in the Czech Republic up to 2025	Comment
Large CHP sources using lignite	≈ 1/2 CHP heat in the Czech Republic	↘	None (savings measures on the consumption side balance the growth in new consumers)	Slight decline (insulation); partial transition to other fuels
Large CHP sources using coal	≈ 1/6 CHP heat in the Czech Republic	↘	None (savings measures on the consumption side balance the growth in new consumers)	Slight decline (insulation); partial transition to other fuels
Large sources with CHP using gas or liquid fuels	≈ 1/6 CHP heat in the Czech Republic	→	None (savings measures on the consumption side balance the growth in new consumers)	Stagnation or slight decline (insulation)
Biomass resources with CHP	≈ 80 MW_e, usually involving CHP	↗	0.3 PJ for relatively small sources (including co-firing with coal, up to 4.5 PJ)	Use of biomass for co-firing and modest development of relatively small sources with CHP
Biogas installations with CHP	≈ 370 MW_e, heat is not usually used	↗	2 PJ (transfer of heat from existing biogas installations and new biogas installations always with CHP)	Modest development of new sources and transfer of heat from existing sources
Waste incinerators with CHP	3 municipal waste incinerators in the Czech Republic (all CHP)	↗	3 PJ	Development of municipal waste incinerators in connection with waste management plans
Nuclear power plants	No significant use of heat	↗	1.5 PJ	Potential heat transfer from Temelín Power Plant
Waste and chemical heat	Heat is usually used at the point of origin	↗	Not quantified	Potential in the form of use of process heat
Small and medium-sized CHP sources using gas fuels	≈ 220 MW_e, predominantly with CHP	↗	13.7 PJ	Development in the form of replacement of heating plant sources or in new consumption areas
Centralised heating plant sources	≈ 1/4 centralised heating sources	↘	None (unless cogeneration plants limit CHP due to inefficient electricity generation)	Decline in heating plants using solid fossil fuels and natural gas
Individual gas boilers	≈ 60% individual heating	→	Not quantified. But it can be the easiest replacement of the centralised source.	Stagnation or modest transition to use of gas heat pumps
Individual solid fossil fuel boilers	≈ 10÷15 individual heating	↘	None	Even despite support for replacing boilers, a decline in the use of fossil fuels is expected
Individual biomass boilers	≈ 10÷15 individual heating	→	4.5 PJ by 2020	Stagnation (pellet boilers in new structures vs. transition to other fuels in existing structures)
Individual electric boilers and heat pumps	≈ 10÷15 individual heating	↗	For new consumption, potential favours heat pumps (8.3 PJ by 2020)	Significant growth in electric heat pumps, in part at the expense of electric boilers
Micro-cogeneration	≈ 200 applications (5 MW_e)	↗	5 PJ	Development in the form of additional separate generation of heat

6. Potential for the energy efficiency of the district heating and cooling infrastructure

The objective of this part of the document is to provide the information under point (f) of Annex VIII of Directive 2012/27/EU, that is, to determine the energy efficiency potential of the district heating and cooling infrastructure.

Heat supply systems in the Czech Republic include about 2,000 registered heat sources, of which 1,800 sources have an output of 5 MW_t. Of the 4.1 million households, district heating is used in 1.6 million households, i.e. approximately 40 %. The total length of heat networks is approximately 10,000 kilometres.

Statistics of losses in heat supply systems kept by the Czech Statistical Office indicate an increase in specific losses (total losses in relation to total heat supply) from 9% in 2004 to 10.8% in 2013.

The upwards trend in specific losses in recent years is due to an aging infrastructure and a reduction of heat consumption while maintaining the value of the losses. In general, the most significant potential for reducing losses in distribution systems lies in the transition from steam distribution lines to hot water distribution lines.

Due to the length of the heat networks and the fact that almost 15% of the heat networks are still steam distribution lines (exactly 1,458 km), there is a great potential for saving heat in the area of its distribution. Old steam distribution networks are characterised by losses that are up to five times greater than those of hot water distribution networks. The average values of specific annual losses in both types of heat distribution are as follows:

- Steam distribution lines … 7.35-9.80 GJ/m
- Hot water distribution lines … 1.61-2.00 GJ/m

If we consider only steam distribution lines without technical operations, that is, without 'big chemistry', the total length of the steam distribution lines used for district heat supply is 1,129 km, of which it is estimated that approximately 900 km requires reconstruction. With the envisaged reduction in the specific heat loss of 5.74 GJ/m per year, achieved through the replacement of steam distribution systems, the expected total annual energy savings can be estimated at around 5.2 PJ. This would increase the efficiency of heat energy distribution by approximately one-third.

The cost of the complete reconstruction of steam distribution lines as hot water distribution lines can be expected to be in the range CZK 21-28 million per km (the full costs of reconstruction in the countryside and in roads, including side roads). This would make the total cost of reconstruction of all steam networks intended for reconstruction CZK 19-24 million.

However, the conversion of steam distribution lines to hot water is technically quite demanding because the lines are usually in densely built-up areas. Despite the positive effects in energy savings, similar projects are economically inefficient in terms of benefits for the investor. Therefore, in the next period, the reconstruction of systems aimed at reducing losses will be a subject of investment support from operational programmes.

6.1 Efficient heat and cold supply systems in the Czech Republic

Article 2(41) of Directive 2012/27/EU defines efficient district heating as *'a district heating or cooling system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat'.* In the Czech Republic no records

are currently kept of efficient district heating and cooling systems and therefore no statistics are available in respect of this segment.

The only relevant data source that can be used for this purpose is a list of heat supply systems with a share of more than 50% of heat energy generated from RES, which are recorded and published by the Energy Regulatory Office pursuant to Section 25(5) of Act No 165/2012 on supported energy sources and on amendments to certain acts, as amended (hereinafter referred to as the 'Act No 165/2012'). Records of other types of efficient heat supply systems are being prepared.

In 2014, a total of 94 heat supply systems were recorded, in which more than half of the heat energy came from RES. The average share of heat energy from RES in these systems was 92.5%. A total of 57 systems reported a share of heat energy from RES of 100%.

Act No 165/2012 now tasks the Energy Regulatory Office with recording and publishing an overview of efficient heat supply systems. This should happen for the first time by 30 April 2016 at the latest. It will then be possible to start monitoring other statistical data on these systems.

7. Strategy, policies and measures

The objective of this part of the document is to provide the information under point (g) of Annex VIII of Directive 2012/27/EU, that is, a description of the strategies, policies and measures to be adopted by 2020 and by 2030 to exploit the potential identified in chapter 5.

The description is formally broken down into existing and proposed strategies, policies and measures.

7.1 Existing strategies, policies and measures

The basic document on sustainable development is the Strategic Framework for Sustainable Development of the Czech Republic, which was approved in Government Resolution No 37 of 11 January 2010. Under Priority 2.2: Ensuring state energy security and enhancing the economic efficiency of energy and raw materials, sets out Goal 3: Promotion of sustainable energy. The aim in particular is to:

- *to increase energy efficiency in transforming primary energy sources while optimally using RES;*
- *to increase energy savings in the individual sectors of the national economy and for the final consumer, and*
- *to support the use of efficient and eco-friendly technologies (e.g. BAT).*

The means of achieving the objective include maximum environmental friendliness based primarily on an efficient and environmentally friendly primary energy source consumption structure and on methods of electricity and heat generation.

This document also follows on from the State Environmental Policy of the Czech Republic 2012-2020 of 2012 and the State Energy Policy of 2015, in which more specific targets and measures are set out, as well as action plans for individual areas such as the Biomass Action Plan of the Czech Republic for the 2012-2020 period, the National Action Plan for Renewable Energy Sources (2012), the National Action Plan for Smart Grids, and the National Energy Efficiency Action Plan.

The concrete measures described below stem from current legislation and are expected to apply at least until 2020.

7.1.1 Increase of the share of CHP

Strategy papers

State Environmental Policy of the Czech Republic 2012-2020

Under thematic area Climate protection and improvement of air quality, priority 2.1 Reducing greenhouse gas emissions and reducing the negative impacts of climate change includes Objective 2.3.3: Ensuring compliance with the commitment to increase energy efficiency by 2020. One of the measures for achieving this objective reads as follows: ‘Support an increase in the share of the cogeneration of heat and power’.

State Energy Policy

One of the strategic aims of the State Energy Policy for at least 60% of heat energy to be supplied from CHP generation by 2040 (page 43).

The following aim in the area of electrical energy and cogeneration is given in strategy to 2040:

PII.5 Transition of most heating plants to high-efficiency cogeneration where economically suitable.

The key basic input assumptions, the 'axioms', which are always adhered to in the implementation of the State Energy Policy, include the channelling of lignite primarily into cogeneration and the most efficient sources (page 43).

The main heat production and supply objectives (chapter 5.4) include:

D.3 Ensuring a gradual transition to cogeneration combined with efficient use of heat pumps for all heating plants.

Sub-targets for the efficient energy conversion include:

Fb.3 Transition to high-efficiency combined heat and power generation in all heat supply systems.

Sub-targets natural gas sources include:

Ae.2 Creation of conditions for the development of micro-cogeneration sources and their sensible integration into networks with preferential use of electricity for own consumption.

Sub-targets for secondary energy sources and waste include:

Ag.4 Promotion of the cogeneration of energy from biogas installations that are fuelled by biodegradable waste from the reusable parts of municipal and agricultural waste and food industry waste.

Biomass Action Plan of the Czech Republic 2012-2020

In chapter 6.2 Conclusions and recommendations for energy recommendations, the document states: *Promotion of the priority use of biomass for combined heat and power (CHP) generation with the highest possible proportion of heat energy, thereby achieving high efficiency in energy conversion of biomass (at least 60-70%)*. In addition, the adjustment is recommended of existing support policies so that investors are motivated to increase energy efficiency (CHP installations, heating plants) to achieve greater use of available heat.

National Action Plan for Energy from Renewable Sources

The National Action Plan for Energy from Renewable Sources, as updated in 2012, predicts an increase in electricity production from CHP from RES from 3,457 GWh in 2013 to 4,502 GWh in 2020. However, it is worth noting that this increase will to a large extent be at the expense of the combined production of electricity and heat from fossil fuels, especially lignite, and is therefore not a net increase in electricity production from combined heat and power generation in the Czech Republic. An update of the National Action Plan for Energy from Renewable Sources is currently under preparation. This update foresees an increase in electricity production from CHP from RES from 4,685 GWh in 2015 to 5,129 GWh in 2020.

National Action Plan for Smart Grids

In chapter 5.3 Development of other energy sectors in the Czech Republic, it is stated that the future importance of cogeneration plant sources can be expected to consist in a larger involvement in the provision of services at the transmission system level and at distribution system level as well. Regulatory capacities of CHP sources can be extended by installing equipment for consuming electricity (electric boilers) and accumulating heat. The primary role of cogeneration plants will continue to be the supply of heat, but their future role should extend the provision of support services and ensuring the supply of electricity supply in the event of an emergency in the grid and disintegration into island operations.

Specific measures

Investment and operational support for the generation of electricity from high-efficiency CHP has been introduced in the Czech Republic and is described in further detail in chapter 10.

Under Act No 165/2012, distribution system operators and the transmission system operator are obliged to preferentially connect power plants with high-efficiency cogeneration of heat and power in the specified territory.

Under Act No 261/2007, as amended, and pursuant to Directive 2003/96/EC, fuel used for cogeneration is exempted from the gas tax and solid fuels tax.

Under Act No 458/2000 on business conditions and public administration in the energy sectors and on amendments to certain acts, as amended ('Energy Act'), as amended (hereinafter referred to as 'Act No 458/2000), the construction of a power plant with a total installed capacity of 1 MW or more is possible only with a state authorisation granted for the construction of a power plant by the Ministry of Industry and Trade. The Ministry will not grant authorisation if the energy assessment shows that the planned power plant will not ensure high-efficiency cogeneration of heat and power in accordance with the Energy Management Act.

In accordance with Act No 406/2000 on energy management, as amended (hereinafter referred to as 'Act 406/2000'), a builder or owner of an energy sector undertaking must, from 1 July 2015, secure an energy assessment to assess the costs and benefits of providing high-efficiency cogeneration in the case of construction of a new power plant or substantial renovation of an existing power plant with a total thermal input exceeding 20 MW, except for power plants with an operating time of less than 1,500 hours per year, and nuclear power plants.

