International Energy Agency
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Energy Policies of IEA Countries

Czech Republic

2016 Review

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INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Over the period since the 2010 in-depth review (IDR), the Czech Republic has made good progress in the development and implementation of energy policy. Some key policy recommendations contained in the last IDR, most notably the need to develop coherent long-term energy and climate strategies, have been implemented. The State Energy Policy (SEP), which replaced the previous 2004 policy, was approved by the Czech government in 2015. The principal strategic objectives of the SEP are security of energy supply and a competitive and sustainable energy sector. Five-yearly reviews of progress against targets will form the basis of any future updates. The SEP also established key targets for energy security, emissions, energy savings, electricity generation and affordability and set out the strategic goals for the proportions of primary energy sources and electricity production, which are set out in relatively broad ranges.

TOWARDS A CLEANER ENVIRONMENT

Greenhouse gas (GHG) emissions in the Czech Republic have been falling since 2000, but GHG emissions per capita and the carbon intensity of the economy are high compared with the average among European member countries of the International Energy Agency (IEA). Emissions are expected to increase alongside economic recovery, but as emissions from sectors outside the European Union Emissions Trading Scheme (EU-ETS) are likely to be 8% below their target value in 2020, the Czech Republic should have no difficulty in meeting its European Union (EU) 2020 emissions target of a 9% increase relative to 2005. Conversely, the Czech Republic is struggling with pollution from local sources, notably domestic heating systems. Air quality in certain regions and cities remains unsatisfactory; therefore, strong measures to address these problems are needed.

In October 2015, the government adopted a Strategy on Adaptation to Climate Change. This document is the national adaptation strategy of the Czech Republic and includes an assessment of the climate change impacts alongside proposals for specific adaptation measures. The State Environmental Policy of the Czech Republic 2012-2020 was adopted by the government in 2013 and is focused on meeting EU climate and energy targets by 2020 and a Climate Protection Policy was approved by Government in July 2016.

The transport sector is one of the largest sources of GHG emissions. The National Action Plan on Clean Mobility has strong ambitions for electric mobility and for the use of compressed natural gas and liquefied natural gas in the transportation sector, for which market incentives have to be designed. Policies related to biofuels are overseen by the Ministry for Agriculture. In August 2014, the Czech government approved a multi-annual programme to support sustainable biofuels in the transport sector for the period2015-20. This programme was abandoned in 2015.

Since 2010, energy demand and energy intensity have decreased significantly, enabling a decoupling of total primary energy supply (TPES) from gross domestic product (GDP). There have been important improvements in developing an integrated strategy and planning for energy efficiency. The National Energy Efficiency Action Plan (NEEAP) 2014, alongside the SEP, plays a new and enhanced role and prioritises the need for greater energy savings and a reduction of the country's energy intensity. This has been complemented by the creation of both the Energy Efficiency and Savings Department at the Ministry of Industry and Trade and the cross-government co-ordination committee on energy efficiency. The Czech Republic should continue to strengthen co-ordination and co-operation between ministries on energy efficiency activities: it is important to ensure there are capacity and resources to plan, implement, monitor and evaluate the energy efficiency policies and programmes set by EU and national targets.

The previous IDR recommended that the government establish separate, but co-ordinated, GHG emissions reduction strategies and targets for both the EU-ETS and the non-ETS sectors. To date, no specific strategy for non-ETS sectors has been adopted, but it is expected that it will be included in the Climate Protection Policy that was approved by government in 2016. One option available to the Czech Republic is the possibility of introducing a carbon tax for those sectors of the economy outside the EU-ETS. Effective tax rates on carbon emissions (apart from transport fuel) are among the lowest in the OECD, which dulls the incentives to transition towards a low-carbon economy.

INVESTING IN STRONG ENERGY MARKETS

The Czech Republic has experienced strong growth in the renewable energy sector, with the share of renewable energy sources (RES) in TPES increasing from 6.7% in 2010 to 9.4% in 2014 despite claims that the potential of RES is limited by natural conditions and environmental protection requirements. The SEP projects up to 25% renewable energy in total energy consumption by 2040. Reaching the envisaged share of RES will require greater focus on developing the sector and examining the potential of all RES. The most promising options, also in terms of comparative advantage for the Czech Republic, should be identified and supported with adequate research and development programmes.

In the electricity market, the share of coal in electricity generation is fourth-highest among IEA member countries. As a result, a long-term security concern is depleting lignite reserves, which are forecast to be exhausted by 2050. The country plans to continue to have surplus generating capacity based on a diversified mix of primary energies while making best use of domestic resources. The goal is to remain self-sufficient in terms of electricity production and to have sufficient generation adequacy, rather than to have surpluses and to be a large electricity exporter as it is at present.

The Czech Republic has a very high share of relatively inflexible generation capacity such as nuclear and lignite. Furthermore, the country has developed large volumes of solar photovoltaic (PV), but a very limited amount of gas-fired capacity. As gas is abundantly available in the country, it could be utilised more, most notably in the power sector, as coal is in decline and the timing of new nuclear projects remains uncertain. With the increase in variable renewables, notably solar PV, the country will need flexible power generation, which gas-fired power can provide. In addition to offering greater flexibility and enhancing energy security, gas can provide certain environmental benefits as a transitional fuel by reducing carbon emissions and air pollution relative to other fossil fuels.

Coal combustion is the largest source of GHG emissions in the Czech Republic and also poses a substantial threat to local air quality in the country. Coal-fired power accounted for 50% of installed generating capacity, 51.5% of electricity production in 2014 and a large share of GHG emissions. The SEP foresees a long-term transition from coal-fired power towards nuclear energy. In the medium term, retrofitting existing coal-fired power plants with cost-effective flue-gas treatments or replacing ageing plants with high-efficiency plants is taking place. These investments are expected to allow coal-fired power plants to continue to make a contribution to energy supply while reducing their harmful environmental impacts. A number of substantial investments in new technology have been made since the previous IDR in 2010.

The government aims to keep electricity costs at affordable levels for households as well as industry in order to preserve the competitiveness of the economy and in order to ensure social sustainability. The government has thus set the goal to keep electricity prices below the average of the 28 EU member states. Furthermore, the aim is to keep the ratio of household energy expenses to total expenses below 10%.

Major power flows in Central Europe, including loop flows, originating in Germany, in the north-south direction through the Czech Republic and Poland, are among the drivers of the need for enhanced operational co-ordination, financial settlement and infrastructure investment in Central Europe. In the case of the Czech Republic, which has the highest level of interconnection capacity within the Central European region, its transmission capacity is reduced at times because of loop flows originating mostly from Germany and flowing via Poland to the Czech Republic. The transmission system operator (TSO) is taking necessary steps to improve the situation including the construction of phase-shifting transformers that control electricity flows while Germany has proposed to increase the financial compensation included in the inter-TSO compensation mechanism. Germany is simultaneously undertaking a substantial programme of investment in its transmission system.

SECURING ENERGY SUPPLY IN THE FUTURE

Nuclear energy plays an important role in the nation's energy mix. Future expansion of nuclear capacity is one of the major pillars of the SEP, one that strongly supports independence and security of supply. To ensure security of supply and reduce emissions of GHGs and solid pollutants, the Czech government, envisages the construction of additional reactors. ČEZ will build new nuclear facilities at Temelín and launched, in August 2009, a public tender to select a contractor for the construction of two nuclear units of advanced pressurised-water designs. The development of additional nuclear facilities will, in the first place, be aimed at replacing thermal power plants at the end of their lifetime. The role of the regulator and the Office for the Protection of Competition will continue to be central in monitoring market developments, as ČEZ already has a dominant position in the Czech electricity market.

In October 2015, the government made a decision to revoke a previous government resolution that limited coal mining in some regions. A number of options were considered before the government decided to lift only some of the mining limits at the brown coal mine near Bílina, which supplies coal to the nearby ČEZ-owned coal-fired plant. It may be helpful to make available a precise explanation of the reasons underlying the decision to amend the mining limits, which have sent a signal that the government may not be fully supportive of the European Union's commitment to a low-carbon transition.

The Czech Republic maintains a high degree of natural gas supply security through a combination of several measures such as long-term supply contracts, a relatively high amount of underground commercial gas storage capacity, and a requirement that the transmission and distribution system operators maintain robust systems. For security of supply reasons, the Czech Republic aims to increase storage capacity from 37% of annual demand to almost 50%. The country also seeks to improve security of supply through capacity extensions at a number of storage facilities and increased flexibility in its gas network, including reversible gas flows throughout the transmission system and expanding interconnectors to neighbouring countries. The Czech Republic has also implemented an efficient wholesale market, where a variety of natural gas products can be traded.