Under Act No 406/2000, the regions and the City of Prague are obliged to prepare Territorial Energy Strategies setting out the objectives and principles for energy management in the regions, the City of Prague, the Prague districts and municipalities. The Territorial Energy Strategy includes defined and projected areas or corridors for public works for the development of the energy sector, while taking into consideration the potential for using efficient heating and cooling systems, particularly ones using high-efficiency cogeneration, and heating and cooling from renewable energy sources, where appropriate. The Territorial Energy Strategy forms the basis for the drawing up of principles for territorial development or land-use plans.

7.1.2 Development of the heat supply system infrastructure

State Energy Policy

The key basic input assumptions, the 'axioms', which are always adhered to in the implementation of the State Energy Policy, include the maintenance (economically and in terms of energy) of efficient heat supply systems as a priority (page 43).

Heat must be supplied through current heat supply systems wherever this is economically advantageous, provided that environmental impacts and other externalities are adequately respected in input prices for both centralised and decentralised sources (page 46). 46)

The strategy until 2040 makes the following requirement:

PI.9 Restoration, transformation and stabilisation of heat supply systems based largely on domestic sources (nuclear, coal, RES, secondary sources) supplemented with natural gas. Use of storage capacities of heating systems, possibly combined with heat pumps.

The main heat production and supply objectives (chapter 5.4) include:

D.1 Long-term maintenance of the broadest economically sustainable range of heat supply systems with a view to their competitiveness and ensuring a comparison of the economic conditions of centralised and decentralised heat sources to cover emissions and other externalities (carbon tax, allowances, emissions).

D.5. Encouragement of the restructuring of energy-inefficient and economically inefficient heat supply systems where there is an assumption of higher energy efficiency, greater flexibility of fuel use and better parameters for sustainable development.

D.6. Promotion of the maximum use of heat from nuclear power plants to heat larger agglomeration units near these sources. The localities of Brno, Jihlava, Dukovany, České Budějovice and others come under consideration by 2030.

D.8 Support for the territorial development of heat supply systems where they are realistic and effective, with the aim of using excess heat output due to savings in buildings.

Sub-targets for decentralised heat production include:

Dc.5 Preference for high-efficiency cogeneration

The main energy efficiency targets (chapter 5.6) include:

F.6 Use of public support (including part of the proceeds of emission allowance auctions) for measures to increase energy efficiency (for example, in the reconstruction and development of heat supply system).

Sub-targets for the efficient energy conversion include:

Fb.4 Reducing losses in heat installation distribution systems

National Action Plan for Energy from Renewable Sources

Paragraph 4.2.9 of the National Action Plan for Energy from Renewable Sources states that the existing district heating and cooling infrastructure is sufficient to achieve the target of the share of renewable sources in gross domestic energy consumption in 2020. In existing systems, it is above all necessary to focus on their recovery and increasing their economy (reducing heat loss during distribution). New heat supply systems can be built primarily in smaller settlements where a suitable renewable energy source (biomass or biogas in particular) will be available in sufficient quantities. An update of the National Action Plan for Energy from Renewable Sources is currently under preparation.

Specific measures

In the Czech Republic, investment support for the reconstruction and development of the heat supply system infrastructure has been introduced and is described in more detail in Chapter 10.

The reconstruction of heat supply systems has also been included in the National Investment Plan under Article 10c of Directive 2009/29/EC amending Directive 2003/87/EC with the aim of improving and extending the greenhouse gas emission allowance trading scheme in the Community. Operators investing in the reconstruction of heat supply systems. However, as part of the investments included in the National Investment Plan, the overlapping of support with grant programmes is excluded.

Under Act No 406/2000, the regions and the City of Prague are obliged to prepare Territorial Energy Strategies setting out the objectives and principles for energy management in the regions, the City of Prague, the Prague districts and municipalities. The Territorial Energy Strategy includes defined and projected areas or corridors for public works for the development of the energy sector, while taking into consideration the potential for using efficient heating and cooling systems, particularly ones using high-efficiency cogeneration, and heating and cooling from renewable energy sources, where appropriate. The Territorial Energy Strategy forms the basis for the drawing up of principles for territorial development or land-use plans.

7.1.3 Development of the use of waste heat and heat from RES

State Energy Policy

Biomass is the only additional and relatively widely available renewable energy source in the Czech Republic for heating. Other forms of renewable sources are limited for technical and other reasons (socio-environmental) for heating purposes. Geothermal energy has untested potential in the Czech Republic, but it may be significant, according to preliminary analyses. The use of geothermal energy is still associated with high costs. Wind and water energy is not suitable for heating, and the use of solar energy does not have sufficient potential for centralised heat supply. Biogas is expected to because of increasing importance in agriculture (page 16). 16)

One of the strategic aims of the State Energy Policy is for at least 20% of heat energy to be supplied from CHP generation by 2040 (page 43).

The main heat production and supply objectives (chapter 5.4) include:

D.2 Promotion of the use of biomass, other renewable and secondary sources and the maximum use of waste in combination with other fuels for heat supply systems, in particular for medium and small sources, and with a reasonable collection distance.

Partial targets for the fuel base for heat supply systems include:

Da.2 Support for the transition of medium and smaller heat supply systems in particular to multi-fuel systems using locally available biomass, natural gas, or other fuels where, above all, natural gas will play the role of a stabilising and supplementary fuel.

Sub-targets for secondary energy sources and waste include:

Ag.2 Ag.2. Prioritisation of the direct (heat) use of non-recyclable waste without prior treatment in cogeneration heat supply systems in accordance with environmental protection, in particular air protection.

The optimised scenario for the development of energy by 2040, as stated in the State Energy Policy, assumes a significant increase in the share of heat from RES for the supply of heat from heat supply systems.

Biomass Action Plan of the Czech Republic 2012-2020

In chapter 6.3.2 Grant policy, this document recommendations supporting the renewal of the boiler stock in the form of solid biomass combustion sources in the household sector and in small heating plants for heat supply systems.

National Action Plan for Energy from Renewable Sources

The National Renewable Energy Action Plan foresees an increase in heat production from biomass outside households, biodegradable parts of solid municipal waste and other wastes, biogas and geothermal energy of approximately 6 PJ. It can be assumed that the overwhelming majority of this increase will provided through heat energy supply systems. An update of the National Action Plan for Energy from Renewable Sources is currently under preparation.

Specific measures

Producers generating heat from biomass, bioliquids and geothermal energy are entitled to operating support under Act No 165/2012. Such support applies to plants with a rated thermal output of more than 200 kW and is paid as a green bonus at the market price of the heat supplied. An amendment to Act No 165/2012, which was approved in 2015 by Act No 131/2015, introduced, as of 1 January 2016, heat support to producers of useful heat from biogas where more than 70% of such biogas is produced from manure and animal by-products or from biodegradable waste in plants with installed electrical capacity of up to 500 kW. However, the support may only be claimed after the notification of this newly established support system with the European Commission has been completed.

In the Czech Republic, investment support has also been introduced for the use of heat from renewable sources, which is described in more detail in chapter 10.

Act No 165/2012 also stipulates an obligation of purchasing heat produced from renewable sources and enabling the connection of heat generators to a heat distribution system. The obligation to purchase shall apply only to quantities of heat that do not endanger the reliable and safe operation of the heat supply system or part thereof or do not restrict the use of renewable sources from another source of heat connected to the heat-distribution facility. The obligation of enabling the connection of a heat generator and the purchase of heat does not arise if the heat producer does not hold a licence for the production of heat energy under the Energy Act if the district heating system is part of an efficient heat supply system, if there is an increase in the total heat purchase costs for the current purchaser holding a heat energy distribution licence, or if the parameters of the heat transfer medium do not correspond to the parameters in the heat distribution installation of the heat supply system at the point of connection.

Heat energy supply systems with a share of heat from renewable sources greater than 50% are listed in Annex 3 to Implementing Decree No 78/2013 on the energy performance of buildings as amended by Implementing Decree No 230/2015 are set a specific factor of non-renewable primary energy, which is favourably reflected in the evaluation of the energy performance of buildings connected to a heat energy supply system with a large share of RES.

Under Act No 406/2000, the regions and the City of Prague are obliged to prepare Territorial Energy Strategies setting out the objectives and principles for energy management in the regions, the City of Prague, the Prague districts and municipalities. The Territorial Energy Strategy includes defined and projected areas or corridors for public works for the development of the energy sector, while taking into consideration the potential for using efficient heating and cooling systems, particularly ones using high-efficiency cogeneration, and heating and cooling from renewable energy sources, where appropriate. The Territorial Energy Strategy forms the basis for the drawing up of principles for territorial development or land-use plans.

7.1.4 Support for the location of cogeneration plant and waste heat sources in areas of potential heat consumption

State Energy Policy

Sub-targets in the field of coal energy include:

Ad.2 Orientate any new coal-fired sources towards high-efficiency or cogeneration production with a minimum annual energy conversion efficiency of 60% or efficiency according to BAT if higher.

Specific measures

Under Act No 458/2000, as amended, the construction of a power plant with a total installed capacity of 1 MW or more is possible only with a State authorisation granted for the construction of a power plant by the Ministry of Industry and Trade. The Ministry will not grant authorisation if the energy assessment shows that the planned power plant will not ensure high-efficiency cogeneration of heat and power in accordance with the Energy Management Act.

In accordance with Act No 406/2000 on energy management, as amended, from 1 July 2015 a builder or owner of an energy sector undertaking must secure an energy assessment to assess the costs and benefits of providing high-efficiency cogeneration in the case of construction of a new power plant or substantial renovation of an existing power plant with a total thermal input exceeding 20 MW, except for power plants with an operating time of less than 1500 hours per year, and nuclear power plants.

7.1.5 Support for the location of areas of consumption in areas offering waste heat

Under Act No 406/2000, the regions and the City of Prague are obliged to prepare Territorial Energy Strategies setting out the objectives and principles for energy management in the regions, the City of Prague, the Prague districts and municipalities. The Territorial Energy Strategy includes defined and projected areas or corridors for public works for the development of the energy sector, while taking into consideration the potential for using efficient heating and cooling systems, particularly ones using high-efficiency cogeneration, and heating and cooling from renewable energy sources, where appropriate. The Territorial Energy Strategy forms the basis for the drawing up of principles for territorial development or land-use plans.

7.1.6 Supporting the connection of new heat sources to heat supply systems

Under Act No 406/2000 the builder or owner of an energy undertaking has been obliged, since 1 July 2015, to provide an energy assessment in order to:

- assess the costs and benefits of using waste heat to meet economically justifiable demand for heat, including cogeneration, and connect equipment at least to a heat energy supply system situated within 1,000 metres of a heat source in the case of a new or substantial reconstruction of the existing industrial operation with a total thermal input exceeding 20 MW that which produces waste heat at a usable temperature
- assess the costs and benefits of using waste heat from at least industrial plants located within 500 metres of a heat distribution system in the case of the construction of a new or substantial reconstruction of the existing heat supply system with a source with a total thermal input exceeding 20 MW.

The assessment is part of the documentation for the issue of a land-use decision, and if no land-use decision is required, it is part of the project documentation for the issue of a building permit or part of the documentation for the issue of a joint land-use decision and a building permit.

7.1.7 Supporting the connection of new heat consumption areas to heat supply systems

Under Act No 235/2004 on value added tax, as amended, heat is classified at a reduced VAT rate of 15%.

Under Act No 406/2000, the regions and the City of Prague are obliged to prepare Territorial Energy Strategies setting out the objectives and principles for energy management in the regions, the City of Prague, the Prague districts and municipalities. The Territorial Energy Strategy includes defined and projected areas or corridors for public works for the development of the energy sector, while taking into consideration the potential for using efficient heating and cooling systems, particularly ones using high-efficiency cogeneration, and heating and cooling from renewable energy sources, where appropriate. The Territorial Energy Strategy forms the basis for the drawing up of principles for territorial development or land-use plans.

Under Act No 406/2000, a builder, association of unit owners or building owner is obliged, when constructing new buildings or making a major modification to a completed building with a source of energy with an installed heat output of more than 200 kW, to carry out an assessment of the technical, economic and environmental feasibility of alternative energy supply systems including heat energy supply systems. The assessment is part of the documentation for the issue of a land-use decision, and if no land-use decision is required, it is part of the project documentation for the issue of a building permit or part of the documentation for the issue of a joint land-use decision and a building permit. In the case of buildings with an installed heat output up to 200 kW, the Act lays down an obligation to carry out a similar assessment with regard to energy performance certificate of the building.

According to Act No 201/2012 on air protection, as amended, legal and natural persons are obliged, if it is technically possible and economically acceptable for them to do so, to use heat from a heat energy supply system or a source that is not a stationary source of air pollution in new buildings or when modifying existing structures.

7.2 Newly proposed measures

During the preparation of this document, further measures were proposed to support high-efficiency CHP and efficient district heating and cooling in the Czech Republic.

1. Ensure continued operational support for high-efficiency CHP and heat from RES compatible with the rules governing EU public support for new installations commissioned from 2016, and ensure adequate legislative regulation of the support scheme.
   Reason: Czech legislation envisages continued operational support for high-efficiency CHP and heat from RES in the coming years. However, the support scheme needs to be notified to the European Commission and, if necessary, the necessary adjustments must be made to ensure its full compatibility with the EU public support rules. In view of investors' confidence, it is necessary to enshrine the operational support in legislation appropriately in order to create suitable economic conditions for the development of high-efficiency CHP and long-term predictability and stability of the business environment.

2. An increase in taxes on the consumption of fossil fuels in stationary sources other than cogeneration in facilities not covered by the emissions trading scheme to a level corresponding to the price of CO_2 emissions resulting from the expected allowance price.
   Reason: This aim is based on the State Environmental Policy Czech Republic 2012-2020 and the National Emissions Reduction Programme. The increase in taxation of installations for the mono-production of heat would increase the competitiveness of the combined generation of heat and power.

3 When updating the National Action Plan for Smart Grids, assess the possibilities for providing support services at the distribution system level (voltage control, reactive power control, short-circuit contribution, black start, island operation, etc.).
   Reason: Heating plants with cogeneration could provide more support services at the distribution system level, which could contribute to the return on investment in their construction and modernisation.

4. The inclusion of a primary energy factor for efficient heat supply systems in the evaluation of the energy performance of buildings (amendment to Implementing Decree No 78/2013).
   Reason: At present, only a share of RES greater than 50% is positively reflected in the energy performance of buildings. Inclusion of efficient heat supply systems would create incentives for connecting new buildings in particular to these systems.

5. To accelerate and simplify the approval processes for high-efficiency CHP installations and for the construction and renovation of heat supply networks.
   Reason: Building new high-efficiency cogeneration facilities and heat networks, including reconstruction, should not be unnecessarily burdened with excessive administration. At the same time, the deadlines for discussing the plan should be shortened and the possibility of obstructions reduced.

6. Set motivational and economic conditions for energy recovery from residual municipal waste after sorting recyclable components. Link any public support to the use of heat.
   Reason: The Waste Act in force envisages the end of the landfill of mixed municipal waste in 2024. In accordance with the waste management hierarchy, it is therefore necessary to create an economic environment for the use of residual municipal waste that would otherwise have to go to landfill. It is also necessary to ensure the

greatest possible use of its energy content. The key economic instrument is the landfill waste fee, which should be substantially increased. This is in line with the Waste Management Plan of the Czech Republic 2015-2024 and the State Environmental Policy of the Czech Republic 2012-2020.

7. Ensure the provision of adequate resources to stimulate the renovation and development of heat distribution systems (HDS) after 2020 also by using part of the funds from the sale of greenhouse gas emission allowances and other support mechanisms.
   Reason: It will only be possible to provide grants from the ESIF until 2023, and at present it is uncertain whether this support will continue in the next programming period. Nevertheless, it would be appropriate to ensure that there are sufficient resources even after that date to support the reconstruction and development of heat supply systems.

8. the share of high-efficiency cogeneration and the potential established and progress achieved under Directive 2004/8/EC;

The aim of this part of the document is to provide the information under point (h) of Annex VIII to Directive 2012/27/EU, that is, data on the share of high-efficiency cogeneration and the potential established and progress achieved under Directive 2004/8/EC.

Progress in the promotion of cogeneration achieved in the legislative area is described in chapters 7 and 10. A system for the promotion of electricity generation from high-efficiency CHP has been introduced through price regulation implemented by the Energy Regulatory Office on the basis of the applicable energy legislation. CHP and remote heating investment support project are emerging from grant programmes. CHP sources and heat supply systems have a long tradition in the Czech Republic. In the future, high-efficiency CHP will be developed, especially at the level of relatively small outputs and relatively small heat supply systems.

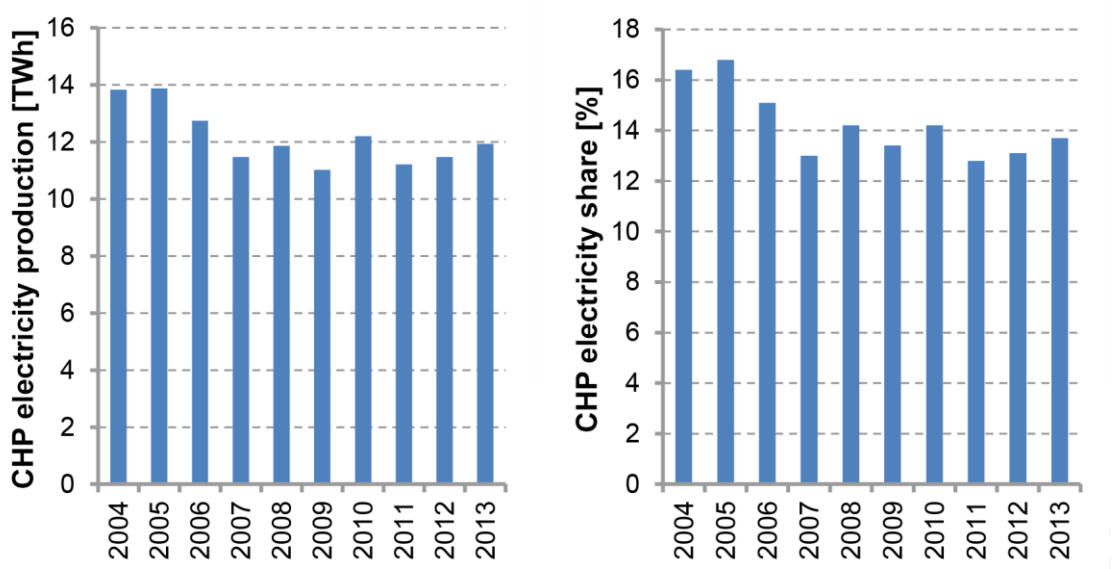
The following tables and graphs illustrate the results of statistical monitoring in the area of CHP. Many other details can be found in other parts of this document.

The following table and graphs show the development of electricity production from CHP and the share of CHP in total gross electricity production. Electricity from high-efficiency CHP accounts for more than half of the total generation of electricity from CHP – see chapter 10.2.1.

Table 26 Development of the share electricity production from CHP

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Gross electricity generation (TWh)	84.3	82.6	84.4	88.2	83.5	82.3	85.9	87.6	87.6	87.1
CHP electricity production [TWh]	13.8	13.9	12.7	11.5	11.9	11.0	12.2	11.2	11.5	11.9
CHP electricity share [%]	**16.4**	**16.8**	**15.1**	**13.0**	**14.2**	**13.4**	**14.2**	**12.8**	**13.1**	**13.7**

Graph 3 Development of electricity production from CHP and share of electricity from CHP



Source: Ministry of Industry and Trade, Eurostat

The decreasing electricity and heat production from CHP corresponds to a decline in centralised heat production. However, the share of heat from CHP has increased in recent years (according to the Czech Statistical Office, the period from 2004 to 2013 saw a rise in the share of supply heat produced in cogeneration plants and power stations using solid fuels, nuclear power plants, steam-gas cycles and cogeneration units with piston engines in total centralised heat production from 70.5% to 74.3%).

9. Estimate of the quantity of primary energy savings

The aim of this part of the document is to provide the information under point (i) of Annex VIII to Directive 2012/27/EU, that is, an estimate of the quantity of primary energy savings.

Primary energy savings were estimated only for all electricity and heat from CHP (efficient heat supply systems are not fully recorded in the Czech Republic at present). It is therefore not possible to determine the potential for primary energy savings for efficient heat supply systems.

In order to calculate the primary energy savings achieved through the use of CHP in the Czech Republic in 2013, CHP statistics compiled by the Ministry of Industry and Trade were used. The reporting methodology is slightly different from the Czech Statistical Office methodology used for reporting to the European Commission and Eurostat, so the values of gross production of electricity and useful heat from CHP also differ slightly.

The calculation of primary energy savings was made in accordance with Annex II of Directive 2012/27/EU and Commission Implementing Decision 2011/877/EU). Harmonised efficiency reference values for separate heat production were always used for the steam/water medium type. Harmonised efficiency reference values for separate electricity generation were always selected for a cogeneration unit put into operation in 2003 (see Directive 2012/27/EU, Annex 2, paragraph (f)(3)) The calculation concerned all electricity from CHP without adjustment for electricity production not tied to useful heat, and includes plants that do not meet the high-efficiency CHP criterion. In this sense, the calculation should considered to be very conservative (the calculated relative primary energy savings include CHP that is classified as highly efficient). For the exact quantification of primary energy savings only for high-efficiency cogeneration, adequate statistical data was not available.

According to paragraph 11 of that Annex, a correction was also made for the climatic conditions in the Czech Republic and the voltage level of the plant connection.

The resulting values of primary energy savings are shown in the following table. These are the results for all CHP, not just high-efficiency CHP. Data for highly efficient CHP are unfortunately not currently recorded to the required extent.

Table 27 Primary energy savings from CHP in 2013

Fuel	CHP electricity [GWh]	Useful heat [TJ]	Fuel charge [TJ]	CHP efficiency [%]	Primary energy savings [TJ]
Biomass	747	7,642	15,395	67	5,679
Biogas	971	3,496	8,741	80	5,126
Coal	1,954	20,240	40,205	68	-365
Lignite	5,630	66,339	116,537	74	11,911
Waste heat	25	296	730	53	-94
Lubricants	9	136	263	64	-31
Other liquid fuels	1	6	10	84	3
Other solid fuels	111	1,677	3,302	63	512
Other gases	868	8,199	19,559	58	-50
Natural gas	1,226	12,880	21,405	81	1,751
Total	**11,542**	**120,911**	**226,147**	**72**	**24,442**

Source: Ministry of Industry and Trade

The primary energy savings associated with the estimated development of high-efficiency CHP between 2016 and 2025 were analysed for three emerging CHP areas:

- Individual heat production using micro-cogeneration (IHS – micro-cogeneration)
- Central heat production in small and medium-scale cogeneration (HSS – small and medium-scale cogeneration powered by natural fuels)
- Central cogeneration production of heat from biomass and alternative fuels (HSS – RES and other alternative fuels)

For the 'IHS – Micro-cogeneration' and 'HSS – small and medium-scale CHP' powered by gas fuels, harmonised efficiency reference values for separate production of heat for natural gas fuel and for steam / hot water medium were used in the calculation of the PES in accordance with Commission Implementing Decision 19 Decision of the European Parliament and of the Council of 20 December 2011 establishing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC of the European Parliament and of the Council and repealing Commission Decision 2007/74/EC. In the case of HSS – RES and other alternative fuels, the harmonised reference value for separate production of heat for agricultural biomass fuel and for steam/water medium was used.

Harmonised efficiency reference values for separate production of electricity were selected for the same fuels as for separate production of heat.

A correction was made for climatic conditions in the Czech Republic for an average temperature of 8 °C. For simplification, the voltage level correction factor was in all cases considered equal to 0.945, which corresponds to the voltage level of plant connection of 0.4 to 50 kV.

The following table shows the resulting estimates of primary energy savings in individual years from new high-efficiency CHPs from to be commissioned in 2016-2025 for CHP and high CHP scenarios (see Chapter 11 - CBA)

Table 28 Estimated primary energy savings from new high-efficiency CHT in 2016-2025

Technology	PES [PJ]									
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
CHP scenario										
Micro-cogeneration	0.01	0.03	0.06	0.10	0.16	0.16	0.17	0.17	0.18	0.18
Heat supply system – small and medium-scale CHP	0.10	0.21	0.32	0.44	0.56	0.79	1.04	1.31	1.60	1.92
Heat supply system – CHP – RES and others	0.5	1.01	1.55	2.10	2.68	2.76	2.84	2.91	2.99	3.07
Total	**0.61**	**1.25**	**1.92**	**2.64**	**3.41**	**3.71**	**4.04**	**4.39**	**4.76**	**5.17**
High CHP scenario										
Individual heat supply – micro-cogeneration	0.01	0.04	0.08	0.14	0.23	0.25	0.27	0.29	0.31	0.34
HSS – small and medium-scale CHP	0.18	0.37	0.58	0.80	1.05	1.31	1.60	1.92	2.26	2.63
Heat supply system – CHP – RES and others	0.70	1.44	2.22	3.05	3.91	4.08	4.25	4.42	4.59	4.76
Total	**0.89**	**1.85**	**2.87**	**3.98**	**5.19**	**5.65**	**6.12**	**6.63**	**7.16**	**7.73**

The table below shows an estimate of cumulated primary energy savings for both the developing areas and overall for all technologies. The table also shows the cumulative amount of useful heat and electricity produced in new high-efficiency CHP plants in 2016-2025 together with the expected efficiency of these plants.