The Czech Republic is fully compliant with the IEA 90-day stockholding obligation, maintaining 133 days of stocks. Its primary response measure in an oil supply disruption is the use of public oil stocks, which are composed of roughly 50% of products and 50% of crude oil. In case of oil supply disruptions, there are also demand restraint measures available, ranging from soft (educating the public on fuel efficiency) to hard (limiting motor vehicle use, imposing driving restrictions and fuel rationing), but they are not likely to be used early on in a crisis.

STATE ENERGY POLICY

Arising from the SEP is a series of sectoral national action plans (NAPs) that together will form part of a coherent overall strategy for the energy sector. To date, action plans have been published for the development of nuclear energy, energy efficiency, renewable energy, smart grids and clean mobility. Further action plans are under development or being updated in order to support implementation of the SEP. The NAPs have taken into account the views of external stakeholders including business and academia. The government needs to set out very precise implementation plans in all future updates to NAPs to support the SEP, setting clear expectations for future investors and industry stakeholders. These should set out the responsibilities for each ministry, local authorities and other state bodies involved in the implementation and mechanisms to ensure close collaboration among them. There is also a need to ensure that the implementation of the SEP, NAPs and other supporting policies are adequately resourced. The human and capital resources should be sufficient to allow sufficient monitoring, evaluation and adaptation of policies based on evidence with robust data published to make future decisions transparent.

The SEP identifies research, development, innovation and education as fundamental factors in establishing the competitiveness of the energy economy and critical factors for success. The government will focus support on sectors in which Czech research, development and deployment already achieve international standards or where it has a significant competitive advantage. In order to achieve the objectives set out in the SEP, the possibilities provided by effective research, development and innovation policy should be fully exploited. The main funding source is the state budget, which lacks a specific part dedicated to energy research. Overall, the level of resources devoted to research and innovation, both private and public, is significantly lower in the Czech Republic compared with other IEA member countries.

SUPPORTING RENEWABLE ENERGY

Between 2010 and 2014, growth of RES output in the electricity sector was supported by a number of different mechanisms: a feed-in tariff (FIT) system (guaranteed price), feed-in premiums (an amount paid on top of the market price for electricity or green bonuses), investment subsidies and fiscal measures. The expanding costs of the FIT system, notably support for PV energy, required a change in the support mechanism. Two-thirds of the subsidies for RES were going to solar power, which produces only 5% of renewable energy. In 2014, access to the FIT system was ended for new capacity with the exception of hydropower, and there is no longer a FIT support mechanism for wind, PV, biomass etc. This has created uncertainty in the market. Predictability of government policy is very important for the investment climate, and a gradual revision of the FIT mechanism would have been more supportive of investor confidence.

With technological progress, investment costs in solar panels falling and production expanding, many IEA member countries have reformed or started a reform of their support schemes for renewables. While the IEA agrees that support should be limited to what is necessary and that support schemes should respond to falling production costs, sudden changes to the support schemes must be avoided. Unexpected changes to the support schemes change the remuneration structure of existing installations. As such, these measures have created uncertainty, undermined investor confidence and arguably increased the cost of capital for future investments. Since 2013, there has been little growth in the RES sector, and capacity is declining as some plants are being decommissioned. There is an urgent need to replace the support schemes with a stable, predictable, long-term measure. Alternative approaches available to the government could include auctions of a certain amount of capacity of renewable energy production, for example solar PV, to the lowest request for subsidies, or quota obligations where energy suppliers have to ensure that a certain share/quota of the electricity they supply comes from renewable or green certificates.

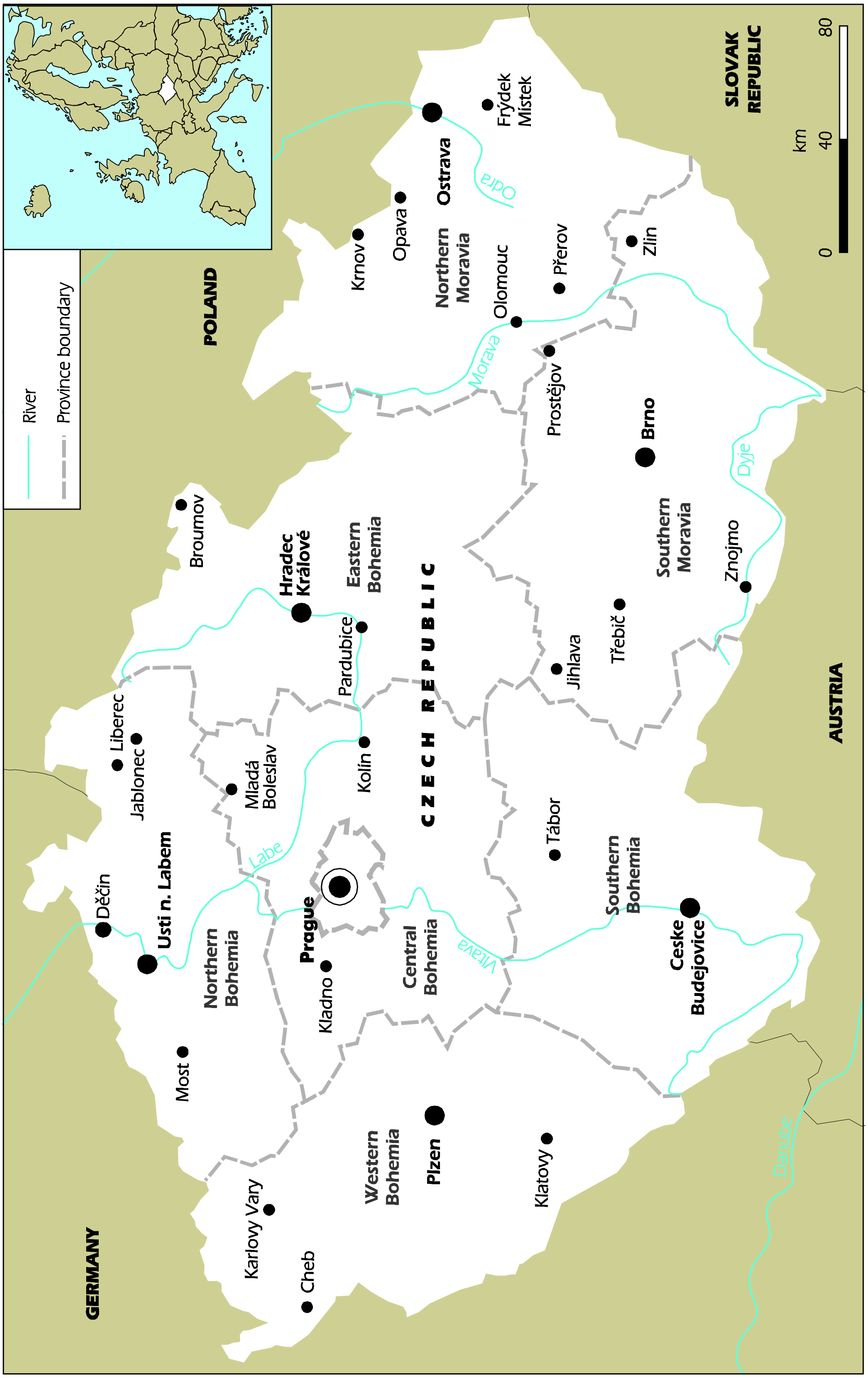
KEY RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Set out very clear implementation plans in all future updates to NAPs to support the SEP in order to establish clear expectations for industry stakeholders and future investors.*
- ☐ *Ensure that the implementation of the SEP, NAPs and other supporting policies are adequately resourced.*
- ☐ *Examine the possibility of introducing a carbon tax for those sectors of the economy outside the EU-ETS.*
- ☐ *Develop and publish proposals for reintroducing support mechanisms for electricity from RES.*

PART I
POLICY ANALYSIS

Figure 2.1 Map of the Czech Republic



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

2. GENERAL ENERGY POLICY

Key data (2015 estimated)

Energy production: 27.8 Mtoe (coal 59.5%, nuclear 25.2%, biofuels and waste 12.5%, oil 0.8%, solar 0.8%, natural gas 0.7%, hydro 0.2%, wind 0.2%, heat 0.1%), -15.5% since 2005

TPES: 40.7 Mtoe (coal 39.2%, oil 20.8%, nuclear 17.2%, natural gas 15.9%, biofuels and waste 8.6%, solar 0.5%, hydro 0.2%, wind 0.1%, electricity -2.6%), -9.4% since 2005

TPES per capita: 3.9 toe (IEA average: 4.5 toe)

TPES per GDP: 0.13 toe/USD 1 000 PPP (IEA average: 0.11 toe/USD 1 000 PPP)

Electricity generation: 82.6 TWh (coal 54%, nuclear 32.5%, biofuels and waste 6.3%, solar 2.7%, natural gas 2.7%, hydro 1%, wind 0.7%, oil 0.1%), + 0.8% since 2005

Power generation per capita: 11 MWh (IEA average: 9.9 MWh)

Currency: EUR 1.00 equals CZK 25.272 (2015)

COUNTRY OVERVIEW

The Czech Republic is a landlocked country in Central Europe. It borders on Germany, Poland, Austria and the Slovak Republic and includes the historical territories of Bohemia, Moravia and Czech Silesia. It has a population of 10.5 million and an area of 78 866 square kilometres. The Czech Republic has been divided into 13 regions since 2000; the capital and largest city, Prague or Praha, has over 1.2 million residents.

The country enjoys a temperate continental climate, generally mild but variable locally and throughout the year with warm summers and cold, cloudy winters. Most rains are during the summer. Temperatures also vary greatly depending on the elevation, as the geography of the Czech Republic is marked by a diverse terrain that is divided between the hilly Moravia in the east and the plateau of Bohemia in the west surrounded by low mountains.

The Czech Republic was established on 1 January 1993, following the separation of the former Czech and Slovak Federal Republic (Czechoslovakia). In the following years, the Czech Republic joined the Organisation for Economic Co-operation and Development (OECD) (1994), the North Atlantic Treaty Organization (NATO) (1999), the International Energy Agency (IEA) (2001), the European Union (EU) (2004) and the Schengen Area (2007). The Czech Republic has now completed the transformation of the formerly centralised state system into a parliamentary democracy and market economy. It uses the Czech koruna (CZK) as its currency, while euro adoption has been under discussion since joining the European Union. Meanwhile it has adopted fiscal and monetary policies that aim to align its macroeconomic conditions within the European Union.

The Czech Republic is a pluralist multiparty parliamentary representative democracy, with the prime minister as the head of government. The Parliament (Parlament České republiky) is bicameral, with the Chamber of Deputies (Poslanecká sněmovna) and the Senate (Senát). The president is a formal head of state.

The Czech Republic has one of the most developed and industrialised economies in Central and Eastern Europe. Its strong industrial tradition is based on the history that Bohemia and Moravia were the industrial heartland of the Austro-Hungarian Empire where 70% of the industrial production was concentrated. Czech industry is focused on metallurgy, engineering, automobiles, electronics, chemistry, food and beverage processing, and production of glass, medicines, textile and paper. Industry makes up 41% of the gross domestic product (GDP).The largest part of the country's GDP comes from the service sector (55%).

The Czech economy returned to growth in 2014 following two years of contraction, and unemployment has been on a declining trend (6.2% in June 2015). The return to growth has been largely driven by domestic demand, with investment growing strongly based on strong foundations of industry, declining oil prices, and domestic fiscal and monetary policy on a weak koruna. Particularly, continued growth in almost all segments of the manufacturing industry, especially in the production of transportation vehicles and machinery, has recently accelerated to a record and outpaces all other members of the European Union.

SUPPLY AND DEMAND

SUPPLY

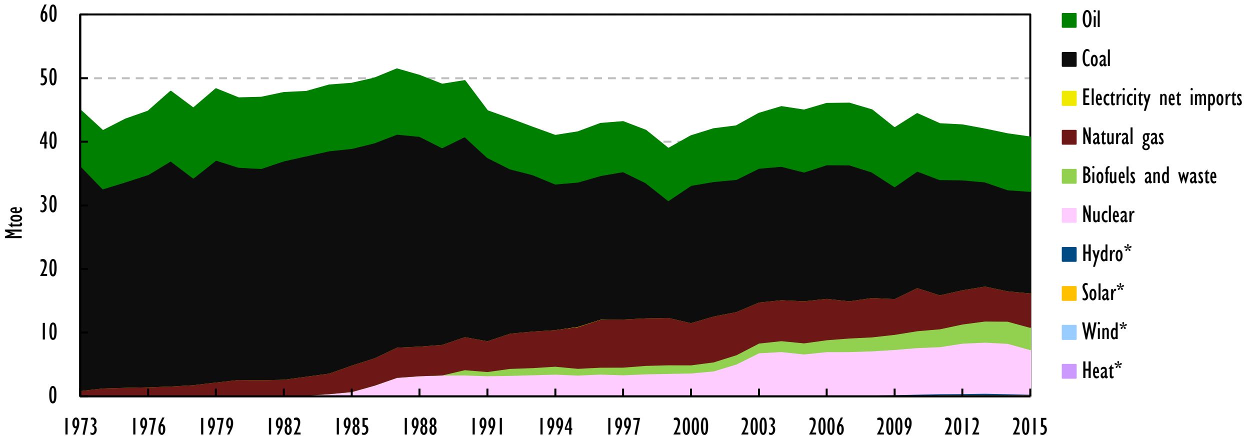
The Czech Republic's total primary energy supply (TPES) was 40.7 million tonnes of oil-equivalent (Mtoe) in 2015.[1] Fossil fuels accounted for 30.9 Mtoe or 76% of TPES in 2015. This is a decrease of 17.8% from 37.6 Mtoe in 2005 (Figure 2.2). TPES per capita was 3.9 tonnes of oil equivalent (toe), which is lower than the IEA average of 4.5 toe per capita.

Coal is the dominant energy source in the Czech Republic, representing 39.2% of TPES. Since 2005, energy produced from coal has decreased by 21.1% from 20.2 Mtoe. The State Energy Policy (SEP) favours reducing greenhouse gas (GHG) emissions, which taken together with restrictions on brown coal mining resulting from territorial ecological limits (which were partially removed in 2015, although mining in the largest coal reserve remains limited) means that coal´s position as the backbone of the power system will be gradually replaced by nuclear. Ongoing gradual contraction in coal use (particularly in the case of hard coal) has been also influenced by external factors, such as an influx of cheap coal from the United States since the North American shale gas boom, that have weakened the competitiveness of domestic coal.

In 2015, energy from oil amounted to 8.5 Mtoe or 20.8% of TPES, and energy from natural gas was 6.5 Mtoe (15.9% of TPES). Over the last three decades, the share of oil in the energy mix has remained relatively stable at an average of 20%. Conversely, the share of gas has been declining since peaking at 19.9% in 1999, influenced by climatic conditions, economic recession and volatile gas prices for end users. Over the next 25 years, oil is expected to decrease to between 14% and 17% of TPES, while the share of natural gas is projected to rebound to between 18% and 25%.

1. TPES is made up of production + imports - exports - international marine bunkers - international aviation bunkers ± stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (for example refining) or in final use.

Figure 2.2 TPES in the Czech Republic, 1973-2015



Note: Data are estimated for 2015.