Table 29 Estimated cumulative primary energy savings from new high-efficiency CHP in 2016-2025

Technology	Useful heat [PJ]	CHP electricity [GWh]	CHP efficiency [%]	PES [PJ]
CHP scenario				
Micro-cogeneration	6.1	675.9	82.0	1.21
HSS – small and medium-scale CHP	18.8	3,725.4	82.0	8.29
Heat supply system – CHP – RES and others	23.7	2,432.1	75.0	22.40
Total	**48.5**	**6,833.4**	**78.7**	**31.90**
High CHP scenario				
Micro-cogeneration	9.8	1,091.4	82.0	1.96
HSS – small and medium-scale CHP	28.8	5,708.8	82.0	12.70
Heat supply system – CHP – RES and others	35.3	3,628.7	75.0	33.43
Total	**73.9**	**10,428.9**	**79.2**	**48.08**

10. Public support measures for heating and cooling

This part of the document aims to provide the information under point (j) of Annex VIII to Directive 2012/27/EU, i.e. to estimate the possible public support measures for heating and cooling, with the annual budget and the definition of the possible support element.

For clarity, the chapter is divided into two subchapters – investment support and operating support.

10.1 Investment aid programmes

Public investment support for high-efficiency CHP and district heating is currently available under several programmes. These are, on the one hand, programmes to increase the efficiency of heat generation and distribution and, on the other, programmes aimed at reducing heat consumption (including increasing the efficiency of individual heating).

10.1.1 Investment support programmes – production and distribution of heat

Investment support for projects increasing the efficiency of production and distribution of heat is available under the Operational Programme Enterprise and Innovation for Competitiveness 2014-2020 (OP EIC) or from the Operational Programme Environment 2014-2020 (OP Environment).

The OP EIC, which is financed by the European Regional Development Fund (ERDF), is divided into three priority axes, with Priority Axis 3 being relevant for the issues at hand: Efficient energy management, development of energy infrastructure and renewable energy sources, promoting the deployment of new technologies in the field of energy management and secondary raw materials (PA3), which will allocate EUR 1.2 billion by 2020.

PA3 contains six specific objectives (SO), of which the following SOs are relevant for this study:

- Specific Objective 3.1: Increase the share of renewable energy production in gross final consumption of the Czech Republic (Allocation: 53 million EUR)
- Specific Objective 3.2: Increase energy efficiency in the business sector (Allocation: 746 million EUR)
- Specific objective 3.4: Use innovative low-carbon technology in the field of
    - energy management and use of secondary raw materials (Allocation: 37 million EUR)
- Specific Objective 3.5: Increase the efficiency of heat supply systems (Allocation: 143 million EUR)

Within the above SOs, individual grant programmes are opened on a continuous basis.

Another source of investment support for projects aimed at increasing the efficiency of production and distribution of heat is the Operational Programme Environment 2014-2020 (OP E). As in OP EIC, the OP E is divided into several priority axes. The following specific objectives in the following priority axes are relevant for this study:

- Priority Axis 2: Improvement of air quality in human settlements
    - Specific Objective 2.2: Reduce the emissions from stationary sources that contribute to the population's exposure to above-limit concentrations of pollutants 95 million EUR)
- Priority Axis 3: Waste and material flows, ecological burdens and risks

  - Specific Objective 3.2: 'Increase the share of material and energy recovery of waste' – Activity 3.2.3 – Construction and modernisation of waste energy recovery facilities and related infrastructure (Allocation: 55 million EUR)

- Priority Axis 5: Energy savings
  - Specific Objective 5.1: Improve the energy performance of public buildings and increase the use of renewable energy sources (Allocation: 510 million EUR)

Funds for SO 5.1 projects can only be used by the public sector, non-governmental non-profit organizations and churches and religious societies and their associations. Funds for SO 2.2 and 3.2 projects can be used by both public sector entities and business entities, companies and cooperatives and self-employed natural persons.

Other possibilities to obtain investment support include programmes launched by the Technology Agency of the Czech Republic (TA CR). These programmes focus on applied research, experimental development and innovation, including heat and cold production and distribution, including cogeneration and trigeneration. Public competitions under the programmes are announced annually and total spending on individual programmes is in the order of billions of CZK. Both research organizations and industrial enterprises can benefit from this support. While research organizations have the option to receive up to 100% of support, support for enterprises in the case of industrial research under the current Epsilon programme ranges between 50 and 80% depending on the size of the enterprise and on the demonstration of effective collaboration with the research organisation. The maximum amount of public support for one project is limited to EUR 3 1.2 billion by 2020.

10.1.2 Investment support programmes – consumption side and individual heating

The Ministry of the Environment plans to replace at least 80,000 obsolete solid fuel boilers in households under the so-called 'boiler subsidies' by 2020; according to the Ministry of the Environment, there are now more than 350,000 of such boilers in the Czech Republic. The funds (a total of CZK 9 billion) will be distributed by the regions, which will apply for the funds from the OP E.

In the OP E, support for the exchange of obsolete solid fuel boilers is provided under Specific Objective 2.1: Reduce the emissions from local heating of households that contribute to the population's exposure to above-limit concentrations of pollutants Grants will be provided only for resources meeting the requirements of Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of eco-design requirements for energy-related products. The support is granted to natural persons for the purchase or replacement of a heat pump, solid fuel boiler, a gas condensing boiler, installation of solar thermal systems for additional heating or hot water and so-called micro-energy measures (e.g. thermal insulation, window replacement etc.)

Another programme aimed at improving the environment by reducing the production of pollutant and greenhouse gas emissions, final energy savings and stimulating the Czech economy with other social benefits is the New Green Savings programme financed from the State budget of the Czech Republic. The Czech Republic has received funds for this programme through the sale of emission allowances (EUA) pursuant to Act No 383/2012 on the conditions of trading in greenhouse gas emission allowances, as amended, within the third period of the Emissions Trading System (EU ETS) in 2013-2020. The programme focuses on two areas – single-family buildings and multi-family buildings.

In the case of single-family buildings, it is possible to obtain grants for improving the energy performance of existing single-family buildings, the construction of single-family buildings with very high energy performance and efficient use of energy sources, including grants for the exchange of dirty heat sources (e.g. those burning coal, coke, coal briquettes, or heating oil) for efficient environmentally friendly sources (e.g. biomass boiler, heat pump or gas condensing boiler).

As regards multi-family buildings, support is provided to the following measures to improve the energy performance of existing multi-family buildings:

- insulation of the building envelope – replacement of windows and doors, thermal insulation of perimeter walls, roof, ceiling, floors
- replacement of dirty heat sources (e.g. those burning coal, coke, coal briquettes or heating oil) by efficient, environmentally friendly sources (e.g. biomass boiler, heat pump or gas condensing boiler)
- replacement of electric heating by systems with a heat pump
- installation of thermic solar systems
- installation of forced ventilation systems with heat recovery from exhaust air
- measures can be taken independently or in various combinations

Other important programmes aimed at reducing energy consumption include the Operational Program Environment (SO 5.2), Integrated Regional Operational Programme 2014–2020, Operational Programme Prague – Growth Pole, the PANEL Programme, the JESSICA Programme and the EFEKT Programme.

10.2 Operating support for CHP electricity and RES heat

10.2.1 Operating support for CHP electricity

The support for high-efficiency CHP electricity in the Czech Republic is part of the system promoting the production of electricity and heat from RES, high-efficiency CHP, secondary energy sources and individual electricity production. Legislatively, support for high-efficiency CHP is laid down in Act No 165/2012 and the related decree on high-efficiency cogeneration electricity and on electricity from secondary sources, which is used to determine the amount of CHP electricity covered by support.

The amount of support for high-efficiency CHP electricity is determined annually in the Energy Regulatory Office price decision. The year 2014 was selected to illustrate the support of a high-efficiency CHP, as of with the resulting amounts of support disbursements are available. For 2014, operating support was disbursed in accordance with the Energy Regulatory Office's Price Decision No 4/2013 of 27 November 2013. Based on the price decision, the amount of the green bonus for individual plants is calculated, taking into account the location and size of the installed power capacity of the plant, the primary fuel used and the operating mode of the power plant.

The annual green bonus for CHP consists of two basic rates – the basic rate and additional rate; the additional rate only applies to the categories of plants listed in the price decision. The basic rate is then divided depending on the total installed capacity of the plant, namely to plants with installed capacity of up to 5 MW_e and over 5 MW_e.

In the case of sources with an installed capacity of up to 5 MW_e, the basic rate is graded according to the installed plant capacity and operating hours.

Table 30 Basic annual electricity green bonus for a CHP plant with an installed capacity of up to 5 MW_e (inclusive) for 2014

Row	Type of supported source	Installed plant capacity (kW)		Operating hours (h/year)	Green bonuses (CZK/MWh)
		from	to (inclusive)		
700	Combined heat and power plant with the exception of those using aid under points (1) and/or (2. 1) of the price decision and the exception of the incineration of municipal waste	0	200	3,000	1,610
701		0	200	4,400	1,150
702		0	200	8,400	220
703		200	1,000	3,000	1,150
704		200	1,000	4,400	750
705		200	1,000	8,400	140
706		1,000	5,000	3,000	800
707		1,000	5,000	4,400	470
708		1,000	5,000	8,400	45
709	Combined heat and power plant using support under points (1) and/or (2.1) of the price decision and incinerating municipal waste	0	5,000	8,400	45

For sources with installed capacity of over 5 MW_e , the installed plant capacity, primary energy savings (PES) and efficiency of energy production are taken into account.

Table 31 Basic rate of annual green bonus for CHP electricity for a power plant with a total installed capacity of cogeneration units of over 5 MW_e for 2014

Row	Type of supported source	Installed plant capacity (kW)		Primary energy source (%)		Efficiency of energy production (%)		Green bonuses (CZK/MWh)
		from	to (inclusive)	from	up to (inclusive)	from	up to (inclusive)	
750	Combined heat and power	5,000	-	10	15	-	-	45
751		5,000	-	15	-	-	45	60
752		5,000	-	15	-	45	75	140
753		5,000	-	15	-	75	-	200
754	New or modernised combined heat and power plant	5,000	-	15	-	45	-	200

The plants defined in the price decision are also eligible for an additional rate of annual green bonus. There are two additional rates – Additional Rate I to the basic rate of the annual

green bonus for all high-efficiency CHP electricity and Additional Rate II to the basic rate of the annual green bonus for high-efficiency CHP electricity attributable to the biomass share.

Table 32 Additional rate I to the basic rate of the annual green bonus for all high-efficiency CHP electricity for 2014

Row	Type of supported source	Plant commissioned on		Installed plant capacity (kW)		Biomass category a utilisation process	Green bonuses (CZK/ MWh)
		from	to (inclusive)	from	up to (inclusive)		
770	Power generating facility burning clean biomass	1 January 2013	31 December 2013	0	5,000	O	100
771		1 January 2014	31 December 2014	0	5,000	O	455
772	Power generating facility burning gas from solid biomass gasification (separately)	1 January 2013	31 December 2013	0	2,500	O	455
773		1 January 2014	31 December 2014	0	2,500	O	755
774	Power generating facility burning biogas in a biogas plant	1 January 2013	31 December 2013	0	2,500	AF	455
775	New power generating facility burning biogas in a biogas plant meeting the condition of point (3.5.2.)	1 January 2014	31 December 2014	0	550	AF	900
776	Plant burning degassing or mine gas	1 January 2013	31 December 2014	0	5,000	-	455
777	Electricity production by incineration of municipal waste or joint incineration of municipal waste with different sources of energy	-	31 December 2012	0	5,000	-	155
778	Power generating facility burning natural gas (separately)	-	31 December 2014	0	5,000	-	455

Additional rate I applies to all high-efficiency CHP electricity

Table 33 Additional rate II to the basic rate of the annual green bonus for high-efficiency CHP electricity attributable to biomass share for 2014

Row	Type of supported source	Biomass category a utilisation process	Green bonuses (CZK/MWh)
780	Joint incineration of biomass and a non-renewable energy source	S1	940
781		S2	520
782		P1	940
783		P2	520

Additional rate II applies to the share of high-efficiency CHP electricity produced from biomass

The following table shows the total amount of support disbursed for electricity produced in high-efficiency CHP in 2014, broken down by individual rows of the ERO price decision, together with the total amount of supported electricity and generating plants.