* Negligible.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

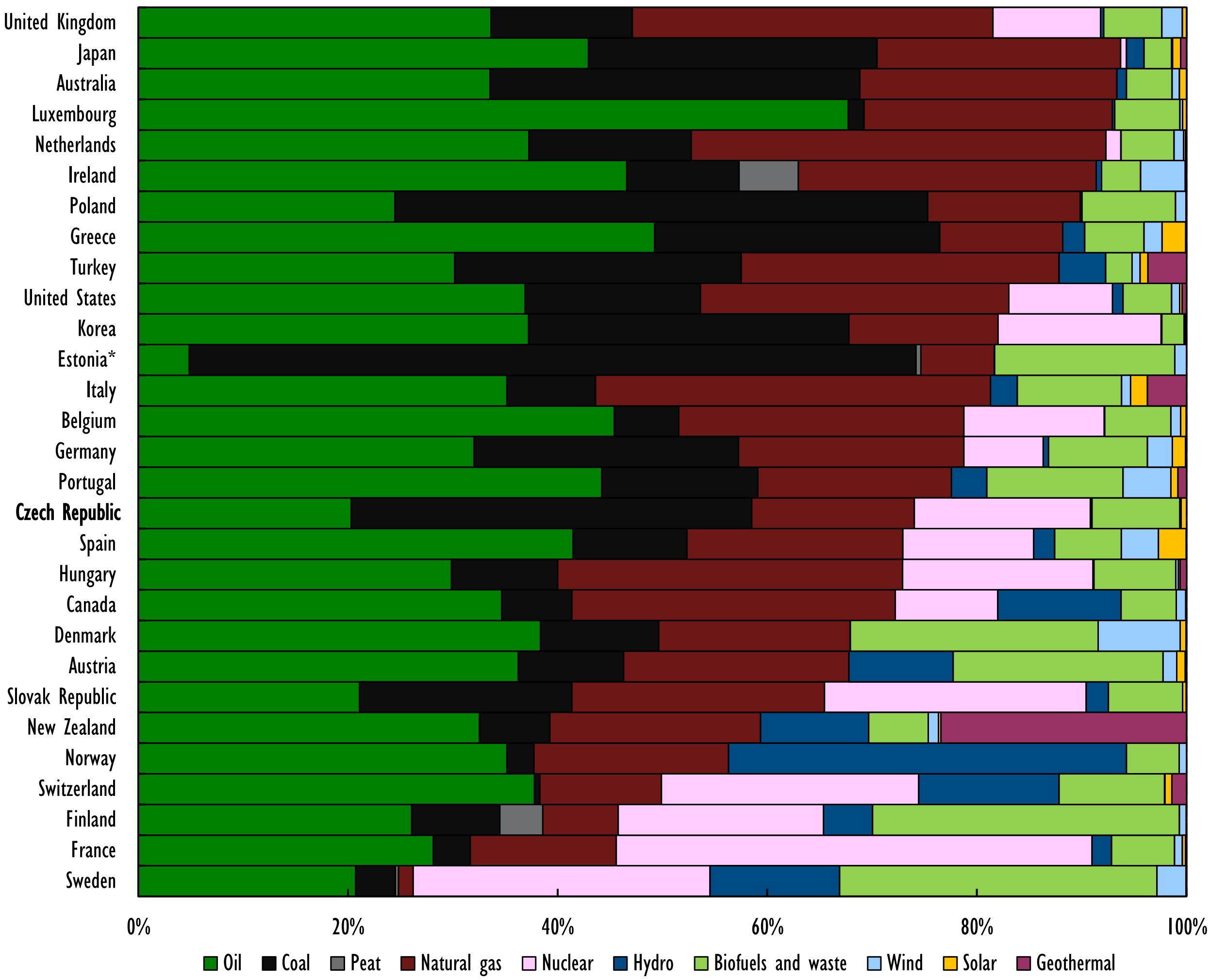
Nuclear energy accounted for 7 Mtoe or 17.2% of TPES in 2015. This represents a moderate increase since 2005 from 6.5 Mtoe, following a surge in 2003 when the 2 000 megawatt Temelín Nuclear Power Station was commissioned. By 2040, the government projects that the share of nuclear energy in TPES will reach between 25% and 33%. This is supported by the National Action Plan for the Development of Nuclear Energy (NAP NE) approved in June 2015, which ensures the future development of nuclear energy.

Renewable energy sources (RES) accounted for 9.4% of TPES; this is made up of biofuels and waste (8.6%), solar (0.5%), hydro (0.2%) and wind (0.1%). Renewable energy production grew by 95.7% over the ten years to 2015, mainly from biofuels and waste, new hydro, and solar photovoltaic (PV), the result of generous support mechanisms and a gradual increase in competitiveness compared with conventional sources of energy. Solar energy has grown from negligible levels in 2009 to around 0.5% in 2015, largely on the back of generous subsidies. Based on the potential of biomass, solar and geothermal energy within the country's large forests, government projections indicate that renewable energy will make up between 17% and 22% of TPES by 2040, with biofuels accounting for 80% of this amount, solar for 8.7%, geothermal (including heat pumps) for 6.1% and hydro 3%.

Compared with other IEA member countries, the Czech Republic is around the median level with regard to the share of fossil fuels in TPES at 76%. The share of coal ranks third-highest after Estonia and Poland, and oil and natural gas rank relatively low.[2] With respect to the share of nuclear, the Czech Republic is the seventh-highest among the 16 IEA members with nuclear energy in their energy mix (Figure 2.3).

2. Estonia's oil shale is classified as coal in IEA statistics.

Figure 2.3 Breakdown of TPES in IEA member countries, 2015



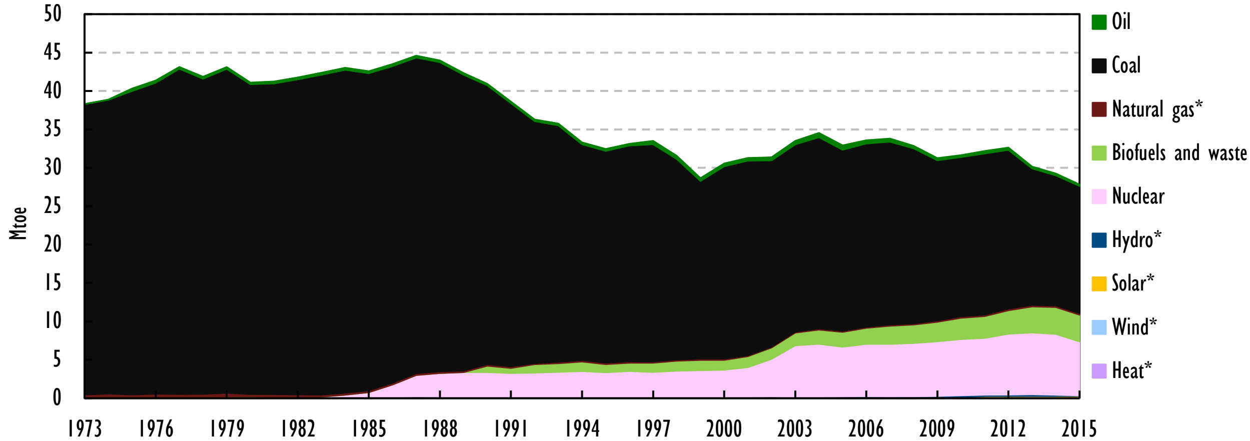
Note: Data are estimated.

* Estonia's coal represents oil shale.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

Around 68% of Czech energy needs are produced locally, representing 27.8 Mtoe in 2015. Domestic primary energy production was largely made up of coal (59.5%), nuclear (25.2%), and biofuels and waste energy (12.5%) (see Figure 2.4). Coal is the only conventional source of energy produced in large amounts; therefore, national energy security is directly related to its use. The decline in coal use over the past decade resulted in a drop in the share of domestic energy production in TPES between 2005 and 2015, offset to some extent by growth in biofuels and wastes and nuclear. The share of domestic production in TPES decreased from 76% in 2005 to 68% in 2015.

Figure 2.4 Energy production in the Czech Republic by source, 1973-2015



Note: Data are estimated for 2015.

* Negligible.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

DEMAND

Total final consumption (TFC) of energy in the Czech Republic amounted to 24.9 Mtoe in 2014 (the latest year for which consumption data are available).[3] TFC represented around 60.4% of TPES in 2014, with the remainder used in power generation and other energy industries (Figure 2.5).

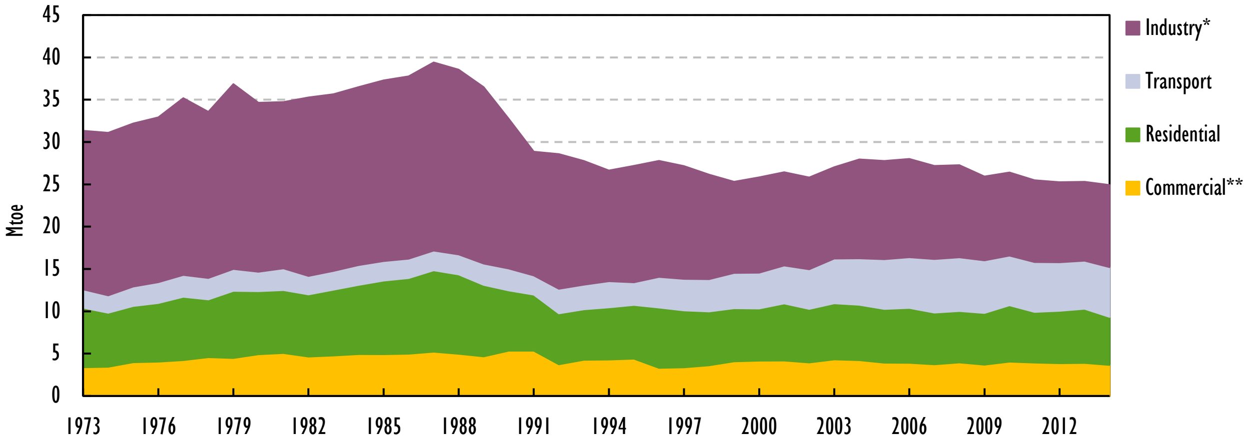
Industry is the largest consuming sector with 39% of TFC in 2014, or 9.7 Mtoe. Energy use in this sector has decreased by 10.8% since 2004. Industrial restructuring towards less energy-intensive industries seems to have had a substantial impact on this sector. A significant drop in coal use by 42.5% in the sector for the past decade contributed to this overall decrease, while oil use decreased by only 16.7% and natural gas use dropped by 14.4%. This is because the coal share within industry is the highest among sectors, and coal demand fully corresponds with coal production, while TPES of coal constituted 93.7% of domestic coal.