Table 34 Support disbursement, the amount of electricity and number of plants broken down by basic and additional annual green bonus rates in 2014

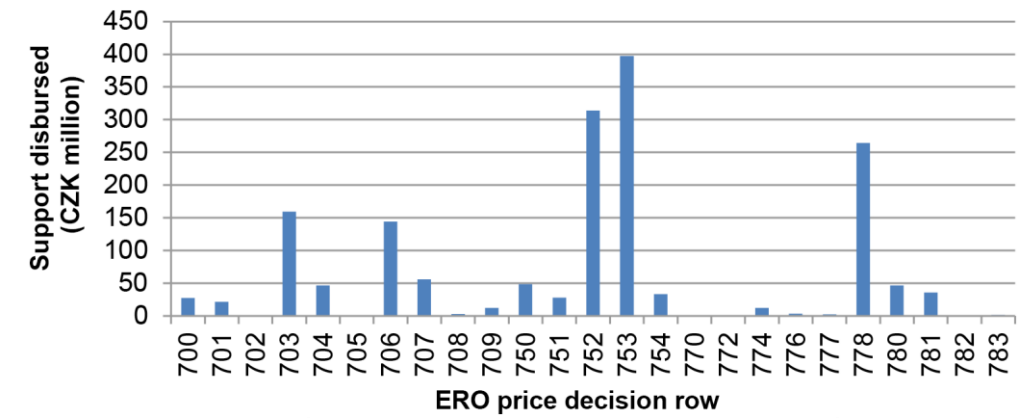
Row	Support (CZK million)	Quantity (GWh)	Number of plants (-)
700	27.5	17.1	158
701	21.7	18.9	85
702	1.1	5.1	31
703	159.3	138.7	173
704	46.4	61.8	62
705	0.4	2.7	6
706	144.1	180.2	54
707	56.1	119.8	29
708	2.9	65.3	6
709	12.4	276.1	169
750	48.5	1,077.8	44
751	28.2	470.0	42
752	314.0	2,243.0	42
753	397.1	1,985.6	17
754	33.4	167.2	6
770	0.5	5.3	3
772	0.2	0.4	2
774	12.5	27.5	38
776	3.6	7.9	2
777	2.5	16.4	1
778	264.6	582.1	579
780	46.5	49.5	10
781	35.7	68.7	10
782	0.0	0.0	1
783	1.4	2.6	2
Total	**1,660.8**	**-**	**-**

Source: Operátor trhu s elektřinou a.s.

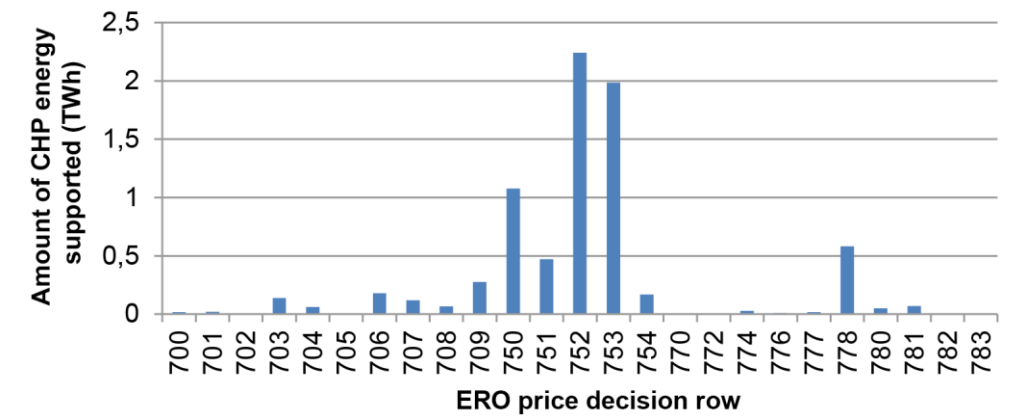
The amount of electricity and the number of plants cannot be added up, as the establishments using the green bonus consisting of the basic and any of the additional rates would be included more than once.

For the sake of clarity, all the monitored values are displayed graphically in the following charts.

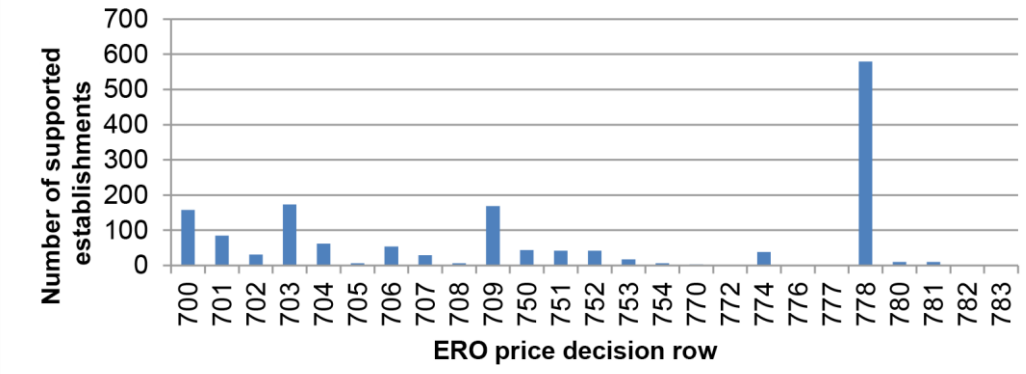
Graph 4 Amount of support paid according to the Energy Regulatory Office price decision row in 2014



Graph 5 Amount of supported high-efficiency CHP electricity based on the Energy Regulatory Office price decision row in 2014



Graph 6 Number of supported power-generating plants from high-efficiency CHP based on the Energy Regulatory Office price decision row in 2014



Source: Operátor trhu s elektřinou a.s.

A total of 6,802 GWh of high-efficiency CHP electricity was supported in 2014 by the green bonus, which is equivalent to 53% of the total gross electricity production from CHP in the Czech Republic (12,830 GWh).

Power-generating facilities with installed capacity up to 5 MW_e produced a total of 3,269 GWh of electricity in 2014, of which 922 GWh (i.e. 28.2%) was supported by the green bonus. Power-generating facilities with the capacity of more than 5 MW_e have gross electricity production of 9,561 GWh, of which 5,908 GWh (i.e. 61.8%) was supported by the green bonus.

The total amount of public support for high-efficiency CHP electricity produced in 2014 amounted to CZK 1,661 million. Of this amount, CZK 760 million was allocated to sources with installed capacity of up to 5 MW_e and CZK 901 million to power-generating facilities with installed capacity of more than 5 MW_e.

All the above values are shown in the table below for clarity. For comparison, also provided are values for the year 2013, which was slightly above the average (annual deviation from the temperature standard of +0.4°C), and in which the amount of high-efficiency CHP electricity (supported production) was determined by the original methodology.

Since 2013, there has been a change in the methodology for determining the amount of high-efficiency CHP electricity for large sources. In addition, the year 2014 was significantly warmer compared to the previous year. These effects led to a reduction in the amount of supported electricity for these sources by up to about 20%, see the following table.

Table 35 Production, supported production and support paid out to power-generating facilities from high-efficiency CHP in 2013 and 2014

	Total production (GWh)		Supported production (GWh)		Support paid (CZK million)	
	2013	2014	2013	2014	2013	2014
Power plants up to 5 MW_e (inclusive)	---	3,269	989	886	680	760
Power-generating facilities over 5 MW_e	---	9,561	7,370	5,943	1,293	901
Total	**11,965**	**12,830**	**8,359**	**6,829**	**1,973**	**1,661**

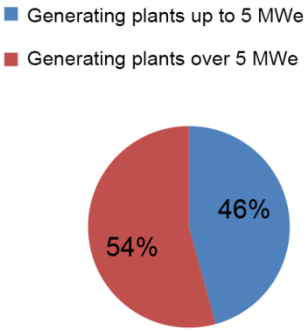
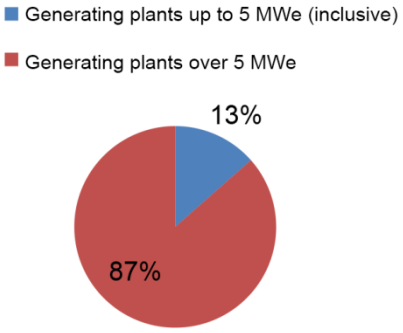
Source: Energy Regulatory Office, Ministry of Industry and Trade, Operátor trhu s elektřinou a.s.

Supported production of high-efficiency CHP electricity plants with an installed capacity of more than 5 MW_e was approximately 6.5 higher in 2014 than in the case of plants of up to 5 MW_e. Differences in financial support are not so noticeable (CHP plants up to 5 MW_e receive significantly higher average support per MWh produced).

In 2014, biogas plants received support for the production of high-efficiency CHP electricity of CZK 12.5 million, the supported amount of electricity reaching 27.5 GWh.

The fundamental difference between 2014 and 2013 is the possibility of obtaining the additional rate to green bonus for plants burning natural gas (independently) (row 778 of the ERO price decision, see above). As shown in the table, the additional rate was used in 2014 to support 582.1 GWh of electricity. All of this electricity, whose total disbursed support reached CZK 264.6 million, was produced in plants with an installed capacity of up to 5 MW_e.

Graph 7 Shares of high-performance CHP by source size

Support disbursed for high-efficiency CHP electricity in 2014 by source size	Volume of supported high-efficiency CHP electricity in 2014 by source size
	

Source: Operátor trhu s elektřinou a.s.

Currently, 1,109 production sources with a total installed capacity of 10,604.3 MW are registered in the Czech Republic which may apply for operating support in the form of green bonuses for high-efficiency CHP electricity. Most sources use biogas (187) and biomass (96) and 'other sources' (755), including natural gas, black coal and brown coal, i.e. fuels which are not eligible for support for renewable or secondary sources.

Since 2013, virtually all sources put into operation have been 'other sources'. Biomass firing sources include both clean biomass firing and co-firing of biomass and non-renewable source in the case of large power plants or heat plants.

Table 36 Production sources with the possibility to apply for support for high-efficiency CHP electricity

	2012		2013		2014		6/2015	
Type of production source/fuel	**Number**	**Installed capacity (MW)**	**Number**	**Installed capacity (MW)**	**Number**	**Installed capacity (MW)**	**Number**	**Installed capacity (MW)**
Biogas	134	79.1	187	100.2	187	100.2	187	100.2
Biomass	79	3,128.9	93	3,181.3	96	3,183.4	96	3,183.4
Degassing gas	9	15.5	11	18.3	11	18.3	11	18.3
Colliery gas	17	22.4	17	22.4	17	22.4	17	22.4
Secondary sources	16	579.5	19	581.3	21	585.1	21	585.1
Landfill and cal. gas	21	12.9	21	12.9	22	13.2	22	13.2
Other sources	561	6,576.9	637	6,602.8	711	6,665.2	755	6,681.7
Total	**837**	**10,415.0**	**985**	**10,519.1**	**1,065**	**10,587.8**	**1,109**	**10,604.3**

Source: Operátor trhu s elektřinou a.s.

10.2.2 Operating support for heat from RES

Operating support for heat from RES is provided through a green bonus in the Czech Republic. The green bonus for heat from RES is provided only under the annual green bonus scheme of CZK 50/GJ, as defined in Section 26 of Act No 165/2012, which also stipulates that heat support in the form of operating support for heat may, within one heat plant, be combined with support for heat in the form of investment support for heat. Pursuant to Section 24(4) of Act No 165/2012, operating support of heat may be provided to heat produced from supported biomass for which electricity support is laid down under Section 4(5)(a) of Act No 165/2012, or from bioliquids meeting the sustainability criteria set out in an implementing regulation in heat plants with a rated thermal capacity exceeding 200 kW or heat produced from geothermal energy in plants with a rated thermal capacity exceeding 200 kW.

The following basic conditions must also be met to obtain operating support for heat from RES:

- the producer must be the holder of a heat production licence
- the rated heat capacity of the heat plant must be more than 200 kW
- the heat produced must be delivered to the HSS
- the heat must be produced in facilities that meet the minimum energy efficiency requirements set out in Implementing Decree No 441/2012 on the determination of the minimum efficiency of energy use in the production of electricity and heat.

This operating support does not apply to heat from biogas plants, co-firing of a renewable and non-renewable source, or other sources. In 2014, support for heat from RES covered 1,017 GWh (3,661 TJ) of heat. Thus, the total support disbursement stood at CZK 183.1 million.