The transport sector is the second-highest consumer, with 23.6% of TFC, or 5.9 Mtoe. Energy use in this sector has contracted since 2007-08, and a rapid integration of biofuels and waste energy in transport has been displacing oil use. Households account for 22.8% of TFC, or 5.7 Mtoe. Energy consumption by the sector has decreased by 13.3% since 2004. The commercial and public services sector (including agriculture) consumes 14.6% of TFC, or 3.6 Mtoe, remaining stable at an average 3.9 Mtoe since 2004.

The Czech Republic has the 10th-highest share of industry in TFC among IEA member countries and the 12th-highest share of residential energy use in TFC, while the share of the commercial and public sector in TFC is the 11th lowest, and the share of transport is ranked seventh-lowest.

3. TFC is the final consumption by end users, i.e. in the form of electricity, heat, gas, oil products, etc. TFC excludes fuels used in electricity and heat generation and other energy industries (transformations) such as refining.

Figure 2.5 TFC in the Czech Republic by sector, 1973-2014



* *Industry* includes non-energy use.

** *Commercial* includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

INSTITUTIONS

The Ministry of Industry and Trade (MIT) is the lead ministry for the development and implementation of energy policy. It also ensures that the Czech Republic meets its obligations arising from its international agreements and treaties. MIT monitors compliance with safety and reliability standards of the electricity and gas network, implementation of protective measures in case of an emergency, and management of a sudden crisis in the energy market. The Ministry of the Environment (MOE) is responsible for the protection of the environment, including the development of all major environmental policies and legislation. In the energy sector, the MOE tries to minimise the impact of energy consumption, promote rational energy supply and use, and promote sustainable development.

The State Office for Nuclear Safety is the regulatory body responsible for administration and supervision in the use of nuclear energy and radiation and of radiation protection. Its responsibilities include state supervision of safety of nuclear facilities, protection of nuclear facilities, radiation protection, and emergency preparedness of nuclear facilities and licensing of nuclear activities.

The Administration of State Material Reserves (ASMR) is the central state body responsible for the administration emergency measures and the state material reserves, including their acquisition. The State Energy Inspection (SEI) is an administrative authority subordinated to the MIT. The SEI oversees compliance with the Energy Act, the Energy Management Act and the Act on Prices. SEI ensures that energy-related products are marketed or otherwise in accordance with the requirements established by the Act on Energy Management.

The State Environmental Fund of the Czech Republic provides financial support in the form of subsidies, loans and contributions to partial interest coverage. Its main activities include the provision of consulting and advisory services and administration of major subsidy programmes. The Agency for Nature Conservation and Landscape Protection of the Czech Republic is responsible for the protection and conservation of nature and the landscape. The Czech Geological Survey provides the state geological service. It has the statutory responsibility to gather, store and interpret geological information.

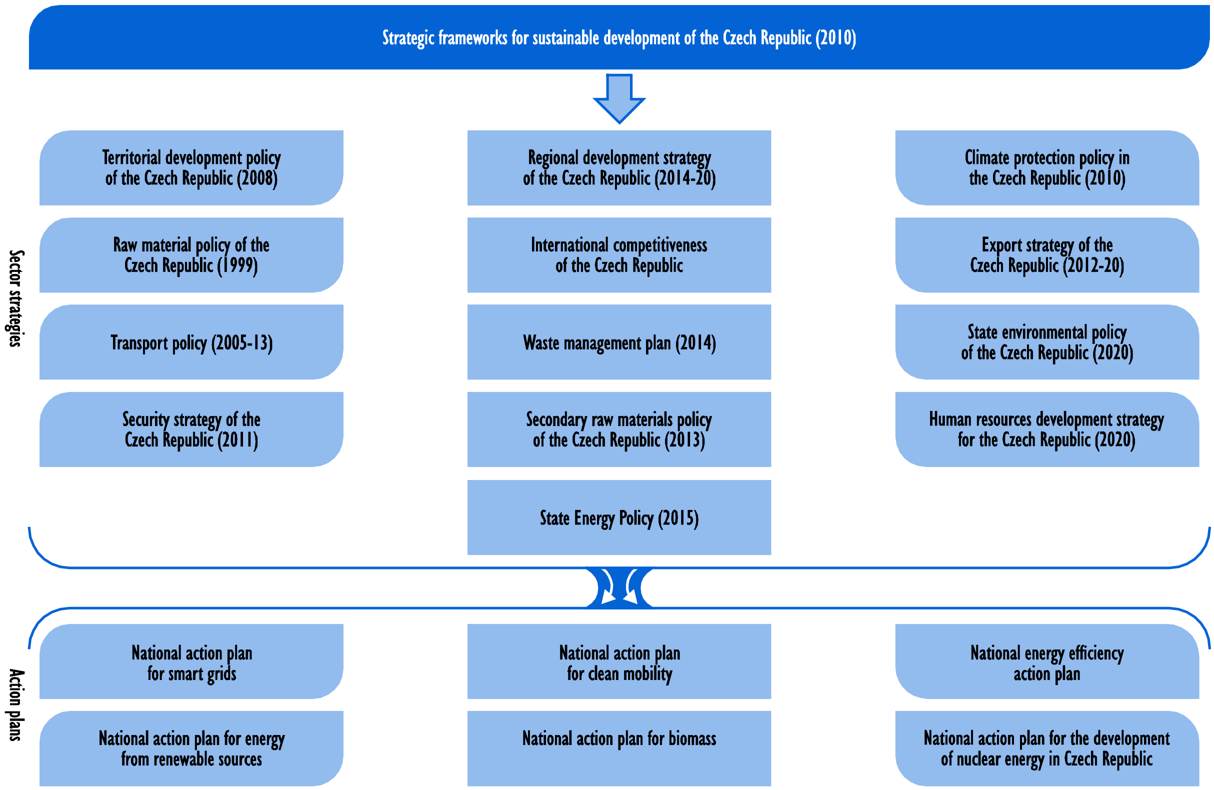
The Energy Regulatory Office is the administrative authority responsible for oversight and economic regulation of the energy sector. The Office for the Protection of Competition (ÚOHS) is the central authority responsible for creating conditions that favour and protect competition, supervision over public procurement and consultation, and monitoring the provision of state aid. The Electricity Market Operator (OTE) is the Czech electricity and gas market operator. OTE organises the short-term electricity and gas markets in co-operation with the transmission system operators as well as the energy balancing market. It also maintains the National Register of Greenhouse Gas Emissions.

KEY POLICIES

POLICY FRAMEWORK

The Strategic Framework for Sustainable Development of the Czech Republic 2010 established a consensual framework for the preparation of sectoral policies and action programmes for strategic decision making within individual government departments, for interdepartmental co-operation, and for collaboration with interest groups (see Figure 2.6).

Figure 2.6 Interdependence of strategic and conceptual frameworks in the Czech Republic



Source: MIT, IDR country submission.

The State Energy Policy is one of the key policies that have emerged from within this framework. The State Energy Policy in turn gives rise to a number of action plans for the energy sector, some of which being implemented and others are in the process of development.

The National Reform Programme (NRP) is an annual forward look at the country's economic policy. Based on the Government's Policy Statement, it details the changes needed to boost the competitiveness of the Czech economy. The 2015 NRP states that the aim of the Czech Republic in the energy and climate sector is to ensure the transition to a competitive low-carbon economy and to reduce the country's dependence on fossil fuels. The 2015 NRP also highlights the need to step up the efforts to improve energy efficiency in the economy.

THE STATE ENERGY POLICY

The State Energy Policy 2015 (SEP) is the document by which the government defines the political, legislative and administrative framework for reliable, affordable and long-term sustainable energy supply. Within the meaning of the Act No. 406/2000 Coll., on Energy Management, it is the strategic document expressing the objectives for energy management of the state. The SEP was approved by Czech Government Resolution No. 362 of 18 May 2015 and replaced the previous 2004 policy.

The principal strategic objectives of the SEP are:

- **Security of energy supply**: Ensure essential energy supplies for consumers and also, when appropriate, guarantee full supply of all forms of energy to the extent necessary to keep the economy functioning in "emergency" mode and to keep the population supplied during emergency situations.
- **Competitiveness:** Ensure end-user prices (electricity, gas, oil products) for industrial consumers and households that are comparable with prices in other countries in the region and those of other direct competitors as well as creation of an energy sector that is able to create added economic value in the long term.
- **Sustainability**: Build an energy structure that is sustainable in the long term from the viewpoint of the environment (no further damage), finance and the economy (financial stability of energy sector and the ability to provide the necessary investment), human resources, social impact (employment), and primary sources (availability).