Amendment to Act No 165/2012 which was approved in 2015 by Act No 131/2015 introduced, as of 1 January 2016, heat support to producers of useful heat from biogas where more than 70% of such biogas is produced from manure and livestock by-products or from biodegradable waste in plants with installed electrical capacity of up to 500 kW. However, the support may only be claimed after the notification of this newly established support system with the European Commission has been completed.

11. Cost-benefit analysis

Article 14(3) of the Energy Efficiency Directive requires a CBA that covers their territory in accordance with Part 1 of Annex IX and is based on climatic conditions, economic feasibility and technical suitability. The CBA allows the identification of the most resource- and cost-efficient solutions to meeting heating and cooling needs. The analysis should aim to: 'facilitating the identification of the most resource- and cost-efficient solutions to meeting heating and cooling needs'.

CBA is primarily performed to analyse the costs and benefits of high-efficiency CHP from a society-wide perspective and does not take into account the public support provided.

The potential in cooling has not been assessed due to the absence of background data. As mentioned in the previous chapters, the Czech Republic does not record the information on the production and distribution of cooling. Consideration will be given to the possibility of obtaining this data and preparing a similar analysis also for the area of cooling in further updates of this report.

11.1 Description of cost-benefit analysis methodology for high-efficiency cogeneration

The aim was to determine the incremental benefits and costs of meeting the demand for heat in 2025 for individual scenarios.

The CBA was conducted as follows:

1) Defining the heat production/supply composition for the period 2016-2025 in the baseline scenario.
2) Defining the heat production/supply composition for the period 2016-2025 in alternative CHP and high CHP scenarios. The scenarios reflect the different percentages of progress towards the technical potential.
3) Calculation of the incremental costs/benefits of alternative scenarios compared to the baseline scenario.
4) Identification of the most appropriate scenario.
5) Sensitivity analysis.

During the CBA process, the scenario with a minimum production of CHP electricity was considered approximately at the level of own electricity consumption. However, this scenario would have negative benefits compared to the baseline scenario and therefore has not been elaborated further in this study and is not included therein.

For scenario comparisons, the same amount of electricity and heat consumed in the Czech Republic is assumed in all scenarios. An increase in CHP electricity reduces the amount of electricity produced by condensing without the supply of useful heat as well as separate heat production. Therefore, the benefits in scenarios with higher levels of power from CHP include fuel cost savings (primary energy savings), reduced losses in the electricity grid and cost savings on externalities compared to the separate generation of heat and power.

The CBA was drawn up using methodology prepared in accordance with Part 1 of Annex IX to Directive 2012/27/EU. The basic principles are given in the table below.

Table 37 Method of drawing up the CBA

Steps/aspects in accordance with Part 1 of Annex IX	Inclusion in methodology
a) Establishing a system boundary and geographical boundary	Whole of the Czech Republic
b) Integrated approach to demand and supply options	The current state and expected developments on the side of the supply and demand for heat reflect all available technologies, information and trends available. Information on cooling is not available in the Czech Republic.
c) Constructing a baseline	An initial scenario was defined, which reflects the assumption of no economic incentives for investors to implement and operate CHP sources. Chapter 5 identified the technical potential of new plants producing high-efficiency CHP electricity, which will serve as a basis for identifying alternative scenarios.
d) Identifying alternative scenarios	Alternative scenarios represent the alternative percentages of the technical potential of high-efficiency CHP.
e) Method for the calculation of net benefits	The NPV method is to be used. The discounted incremental costs/benefits of alternative scenarios will be compared against the baseline scenario.
f) Calculation and forecast of prices and other assumptions for the economic analysis	Available prognoses (national and international) will be used.
g) Economic analysis: inventory of effects	For the purposes of this CBA, a conservative approach has been chosen (to minimise the number of expert estimates, not to quantify the costs and benefits that cannot be based on relevant background data, etc.). Therefore, the following is included and quantified: • projected investment and operating costs related to meeting the demand for heat; • saved fuel costs and externalities related to separated electricity production, which is replaced by combined electricity production; • additional costs (or savings) related to emissions of harmful substances; • savings related to the savings of costs of the transmission and distribution of electricity and heat distribution (on-site consumption). For the below reasons, the following is excluded: • costs and energy savings resulting from the increased flexibility of energy supply, which are difficult to quantify in the Czech Republic and have been disregarded for the purposes of this study; • savings resulting from the restriction of infrastructure investments because their high impact on CBA is not expected, also due to the need to take out the output; • costs/benefits related to job creation – these benefits are very difficult to quantify and, at the same time, no significant change in the number of jobs in individual heat supply scenarios is expected; • benefits due to increased reliability of electricity supply due to the installation of high-efficiency CHP, because they are very difficult to quantify in the Czech Republic and a significant impact on CBA results is not expected;
h) Sensitivity analysis	The most important factors that have an impact on CBA results (NPV change) have been identified

11.1.1 Approach to the evaluation of the benefits of alternative scenarios

The baseline scenario assumes electricity produced from separate electricity generation without simultaneous heat production (excluding CHP) from lignite at 32.5% efficiency (hereinafter referred to as 'condensation electricity').

Fuel cost savings for non-produced condensation electricity are fuel costs that need not be incurred because the corresponding amount of electricity is produced at combined heat and power generation in high-efficiency CHP sources (the relevant fuel costs in CHP sources are included in the costs of the relevant alternative scenario).

CO_2 savings for non-produced condensation electricity are costs of emission allowances that need not be incurred because the corresponding amount of electricity is produced at combined heat and power generation in high-efficiency CHP sources (the relevant costs of emission allowances in high-efficiency CHP sources are included in the costs of the relevant alternative scenario).

Emission savings (SO_x, NO_x, PM) for non-produced condensation electricity are emission estimates that do not have to be emitted as the corresponding amount of electricity is produced at combined heat and power generation in high-efficiency CHP sources (the respective CERs emission estimates are included in the costs of the relevant alternative scenario).

The quantification of **savings in electricity transmission and distribution** is based on the assumption that 50% of electricity produced in newly installed high-efficiency CHP sources is consumed at the site of production, and therefore there are no technical losses in the network of 8% of the volume of this electricity. The remaining 50% of electricity is consumed in the distribution network, and there are therefore no technical losses (mainly in the absence of transmission from central sources) in the network of 2% of the volume of this electricity. This electricity is valued at the market price of electricity (for 2016 EEX base plus 10%; for further years EEX plus inflation). Savings also include externality valuation (SO_x, NO_x, PM).

11.2 Description of basic assumptions

A change in operating costs (OPEX) includes mainly a change in fuel costs, change in personnel costs and the costs of maintenance of newly established sources. It also reflects costs/fuel savings depending on cogeneration/heat production in a cogeneration unit.

A change in investment costs (CAPEX) is a change which is due to the need to establish sources to meet the demand for heat. A change in CAPEX also reflects a change in the composition of the sources in individual scenarios.

The calculation of NPV includes a contribution to cover fixed costs reflecting the projected lifetime of the source of 20 years so that appropriate consideration can be given to the relevant costs and benefits of the different scenarios. This means that only an appropriate investment cost ratio of 1/20 for each year of operation of a particular cogeneration unit was considered for the period 2016-2025.

The model considers a number of parameters and assumptions. The table gives an overview of the basic parameters entering the CBA.

Table 38 Selected input parameters for the CBA

Parameter	Value assumed for CBA	Note
Inflation	2%	According to CNB inflation target
Efficiencies	By type of source, fuel and method of operation	Conservative approach selected
Period under assessment	2016-2025	For investment costs, depreciation of 1/20 for each year under evaluation was used to calculate the NPV.
Discount rate	6.94%	Determined using WACC for 4th regulatory period in electricity distribution and transmission[44], increased by 0.5 percentage point.
NO_x valuation	CZK 32,000/t	Rate determined based on levelised costs of preventing pollution emissions Based on the explanatory memorandum to Act No 20/2012 on air protection.
SO_2 valuation	CZK 16,000/t	
PM valuation	CZK 97,000/t	
CO_2 valuation	CZLK 229-715/t	According to the expected allowance price in individual years.
Investment costs of new micro-cogeneration	CZK 45 million/MW_e	
Average investment cost of new small and medium-scale gas fuel production plants with high-efficiency CHP	CZK 31 million/MW_e	Average reflecting various sizes of cogeneration units.
CZK/EUR exchange rate	CZK 27 = EUR 1	

11.2.1 CO_2 valuation

CO_2 emissions were valued at projected emission allowance price. In 2016, the CBA assumed a price of EUR 8.5 and in 2020 16.5 of this parameter, the sensitivity of the NPV to the rate of increase of this parameter is given at the end of this chapter.

[44] A post-tax value below the nominal value set for the relevant electricity entities was considered.

11.2.2 Emissions valuation (SO_x, NO_x, TZL)

Emissions valuation is an area with evident variability of the valuation depending on the approach selected. In principle, there are two basic approaches to valuation:

a) Valuation based on the determination of the costs of avoiding emissions, i.e. what costs need to be incurred to avoid the production of a certain amount of emissions.
b) The valuation is based on assessing the consequences of emissions (for health, environment, etc.).

For the purposes of the CBA, option (a) was chosen, using the valuation under the explanatory memorandum to Act 201/2012 on air protection. Given the high range of valuation values, a sensitivity analysis has been prepared, which also reflects the high valuation values of emissions calculated in the CASES[45] project (14x higher on average than the values considered in the CBA).

11.3 Description of the base level – Baseline scenario

The scenario is based on a situation where there is no operating support for high-efficiency CHP, and thus there is no substantial economic incentive for investors to build and operate these types of sources.

Assumptions:

Minimal to zero development of micro-cogeneration due to economic inefficiency.

Minimal development of high-efficiency CHP in small and medium-scale sources due to economic inefficiency.

In order to meet the demand for heat, the heat production in heat plants will develop, mainly using natural gas (both district and individual heating).

In relation to existing sources, there will primarily be changes in their use to meet the demand for heat.

There is a reduction in electricity production from high-efficiency CHP.

If further developments are in line with the assumptions of this scenario, there could be a risk of failing to meet the European commitments of the Czech Republic in terms of energy savings and the development of the use of renewable sources and high-efficiency CHP.

The following table shows how heat demand is met in this scenario.

[45] http://www.feem-project.net/cases/index.php

Table 39 Production of heat in the baseline scenario [%]

	2013	2020	2025
Individual	**66.3**	**67.0**	**67.2**
Micro-cogeneration	*0.0*	*0.0*	*0.0*
Electric boilers and heat pumps	*4.8*	*6.1*	*6.2*
Boilers using solid fuels (coal)	*7.8*	*7.5*	*7.2*
CHP, RES and other alternative fuels	*12.3*	*13.1*	*13.3*
Gas boilers	*41.4*	*40.4*	*40.5*
Heat supply systems	**33.7**	**33.0**	**32.8**
Heat supply systems – heating plant total	**9.0**	**10.2**	**11.3**
Coal heating plants	*0.1*	*0.1*	*0.2*
Lignite heating plants	*0.8*	*1.2*	*1.4*
CHP, RES and other alternative fuels	*1.0*	*1.0*	*0.9*
Heating plants using gas fuels	*7.1*	*7.9*	*8.9*
Heat supply systems – CHP total	**24.7**	**22.8**	**21.5**
Nuclear power plants	*0.0*	*0.0*	*0.4*
Small and medium CHP for gas fuels[46]	*0.9*	*0.9*	*0.9*
Large CHP, gaseous fuels (CCGT, boilers+TG)	*3.5*	*3.1*	*3.2*
Black coal CHP	*4.2*	*3.8*	*3.4*
Lignite CHP	*13.3*	*12.4*	*11.1*
CHP, RES and other alternative fuels	*2.7*	*2.5*	*2.5*
Total	**100.0**	**100.0**	**100.0**

11.4 Evaluation of alternative scenarios

Technical potential of new CHP

The basis for specifying alternative scenarios is the technical potential of new plants with high-efficiency CHP. The technical potential for the development of different technologies is set out in chapter 5.

[46] In this category, in all scenarios there can be sources with no supply to the HSS which use the heat and electricity produced for their own consumption, but whose size and nature of operation correspond to this category rather than the category of micro-cogeneration.

11.4.1 CHP scenario

It represents a low percentage of fulfilment of the technical potential.

Realisation of the CHP scenario:

33 MW_e of new installed micro-cogeneration sources, which will generate more than 101 GWh of electricity and 0.91 PJ of heat in 2025.

227 MW_e of new installed small and medium-scale cogeneration sources using gaseous fuel, which will generate more than 862 GWh of electricity and 4.35 PJ of heat in 2025.