The strategic direction of the energy sector is defined by a number of targets. The Czech Republic will aim to achieve a 40% reduction in carbon dioxide (CO_2) emissions by 2030 in comparison with 1990 and a further reduction in emissions in compliance with EU strategies aimed at decarbonising the economy by 2050 in accordance with the financial capacity of the country. The government also aims to increase energy savings in 2020 by 20% compared with business-as-usual with the target of achieving net final energy consumption of 1 060 petajoules (PJ) (according to the Eurostat methodology, or 1 020 PJ according to the IEA methodology) and continue increasing energy efficiency by 2040 in compliance with EU strategies with the aim of reducing energy intensity and average energy consumption per capita to below the average of the 28 EU member states (EU-28).

The country has established a target ratio of annual electricity production from domestic primary sources to the total gross amount of electricity generated of at least 80% (RES, secondary sources and waste, brown and hard coal, and nuclear fuel, assuming adequate supplies) with the target electricity generation structure (in proportion to the total gross annual amount of electricity generated) in corridors (Table 2.1). The government also aims to diversify the mix of primary energy sources (in proportion to the total gross annual consumption of primary energy sources) with a target structure in corridors (Table 2.2).

Other ambitions include maintaining a positive electricity power balance, the adequacy of power reserves and regulation (provision of the necessary support services) and keeping electricity generation adequacy within the range of -5% to 15% of maximum load on the system.

Further goals for the electricity sector include preventing import dependency from exceeding 65% by 2030 and 70% by 2040, keeping final electricity prices (energy plus the regulated network component) for the non-household sector comparable with trends in neighbouring countries (final electricity prices at large user level) and below the EU-28 average, while also remaining below 120% of the OECD average and reducing the share of energy expenses to total household expenses, aiming to keep the share below 10%.

In order to ensure reliable, secure and environment-friendly energy supplies for the people and the economy of the Czech Republic at competitive and acceptable prices, the SEP defined a number of key priorities.

- **Balanced energy mix:** A balanced mix of primary energy sources and electricity generation sources based on a broad portfolio of technology and efficient use of all available domestic energy sources. Maintaining available strategic reserves of domestic forms of energy.
- **Savings and efficiency:** Increasing energy efficiency and achieving energy savings throughout the energy chain in the economy and in households. Meeting EU strategic objectives for cutting consumption and achieving energy efficiency at least to the level of the EU-28 average.
- **Infrastructure and international co-operation:** Developing the Czech Republic's network infrastructure, strengthening international co-operation and integration of the electricity and gas markets in the region, including support for the creation of an effective and operational joint EU energy policy.
- **Research, development and innovation:** Supporting research, development and innovation so as to ensure the competitiveness of the Czech energy industry and support education, with the aim of achieving generational exchange and improving the quality of technical expertise in the field of energy.
- **Energy security:** Increasing energy security and resilience of the Czech Republic and enhancing its ability to ensure essential energy supplies in cases of accumulated outages or multiple attacks against critical infrastructure, and in times of prolonged fuel supply crises.

Table 2.1 Relative corridors for gross electricity generation in Czech Republic State Energy Policy

Source	Minimum	Maximum
Nuclear fuel	46%	58%
Renewable and secondary sources	18%	25%
Natural gas	5%	15%
Brown and black coal	11%	21%

Source: MIT, IDR country submission.

Table 2.2 Relative corridors for primary energy sources in Czech Republic State Energy Policy

Source	Minimum	Maximum
Nuclear fuel	25%	33%
Solid fuels	11%	17%
Gaseous fuels	18%	25%
Liquid fuels	14%	17%
Renewable and secondary sources	17%	22%

Source: MIT, IDR country submission.

NATIONAL ACTION PLAN OF THE DEVELOPMENT OF NUCLEAR ENERGY

The National Action Plan for the Development of Nuclear Energy in the Czech Republic (NAP NE) was prepared by MIT and the Ministry of Finance in compliance with Czech Government Resolution No. 243 of 9 April 2014. Its objective is to ensure the option of future development of nuclear energy by preserving competencies and technologies. This involves preparations for the siting and construction of one unit at each nuclear power plant (NPP) site, with the possibility of the construction of two units at each site in anticipation of the closure of existing units in Dukovany within two decades.

As a result of the need to ensure the energy self-sufficiency and security of the Czech Republic, the NAP NE highlights the need to start preparing for the construction of one nuclear unit in Dukovany and one unit in Temelín, with the possibility of extension at both sites. In order to maintain continuity of operation in Dukovany, NAP NE points to the need to build in this location and ensure it is fully operational by 2037, when the current Dukovany NPP will have been in operation for 50 years and is expected to be decommissioned.

Owing to the high degree of uncertainty relating to the future development of the electricity market, the NAP NE contains recommendations to continue the process of preparation and construction of a new NPP in two phases. In the first phase, preparatory works will continue leading to the possibility of construction immediately. In the second stage, once the shape of the market is known, the government must make a decision on if it will provide some guarantees to the investor and in what form. This decision must be made at the latest before the issue of a building permit, which should be obtained according to the preliminary schedule set out in NAP NE and no later than 2025.

One of the priority tasks of this document was the identification of possible investment and business models allowing the construction of a new nuclear source. In this regard, NAP NE presented three possible options, each of which is feasible in the Czech Republic. NAP NE will be followed by a further study of each construction option and setting out business and investment models and other necessary steps to ensure the construction of the preferred model.

NATIONAL ACTION PLAN FOR ENERGY EFFICIENCY

National Energy Efficiency Action Plans (NEEAPs) set out estimated energy consumption, planned energy efficiency measures and the improvements that individual EU member countries expect to achieve. Under the 2012 Energy Efficiency Directive, each EU member country must draw up these plans every three years and also provide annual reports. The third National Action Plan on Energy Efficiency of the Czech Republic (NEEAP) was approved with Czech Government Resolution No. 1085 of 22 December 2014. It defines the main energy efficiency strategies in the Czech Republic by 2020 and includes measures that are focused on increasing energy efficiency. An important part of the NEEAP is a list of objectives that the country has set for 2020 and a description of their implementation, including an estimate of financing needs.

The national indicative target was set at 47.78 PJ (13.27 terawatt-hours) of new final energy savings by 2020. The highest projected energy savings are expected in the residential sector (25.1 PJ) followed by the industrial sector (22.8 PJ) by 2020. Although the transport sector is included in the NEEAP, there are no estimates available for it.

NATIONAL ACTION PLAN FOR ENERGY FROM RENEWABLE ENERGY SOURCES

The Directive of the European Parliament and of the Council No. 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources implies for the European Union as a whole a target of a 20% share of energy from renewable sources and a 10% share of energy from renewables in transport in 2020. For the Czech Republic, the European Commission has set a minimum 13% share of energy from renewable sources in gross final energy consumption. Reaching this goal must also ensure at least a 10% share of renewables in transport. The National Plan for Energy from Renewable Energy Sources was approved by Czech Government Resolution No. 603 of 25 August 2010. An updated version of the plan, which was approved by the government in November 2012, expects to achieve a 14% share of energy from renewable sources in gross final energy consumption and a 10.8% share of energy from renewable sources in gross final consumption in transport in 2020. An updated version of the plan was approved by government on 25 January 2016 to take into account changes to domestic policy and the latest revisions of EU rules on the restriction of the use of first-generation biofuels.

The State Programme for Support of Energy Savings and Use of Renewable and Secondary Energy Sources is a national subsidy programme that aims to stimulate interest in energy savings and use of RES. It has established the following priorities:

- education and training of public and professional awareness
- support the introduction of energy management measures in cities and regions
- support for small investment projects that deliver direct energy savings, notably in small towns and villages, but also small business projects.

NATIONAL ACTION PLAN FOR SMART GRIDS

The National Action Plan for Smart Grids (NAP SG) was approved in March 2015. It assumes a gradual introduction of smart grids and other measures in several stages. The NAP SG sets out the expected development of the electricity sector of the Czech Republic for three periods, starting with the period until 2019, followed by two five-year periods until 2024, until 2029, and finally, the last between 2030 and 2040. The period up to 2019 can be characterised as a period of preparation (analysis, solutions to individual problems, partial measures, drafting and final approval of the Target Model Smart Grid). The other periods identified, 2020-24 and 2025-29, focus on implementation in accordance with the needs of the electricity system and the existing technological level at that time.

NATIONAL ACTION PLAN FOR CLEAN MOBILITY

The draft National Action Plan for Clean Mobility (NAP CM), which was approved on 20 November 2015, was prepared in order to fulfil the following basic objectives:

- to reduce the negative impacts of transport on the environment, notably with regard to emissions
- to reduce dependency on liquid fuels, to diversify the source mix and to increase energy efficiency in transport.

The NAP CM, when approved, will fulfil the requirement for the adoption of an appropriate national policy framework for the development of market infrastructure for alternative fuels in the transport sector and the development of applicable infrastructure. This obligation arises from EU Directive 2014/94/EU.[4]

CLIMATE POLICY OF THE CZECH REPUBLIC

The National Programme to Abate Climate Change Impacts in the Czech Republic represents the climate protection strategy of the Czech Republic. The programme has been developed in accordance with the requirements of Council Decision 99/296/EC and approved by the Czech Government Resolution No. 187 of 3 March 2004.

The programme examines the impacts of the climate change occurring across various sectors and defines a national strategy leading towards a mitigation of the negative impacts. It contains data on GHG emissions in the Czech Republic, including projections of future development, and presents proposals mainly for measures to reduce GHG emissions. Its main objectives for the period commencing after the end of the first commitment period of the Kyoto Protocol include the following requirements:

- Reduce CO_2 emissions per capita to 2020 by 3% compared with 2000.
- Reduce total aggregate CO_2 emissions to 2020 by 25% compared with 2000.
- Increase the share of renewables in primary energy consumption to 20% by 2030.

In addition, in October 2015, the Czech government adopted the Strategy on Adaptation to Climate Change in the Czech Republic. This document represents the national

4. Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure.

adaptation strategy of the country and it includes an assessment of climate change impacts and proposals for specific adaptation measures.

TAXATION

The environmental tax policy of the Czech Republic in recent years has been closely connected to EU energy/environmental taxation initiatives, particularly the revision of Directive 2003/96/EC, which aimed to establish a minimum rate for taxation of the CO_2 component for all uses of energy products. This legislative proposal was withdrawn in December 2014, which resulted in a need for a revision of Czech environmental policy. Accordingly, the Ministry of Finance is revising all environmental tax policy and further steps towards defining a low-carbon environmental tax policy are being considered.

Table 2.3 Energy taxes in the Czech Republic

Product	Rate
Brown coal heating	CZK 8.50/GJ GCV
Electricity	CZK 28.30/MWh
Natural gas for heating in business	CZK 30.60/MWh
Natural gas for heating in households	Exempt
Natural gas for transport	CZK 68.4/MWh until 31 December 2017 and rising thereafter

Note: GJ = gigajoules; GCV = gross calorific value; MWh = megawatt-hours.

Source: MIT, IDR country submission.

Regarding broader taxes on energy, the standard rate of value-added tax (VAT) is 21%, while district heating and cooling are levied at a reduced rate of 15%. Consumers relying on district heating are not granted a tax exemption because heat is not subject to energy taxation (implied by the Energy Taxation Directive). Energy products used for heating in heat-producing plants are, however, subject to taxation.

The electricity tax rate applies to all electricity, including electricity produced from renewable energy sources, with exception of electricity consumed in combined heat and power, public transport, and electrolytic, mineralogical and metallurgical processes.

The Czech Republic supports biofuels by means of reduced excise tax rates and annual mandatory blending quotas. Mandatory ratios are set out in the Air Protection Act. The rate is 4.1% for gasoline and 6% for diesel. The tax rates of biofuels are expected to be amended and the current level of tax incentives reduced.

ENERGY SECURITY

The main purpose of the SEP is to ensure reliable, secure and environment-friendly energy supplies to meet the needs of the Czech Republic, at competitive and acceptable prices under standard conditions. It must also secure uninterrupted energy supplies in crisis situations to the extent necessary to ensure the functioning of the main components of the state and the survival of the population.

In 2014, domestic coal accounted for the largest share of TPES, followed by oil and natural gas. Over the next two decades, the country aims to reduce its reliance on coal, while at the same time remaining self-sufficient by increasing the use of nuclear and renewable energy. Nevertheless, natural gas will have a growing role in the country's future supply mix, and unlike oil, demand for gas will continue to rise in the coming years.

Approximately 98% of oil demand is met by imports, largely in the form of crude oil from countries of the Former Soviet Union, particularly the Russian Federation (hereinafter "Russia") and Azerbaijan. Roughly two-thirds of this is delivered through the Druzhba pipeline, a supply line that has experienced interruptions and reduced flows in recent years. Natural gas supplies are equally dependent on imports, and over three-quarters of the 7.5 billion cubic metres (bcm) in gas demand is met by imports from Russia. The Czech Republic also transits some 30 bcm/year of Russian gas to other markets farther west, and expansion of storage and pipeline capacities will play an important role in transiting supplies through the Nord Stream pipeline project.

The country's primary response measure in an oil supply disruption is the use of public oil stocks. The office that oversees the state's emergency reserves, the ASMR, has the mandate to cover the entire Czech oil stockholding obligation to the European Union. The chairman of the ASMR has the power to draw down public stocks held in excess of this minimum level, without needing to seek government approval. This allows the Czech Republic to respond quickly to an IEA collective action or to provide loans to relieve shortages in domestic supplies. The country benefits from having a relatively high level of underground commercial gas storage. It does not, however, have strategic reserves or fuel-switching potential for responding to a gas crisis. Following the January 2009 gas crisis in Europe, the Czech government put in place, over a short period of time and ahead of the 2009/10 winter season, a response plan for dealing with a reduction in gas supplies. This plan relies on co-ordination with industry in order to optimise gas storage use and regulate demand-side measures in a crisis.

The country's electricity system is robust: the transmission grid is highly interconnected with the neighbouring electricity networks and in combination with its geographical location makes it a significant electricity exporter and transit hub. Coal is the main source of electricity generation, with nuclear second. The share of renewables is low, and natural gas represents only 2% of electricity generation (mainly during times of peak load). The proportion of renewables in the generation mix is not currently high enough to create grid stability issues or lead to other short-term security concerns. Loop flows from other countries have placed undue stress on the electricity grid. These flows have reduced usable cross-border transfer capacity by about one-third and therefore have a material impact on electricity security. The short- to medium-term solution to this problem is the installation of additional phase-shifting transformers, which increase control and therefore reduce the incidence of unplanned cross-border flows. Over the long term, however, a regional or EU-wide solution is needed.

ASSESSMENT

In May 2015, the Czech government approved the SEP, which replaced the previous 2004 policy. This revision, which was prepared and finalised between 2013 and 2015, sets out the direction of energy policy for the country for the next 25 years. The SEP received cross-party political support, having been partly developed under the opposition. It sets out the key strategic priorities for the country's energy policy, recognising its geographical and market position and its responsibilities regarding implementation of EU energy and climate policy directives. The SEP is supported by an amendment to the Energy Act and regulatory changes that will codify its structure, its indicators and its link to regional policies. Reviews of progress every five years against targets will form the basis of any future updates.

Since the last in-depth review was published in 2010, the Czech government has also prepared key NAPs, notably on energy efficiency, nuclear energy, renewable energy and smart grids. Further action plans are under development or being updated in order to support implementation of the SEP. The NAPs have been written with input from external stakeholders including those within the business and academic spheres.

The SEP sets out key targets for energy security, emissions, energy savings, electricity generation and affordability. It sets out the strategic goals for the proportions of primary energy sources and electricity production. These are set out in ranges, or corridors, which are relatively broad, owing to the uncertainties of the next 25 years. Such ranges can create uncertainty about clarity of vision, particularly in the electricity generation sector.

The policy and regulatory proposals contained in the SEP represent the large number of amendments to energy policy over the past year, notably the development of a number of NAPs. Further key NAPs are being developed and updated with a new climate policy also likely in the next year. Added to this, there are a number of organisations – among them several ministries – that are important to the implementation of the overall strategy. It will be crucial that responsibilities are clear and for central and local government to work effectively together, setting a clear, cohesive message.

The Czech Republic is progressing well with regard to its 2020 targets on emissions and renewables and expects to exceed them. The notable exception may be the goals for transport, where the targets for renewable share and, particularly, emissions, appear challenging, though this problem is not unique to the Czech Republic. A key reason for the relatively rapid progress on renewables in the last five years was the boom in the solar PV sector, supported by generous feed-in tariffs. The support mechanism was deemed to be imposing a significant economic burden on the government and consumers and was ended in 2013 in an effort to control costs. This decision may carry wider implications by creating investor uncertainty, and such a stop-start approach could result in economic inefficiency and slower deployment.

Energy security is a clear strategic priority for the Czech Republic, and its policies, including close international co-operation, have made its short- and medium-term future secure. While the country does not have an indigenous gas supply, it has diversified its supply sources and routes over the last five years. It has a tradition and expertise in nuclear and coal, with sufficient reserves – particularly of lignite – to sustain its planned use in power and heat generation in the medium term. Decisions on the extension of existing nuclear power stations, and the construction of new ones, will play a critical role in the Czech Republic's energy security beyond 2025 (for existing stations) and 2035 (for new ones) and will also affect its future emissions targets. There is relatively strong public support for nuclear energy.