62 MW_e of new installed cogeneration sources using RES and other alternative fuels, which will generate more than 332 GWh of electricity and 3.25 PJ of heat in 2025.

The following table shows how heat demand is met in this scenario.

Table 40 Production of heat in the CHP scenario [%]

	2013	2020	2025
Individual	**66.3**	**66.7**	**67.0**
Micro-cogeneration	*0.0*	*0.2*	*0.2*
Electric boilers and heat pumps	*4.8*	*6.1*	*6.2*
Boilers using solid fuels (coal)	*7.8*	*7.5*	*7.2*
CHP, RES and other alternative fuels	*12.3*	*13.1*	*13.3*
Gas boilers	*41.4*	*39.9*	*40.1*
Heat supply systems	**33.7**	**33.3**	**33.0**
Heat supply systems – heating plant total	**9.0**	**8.5**	**8.3**
Coal heating plants	*0.1*	*0.1*	*0.0*
Lignite heating plants	*0.8*	*0.5*	*0.4*
CHP, RES and other alternative fuels	*1.0*	*1.6*	*1.6*
Heating plants using gas fuels	*7.1*	*6.2*	*6.2*
Heat supply systems – CHP total	**24.7**	**24.8**	**24.8**
Nuclear power plants	*0.0*	*0.0*	*0.4*
Small and medium CHP for gas fuels[47]	*0.9*	*1.2*	*1.9*
Large CHP, gaseous fuels (CCGT, boilers+TG)	*3.5*	*3.4*	*3.1*
Black coal CHP	*4.2*	*4.0*	*3.8*
Lignite CHP	*13.3*	*12.7*	*11.9*
CHP, RES and other alternative fuels	*2.7*	*3.4*	*3.6*
Total	**100.0**	**100.0**	**100.0**

[47] In this category, in all scenarios there can be sources with no supply to the HSS which use the heat and electricity produced for their own consumption, but whose size and nature of operation correspond to this category rather than the category of micro-cogeneration.

Assumptions:

Medium to high development of micro-cogeneration

Medium to high development of small and medium-scale CHP

Decrease in heat production in heat plants (replaced by CHP)

In relation to existing sources, there will primarily be changes in their use to meet the demand for heat.

Increasing production from high-efficiency CHP

In contrast to the baseline scenario, the CHP scenario represents the following incremental changes:

For the period 2016–2025, total costs (OPEX, contribution to fixed cost amounting to depreciation, CO_2 and emissions of SO_x, NO_x, PM) are higher by CZK 43.11 billion compared to the baseline scenario.

For the period 2016-2025, the total benefits (savings in fuel costs for non-produced condensation electricity, savings on non-produced condensed electricity emissions, savings in transmission and distribution of electricity) are higher by CZK 71.59 billion compared to the baseline scenario. billion compared to the baseline scenario.

Therefore, the CHP scenario is cheaper by CZK 28.48 billion compared to the baseline scenario in the 2016-2025 period. Converted to net present value, additional savings under this scenario amount to CZK 19.28 billion compared to the baseline scenario. The satisfaction of demand for heat until 2025 is thus cheaper from the society-wide perspective and therefore more advantageous in the CHP scenario than in the baseline scenario.

The results of the calculation are presented in the following table.

Table 41 Additional costs and benefits of the CHP scenario compared to the baseline scenario

Parameter (CZK billion)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Contribution to CAPEX	0.04	0.10	0.17	0.25	0.36	0.40	0.44	0.49	0.54	0.60	3.41
OPEX	2.52	2.54	2.73	3.00	3.38	3.59	3.83	4.06	4.33	4.63	34.62
CO2	0.16	0.18	0.19	0.21	0.21	0.26	0.31	0.36	0.42	0.49	2.80
Externalities (SO_x, NO_x, PM emissions)	0.21	0.22	0.19	0.21	0.22	0.24	0.25	0.26	0.24	0.25	2.28
Total costs	**2.93**	**3.04**	**3.29**	**3.67**	**4.18**	**4.49**	**4.83**	**5.17**	**5.53**	**5.97**	**43.11**
Fuel cost savings for non-produced condensation electricity	3.01	3.15	3.31	3.48	3.67	3.81	3.95	4.11	4.28	4.47	37.24
CO_2 savings for non-produced condensation electricity	1.25	1.59	1.95	2.34	2.75	3.13	3.53	3.95	4.40	4.86	29.76
Emission savings (SO_x, NO_x, PM) for non-produced condensation electricity	0.39	0.40	0.41	0.42	0.23	0.23	0.23	0.24	0.24	0.25	3.05
Savings in the transmission and distribution of electricity, including externalities	0.10	0.10	0.12	0.13	0.15	0.16	0.17	0.19	0.20	0.22	1.54
Total benefits	**4.75**	**5.25**	**5.79**	**6.37**	**6.79**	**7.33**	**7.89**	**8.49**	**9.13**	**9.80**	**71.59**
Benefits – costs	**1.82**	**2.21**	**2.50**	**2.70**	**2.61**	**2.84**	**3.06**	**3.32**	**3.59**	**3.83**	**28.48**
Benefits – costs (NPV)	**1.70**	**1.93**	**2.04**	**2.06**	**1.86**	**1.90**	**1.92**	**1.94**	**1.96**	**1.96**	**19.28**

11.4.2 High CHP scenario

It represents a high percentage of fulfilment of the technical potential.

Fulfilment of the high CHP scenario:

63 MW_e of new installed micro-cogeneration sources, which will generate more than 187 GWh of electricity and 1.7 PJ of heat in 2025.

311 MW_e of new installed small and medium-scale cogeneration sources using gaseous fuel, which will generate more than 1,183 GWh of electricity and 5.96 PJ of heat in 2025.

108 MW_e of new installed cogeneration sources using RES and other alternative fuels, which will generate more than 517 GWh of electricity and 5.03 PJ of heat in 2025.

The following table shows how heat demand is met in this scenario.

Table 42 Production of heat in the high CHP scenario [%]

	2013	2020	2025
Individual	**66.3**	**66.8**	**67.0**
Micro-cogeneration	*0.0*	*0.3*	*0.4*
Electric boilers and heat pumps	*4.8*	*6.1*	*6.2*
Boilers using solid fuels (coal)	*7.8*	*7.5*	*7.2*
CHP, RES and other alternative fuels	*12.3*	*13.1*	*13.3*
Gas boilers	*41.4*	*39.8*	*39.9*
Heat supply systems	**33.7**	**33.2**	**33.0**
Heat supply systems – heating plant total	**9.0**	**7.8**	**7.1**
Coal heating plants	*0.1*	*0.1*	*0.0*
Lignite heating plants	*0.8*	*0.5*	*0.4*
CHP, RES and other alternative fuels	*1.0*	*1.0*	*0.9*
Heating plants using gas fuels	*7.1*	*6.2*	*5.7*
Heat supply systems – CHP total	**24.7**	**25.4**	**25.9**
Nuclear power plants	*0.0*	*0.0*	*0.4*
Small and medium CHP for gas fuels[48]	*0.9*	*1.5*	*2.3*
Large CHP, gaseous fuels (CCGT, boilers+TG)	*3.5*	*3.4*	*3.4*
Black coal CHP	*4.2*	*4.0*	*3.8*
Lignite CHP	*13.3*	*12.7*	*11.9*
CHP, RES and other alternative fuels	*2.7*	*3.8*	*4.1*
Total	**100.0**	**100.0**	**100.0**

[48] In this category, in all scenarios there can be sources with no supply to the HSS which use the heat and electricity produced for their own consumption, but whose size and nature of operation correspond to this category rather than the category of micro-cogeneration.

Assumptions:

High development of micro-cogeneration

High development of small and medium-scale CHP

Decrease in heat production in heat plants (replaced by CHP)

In relation to existing sources, there will primarily be changes in their use to meet the demand for heat.

Significant increase in electricity production from high-efficiency CHP.

In contrast to the baseline scenario, the high CHP scenario represents the following incremental changes:

For the period 2016-2025, total costs (OPEX, contribution to fixed cost amounting to depreciation and externalities due to emissions) are higher by CZK 67.18 billion compared to the baseline scenario. billion compared to the baseline scenario.

For the period 2016-2025, the total benefits (savings in fuel costs for non-produced condensing electricity, savings on non-produced condensed electricity emissions, savings in transmission and distribution of electricity) are higher by CZK 78.31 billion compared to the baseline scenario.

In 2016-2025, the high CHP scenario is therefore cheaper by CZK 11.13 billion compared to the baseline scenario in the 2016-2025 period. Converted to net present value, additional savings in the high CHP scenario amount to CZK 7.60 billion compared to the baseline scenario. The satisfaction of demand for heat until 2025 is thus cheaper from the society-wide perspective and therefore more advantageous in the high CHP scenario than in the baseline scenario. However, compared with the CHP scenario, the benefit of this scenario is lower, mainly due to a different composition of sources, higher average fuel costs and high investment costs (especially microcogeneration).

The results of the calculation are presented in the following table.

Table 43 Additional costs and benefits of the high CHP scenario compared to the baseline scenario

Parameter (CZK billion)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Contribution to CAPEX	0.07	0.17	0.29	0.43	0.61	0.69	0.76	0.85	0.94	1.04	5.85
OPEX	3.37	3.61	3.98	4.49	5.21	5.50	5.84	6.22	6.65	7.14	52.02
CO2	0.30	0.35	0.41	0.47	0.53	0.61	0.70	0.80	0.90	1.01	6.08
Externalities (SO_x, NO_x, PM emissions)	0.33	0.34	0.28	0.30	0.31	0.32	0.34	0.35	0.32	0.33	3.23
Total costs	**4.07**	**4.47**	**4.96**	**5.69**	**6.66**	**7.13**	**7.64**	**8.22**	**8.81**	**9.52**	**67.18**
Fuel cost savings for non-produced condensation electricity	3.10	3.29	3.49	3.73	3.99	4.17	4.37	4.58	4.81	5.05	40.57
CO_2 savings for non-produced condensation electricity	1.29	1.66	2.06	2.50	2.98	3.43	3.90	4.41	4.94	5.50	32.67
Emission savings (SO_x, NO_x, PM) for non-produced condensation electricity	0.40	0.42	0.43	0.45	0.25	0.25	0.26	0.27	0.27	0.28	3.28
Savings in the transmission and distribution of electricity, including externalities	0.10	0.11	0.13	0.15	0.17	0.18	0.20	0.22	0.25	0.27	1.78
Total benefits	**4.89**	**5.47**	**6.12**	**6.83**	**7.39**	**8.04**	**8.74**	**9.48**	**10.26**	**11.11**	**78.31**
Benefits – costs	**0.82**	**1.00**	**1.15**	**1.14**	**0.73**	**0.91**	**1.09**	**1.26**	**1.45**	**1.58**	**11.13**
Benefits – costs (NPV)	**0.76**	**0.87**	**0.94**	**0.87**	**0.52**	**0.61**	**0.68**	**0.73**	**0.79**	**0.81**	**7.60**

11.5 Comparison of scenarios and interpretation of CBA results

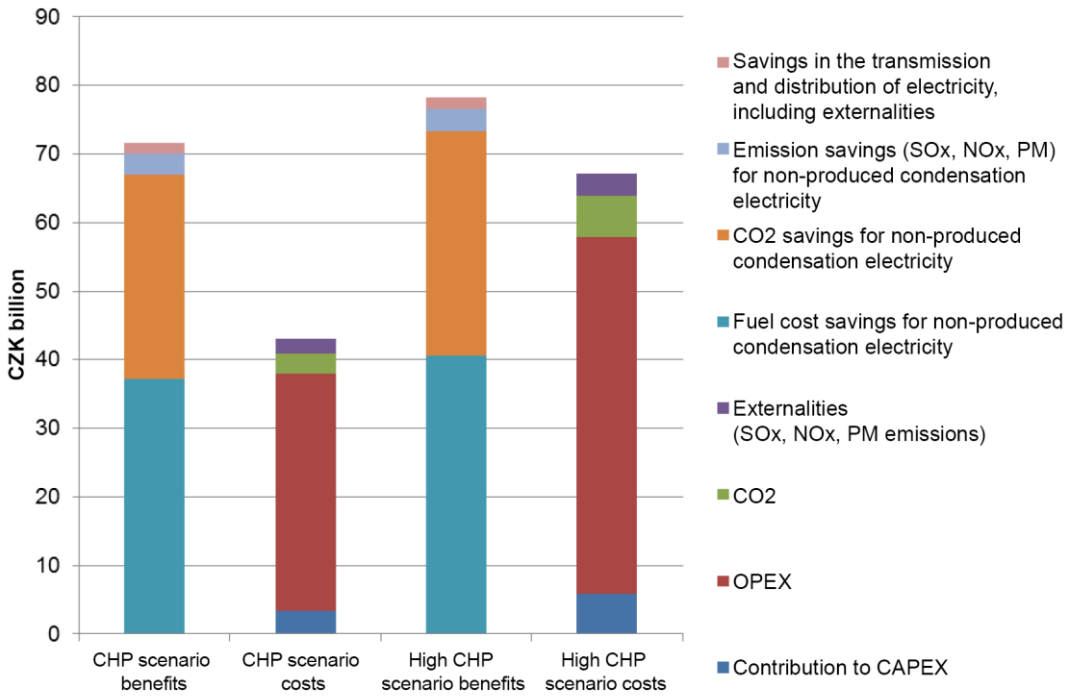
The most significant potential for the development of high-efficiency CHP in the Czech Republic lies in medium-scale and small gaseous fuel sources, complemented by the development of RES or alternative fuel sources. While gaseous fuels can complement or replace separate heat production, RES and alternative solid fuels often represent only a change in the existing cogeneration fuel base (especially coal).

Compared to the baseline scenario, meeting heat demand under alternative (development) scenarios provides additional benefits and additional costs as presented in the following chart. The CBA shows that the benefits of both alternative scenarios outweigh the extra costs. This is primarily due to:

Savings on fuel costs for non-produced condensing electricity, which is replaced by high-efficiency CHP electricity production;

Savings on emissions for non-produced condensing electricity which is replaced by high-efficiency CHP electricity production;

Graph 8 Total incremental costs and benefits of alternative scenarios compared to the baseline scenario



The above chart illustrates total incremental benefits and costs for the period under evaluation (2016-2025). The incremental benefits outweigh the incremental costs in both alternative scenarios. The society-wide benefit is highest in the case of CHP scenario. In the case of the high CHP scenario, the relatively high total fuel costs (resource mix with intensive use of natural gas) and high investment in new cogeneration sources largely eliminate the benefits of this scenario, and therefore it does not reach the absolute benefits of the CHP scenario. In this context, it should be remembered that this is a society-wide perspective – the market itself does not reward operators of high-efficiency CHP sources for energy and emission savings from the combined production of electricity and heat. Conversely, the

developments in energy markets in recent years have posed risks for operators and investors of high-efficiency CHP plants that CHP will become unprofitable.

11.6 Sensitivity analysis

On the basis of a model of the development of heat production in the Czech Republic, the factors that most influence the results of the CBA were identified. A sensitivity analysis was carried out for these factors.

An overview of factors for which sensitivity analysis was carried out:

Price of fuels (lignite and natural gas for centralised sources) Year-on-year increase in the price of CO_2 emission allowances

Discount rate

Valuation of externalities due to NO_x, PM, SO_x emissions

The results of sensitivity analysis are shown in the following tables.

11.6.1 Sensitivity analysis for the CHP scenario Table 44 Sensitivity analysis of NPV to fuel prices, CHP scenario

NPV [CZK million]		Initial price of lignite [CZK/GJ]							
		35	40	45	50	55	60	65	70
Initial price of natural gas [CZK/GJ]	185	11.02	13.18	15.34	17.50	19.66	21.82	23.98	26.15
	190	10.95	13.12	15.28	17.44	19.60	21.76	23.92	26.08
	195	10.89	13.05	15.21	17.37	19.54	21.70	23.86	26.02
	200	10.83	12.99	15.15	17.31	19.47	21.63	23.79	25.95
	205	10.76	12.93	15.09	17.25	19.41	21.57	23.73	25.89
	210	10.70	12.86	15.02	17.18	19.35	21.51	23.67	25.83
	215	10.64	12.80	14.96	17.12	19.28	21.44	23.60	25.76
	220	10.57	12.74	14.90	17.06	19.22	21.38	23.54	25.70
	225	10.51	12.67	14.83	16.99	19.15	21.32	23.48	25.64
	230	10.45	12.61	14.77	16.93	19.09	21.25	23.41	25.57
	235	10.38	12.55	14.71	16.87	19.03	21.19	23.35	25.51
	240	10.32	12.48	14.64	16.80	18.96	21.13	23.29	25.45
	245	10.26	12.42	14.58	16.74	18.90	21.06	23.22	25.38
	250	10.19	12.35	14.52	16.68	18.84	21.00	23.16	25.32

The previous table shows that with the rising price of lignite, the NPV of the CHP scenario is more cost-effective. Conversely, the fall in NPV with an increase in the price of natural gas is mainly due to an increase in operating costs natural gas sources (micro-cogeneration, small and medium-scale CHP).

Table 45 Sensitivity analysis of NPV to CO_2 allowance price escalation, CHP scenario

	Year-on-year price escalation [EUR/year]							
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
NPV [CZK million]	10.49	12.69	14.89	17.08	19.28	21.48	23.68	25.87

The previous table shows that a higher year-on-year increase in the price of an allowance increases the benefits of the CHP scenario (the effect of higher efficiency in high-efficiency CHP compared to separate electricity production).

Table 46 Sensitivity analysis of NPV to the discount rate, CHP scenario

	Discount rate [%/year]							
	0.50	**1.25**	**2.25**	**3.00**	**3.75**	**4.50**	**5.25**	**6.00**
NPV [CZK million]	28.48	26.42	24.92	23.88	22.89	21.96	21.08	20.25
	6.75	**6.94**	**7.50**	**8.00**	**8.50**	**9.00**	**9.50**	**10.0**
NPV [CZK million]	19.47	19.28	18.73	18.26	17.81	17.37	16.95	16.54

Table 47 Sensitivity analysis of NPV to the valuation of emissions, 'CHP' scenario

	Multiples of emission prices							
	0	**Baseline value**	**2**	**5**	**7**	**10**	**15**	**20**
NPV [CZK million]	18.60	19.28	19.96	22.00	23.35	25.39	28.79	32.18

The model factors in the valuation of the externalities due to the emissions of NO_x, SO_x and PM according to the values given in chapter 11.2.2. The NPV of this externality valuation is marked as the baseline in the table. Other values in the table represent the NPV of the CHP scenario for different multiples of the baseline of the valuation of each emission type. With the valuation of emissions calculated in the CASES45 project (the valuation is 14 times higher on average than baseline), the NPV of the 'CHP' scenario exceeds CZK 28 billion compared to the baseline scenario. It is clear that if the valuation of the impact of emissions is higher, the NPV of the CHP scenario is also increasing (emissions from separate electricity production burden the baseline scenario).

11.6.2 Sensitivity analysis, high CHP scenario

Table 48 Sensitivity analysis of NPV to the price of fuels, high CHP scenario

NPV [CZK million]		Initial price of lignite [CZK/GJ]							
		35	40	45	50	55	60	65	70
Initial price of natural gas [CZK/GJ]	185	0.08	2.28	4.47	6.67	8.86	11.06	13.25	15.45
	190	-0.13	2.07	4.26	6.46	8.65	10.85	13.04	15.24
	195	-0.34	1.86	4.05	6.25	8.44	10.64	12.83	15.03
	200	-0.55	1.65	3.84	6.04	8.23	10.43	12.62	14.82
	205	-0.76	1.43	3.63	5.83	8.02	10.22	12.41	14.61
	210	-0.97	1.22	3.42	5.62	7.81	10.01	12.20	14.40
	215	-1.18	1.01	3.21	5.41	7.60	9.80	11.99	14.19
	220	-1.39	0.80	3.00	5.20	7.39	9.59	11.78	13.98
	225	-1.60	0.59	2.79	4.99	7.18	9.38	11.57	13.77
	230	-1.81	0.38	2.58	4.77	6.97	9.17	11.36	13.56
	235	-2.02	0.17	2.37	4.56	6.76	8.96	11.15	13.35
	240	-2.23	-0.04	2.16	4.35	6.55	8.75	10.94	13.14
	245	-2.44	-0.25	1.95	4.14	6.34	8.54	10.73	12.93
	250	-2.65	-0.46	1.74	3.93	6.13	8.33	10.52	12.72

The previous table shows similar conclusions as for the CHP scenario – with the rising price of lignite, the NPV of the CHP scenario is more cost-effective. Conversely, the fall in NPV with an increase in the price of natural gas is mainly due to an increase in operating costs natural gas sources (micro-cogeneration, small and medium-scale CHP).

Table 49 Sensitivity analysis of NPV to CO_2 allowance price escalation, high CHP scenario

	Year-on-year price escalation [EUR/year]							
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
NPV [CZK million]	-1.14	1.05	3.23	5.42	7.60	9.79	11.97	14.16

The previous table shows that a higher year-on-year increase in the price of an allowance increases the benefits of the high CHP scenario (the effect of higher efficiency of electricity production in high-efficiency CHP compared to separate electricity production).

Table 50 Sensitivity analysis of NPV to the discount rate, high CHP scenario

	Discount rate [%/year]							
	0.50	1.25	2.25	3.00	3.75	4.50	5.25	6.00
NPV [CZK million]	10.80	10.34	9.77	9.36	8.99	8.63	8.29	7.97
	6.75	6.94	7.50	8.00	8.50	9.00	9.50	10.0
NPV [CZK million]	7.67	7.60	7.39	7.21	7.04	6.87	6.71	6.55

Table 51 Sensitivity analysis of NPV to the valuation of emissions, high CHP scenario

	Multiples of emission prices [EUR]							
	0	Baseline value	2	5	7	10	15	20
NPV [CZK million]	7.44	7.60	7.76	8.25	8.58	9.06	9.87	10.69

The model factors in the valuation of the externalities due to the emissions of NO_x, SO_x and PM according to the values given in chapter 11.2.2. The NPV of this externality valuation is marked as the baseline in the table. Other values in the table represent the NPV of the high CHP scenario for different multiples of the baseline of the valuation of each emission type. With the valuation of emissions calculated in the CASES[45] project (the valuation is 14 times higher on average than baseline), the NPV of the CHP scenario is close to CZK 10 billion compared to the baseline scenario. It is clear that if the valuation of the impact of emissions is higher, the NPV of the high CHP scenario is also increasing (emissions from separate electricity production burden the baseline scenario).

11.7 CBA summary

The aim of the CBA was to evaluate the defined composition of the generation/supply of heat for the 2016-2025 period in the baseline and alternative scenarios in terms of the society-wide benefit in the Czech Republic. The identification of the most appropriate scenario resulted from the comparison of incremental costs/benefits of alternative scenarios compared to the baseline scenario. The CBA was drawn up using methodology prepared in accordance with Part 1 of Annex IX to Directive 2012/27/EU.

With regard to the comparability of results, the same amount of heat and power supplied in the Czech Republic was assumed in all scenarios. Therefore, the benefits in scenarios with higher levels of electricity production from high-efficiency CHP include fuel cost savings (primary energy savings), reduced losses in the electricity grid and cost savings on externalities compared to the separate generation of heat and power.

The CBA found that incremental benefits outweigh the incremental costs in both alternative scenarios. The society-wide benefit is highest in the case of CHP scenario. Converted to net present value, additional savings under this scenario amount to CZK 17.65 billion compared to the baseline scenario. In the ‘CHP’ scenario, it is assumed that 33 MW_e of micro-cogeneration, 227 MW_e of small and medium-scale gas fuel cogeneration and 62 MW_e of new installed cogeneration sources using RES and other alternative fuel will be installed in 2016-2025. The utilisation of the technical potential in heat supply with the emerging CHP technologies is shown in the following table.

Table 52 Use of the technical potential in emerging CHP technologies

	Technical potential	CHP scenario
Micro-cogeneration	5.0 PJ in 2025	0.9 PJ in 2025
Small and medium CHP, gas fuels	13.7 PJ in 2025	4.6 PJ in 2025
CHP, RES and other alternative fuels	9.5 PJ in 2025	3.2 PJ in 2025

With the installation of these new small and medium-scale sources with high-efficiency CHP, high-efficiency CHP electricity will increase by 1.3 TWh (in 2025).

In the case of the high CHP scenario, the relatively high total fuel costs (resource mix with intensive use of natural gas) and high investment in new cogeneration sources largely eliminate the benefits of this scenario, and therefore it does not reach the absolute benefits of the CHP scenario.

The sensitivity analysis shows a significant impact on the resulting NPV by fuel prices, the price of emission allowances and the costs of externalities, which may vary significantly, depending on the methodology. Under the CHP scenario, however, NPV should not be less than zero.

The above shows that the Czech Republic should create conditions for the development of cogeneration as a contributor to the CHP scenario, which was shown to provide the highest society-wide benefits.