The government's recent decision on the partial relaxation of territorial environmental limits in the mining sector has improved its energy security, and this decision was taken in light of considerations beyond energy such as social policy. The decision went in favour of the mining company, whose largest shareholder is ČEZ; therefore, it will be essential that the reasoning is communicated clearly and widely to ensure transparency and prevent a perception of favouritism from future investors not to mention clarification on continued intentions to reduce GHG emissions.

The Czech Republic uses revenue from the sale of EU Emissions Trading Scheme (EU-ETS) allowances to fund a green savings programme and a portion of the European structural and investment funds for 2014-20 for energy efficiency in buildings and industrial processes. The current NEEAP also sets out savings targets for 2020 that are distributed to all sectors. While the government should be commended for increasing efforts to address energy efficiency, its ambition should continue to increase given the scope for energy and emissions savings, particularly in the heating sector. Furthermore, greater effort to encourage the reduction of coal use in single domestic premises has the potential to reduce local air pollution and deliver positive public health benefits.

The Czech Republic operates a liberalised energy market, although state ownership remains throughout the sector. While there is no suggestion that the state-owned incumbents have an unfair competitive advantage - this position is based more on history than principle - government should examine this arrangement periodically to test whether it provides the best overall outcomes.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Set out very clear implementation plans in all future updates to NAPs to support the SEP, setting clear expectations for future investors. These should set out precise responsibilities for each ministry, local authorities and other state bodies involved in the implementation and mechanisms to ensure close collaboration among them.*
- ☐ *Ensure that the implementation of the SEP, NAPs and other supporting policies are adequately resourced. The human and capital resources should be sufficient to allow sufficient monitoring, evaluation and adaptation of policies based on evidence with robust data published to make future decisions transparent.*
- ☐ *Demonstrate a long-term commitment to energy efficiency up to 2050, by reducing and simplifying the number of schemes and offer a simple, co-ordinated programme for household energy efficiency in the short term. This should include a rationalisation of responsibilities for the sector into one organisation.*
- ☐ *Closely evaluate the external costs of the continued use of coal in those sectors outside the EU-ETS, particularly the use of coal in households, and develop measures to reduce such use in the short term through changes to current schemes, new incentives or penalties.*

References

IEA (International Energy Agency) (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/, OECD/IEA, Paris

3. ENERGY AND THE ENVIRONMENT

Key data (2014)

GHG emissions without LULUCF (2013)*: 127.1 $MtCO_2$-eq, -34% since 1990

GHG emissions with LULUCF (2013)*: 120.4 $MtCO_2$-eq, -35.6% since 1990

2008-12 target: -8% compared with base year

CO_2 emissions from fuel combustion: 96.6 $MtCO_2$, -35.8% since 1990

CO_2 emissions by fuel: coal 65.1%, oil 18.1%, natural gas 15.6%, other 1.2%

CO_2 emissions by sector: power generation 56.1%, transport 17%, manufacturing and construction 14%, residential 6.3%, commercial and other services including agriculture 4.1%, other energy industries 2.5%

* UNFCCC, 2015.

OVERVIEW

The 2015 State Energy Policy (SEP) is a key strategic document for both energy and climate policy. The State Environmental Policy (SEnvP) of the Czech Republic 2012-2020, which was adopted by the government in 2013, is mostly focused on meeting European Union (EU) climate and energy targets by 2020. A Climate Protection Policy was approved by government in July 2016 and is undergoing an environmental impact assessment procedure.

TARGETS AND OBJECTIVES

The Czech Republic, as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), acceded to the Kyoto Protocol in 2001. Under the Kyoto Protocol, the Czech Republic is committed to an average reduction of greenhouse gas (GHG) emissions of 8% below the level of the base year (1990 for carbon dioxide [CO_2], methane [CH_4] and nitrous oxide [N_2O], and 1995 for fluorinated gases [F-gases]) over the first commitment period (2008-12).

According to the latest official inventory, the Czech Republic has exceeded its target by more than 20%. Domestic GHG emissions in 2013 were 34% below the Kyoto Protocol base year level, 127.1 million tonnes of carbon dioxide-equivalent ($MtCO_2$-eq) compared with 193.4 $MtCO_2$-eq in 1990. For a comparison with a five-year average of 2008-12, the total aggregate GHG emissions without land use, land-use change and forestry (LULUCF) was 30% lower compared with 1990, and the total aggregate emissions including LULUCF was 30.9% lower than the base year.

In line with the EU climate and energy package, the Effort Sharing Decision further established binding annual GHG emissions targets for EU member states for the period 2013-20. Accordingly, the Czech Republic is required to reduce emissions by 21% by

2020 (with 2005 as the reference year) in sectors covered by the EU Emissions Trading Scheme (EU-ETS). For the sectors not covered by the EU-ETS (non-ETS sectors), the Czech Republic is allowed to increase its emissions by 9% compared with 2005. In 2012, non-ETS emissions were 0.9% below the 2005 level, well below its target.

In October 2014, the EU 2030 climate and energy policy framework was adopted, and it revised the EU-wide emissions reduction targets for the ETS and the non-ETS sectors up to 43% and 30% by 2030 compared with 2005, reaching 40% reduction overall. The breakdown of the non-ETS for individual member states is yet to be established.

ENERGY-RELATED GHG EMISSIONS

EMISSION TYPES

According to the UNFCCC, CO_2 accounted for 83.4% of total GHG emissions excluding LULUCF in 2013, followed by CH_4 (9.8%), N_2O (4.7%); hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride collectively accounted for 2.25% of the total. Emissions of all gases have decreased since 1990, contributing to an overall decrease of 34%.

The UNFCCC's data shows that the Czech Republic's energy sector accounted for 79.3 % of total GHG emissions in 2013, particularly CO_2, CH_4 and N_2O, 35.9% lower compared with its 1990 levels. Excluding LULUCF, 89.9% of total CO_2 emissions and 30.1% of total CH_4 emissions are from this sector.

Industrial processes and product use (mainly mineral, metal and chemical production) are the second-largest source of emissions, representing 11.1% of emissions with all six direct gases present. Furthermore, 8.4% of total CO_2 emissions originate from this sector, and this is the only sector that emits HFCs, PFCs and SF_6. The agriculture sector accounts for 5.7% of emissions with CH_4 and N_2O the major sources. Waste (3.8%) represents the remainder with the benefits from LULUCF (99% of which is forest land) of 5.3%.

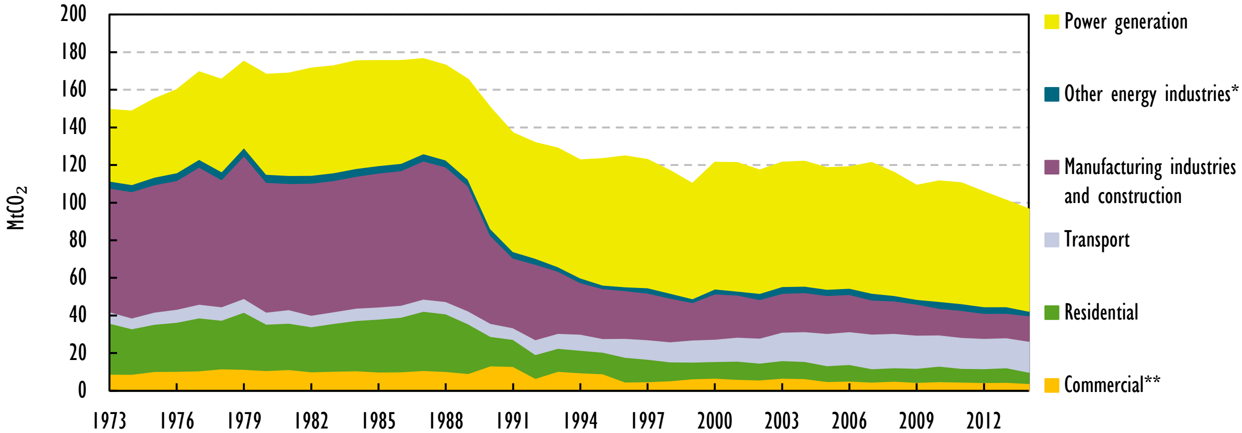
SOURCES OF CO_2 EMISSIONS

Energy-related CO_2 emissions from fuel combustion were 96.6 million tonnes (Mt) in 2014, which is 35.8% lower than 150.3 Mt in 1990. Over the ten-year period from 2004, CO_2 emissions have declined by 20.8% (Figure 3.1).

The largest CO_2-emitting sector in the Czech Republic is the power generation sector, representing 56.1% of the total. The transport sector accounted for 17% in 2014, and industry (manufacturing industries and construction) for 14%, while households and the commercial and public services sector (including agriculture, forestry and fishing) emitted 10.4% of the total. Other energy industries (including refining) accounted for the remaining 2.5% in 2014.

The overall decline in emissions since 1990 is mainly the result of a fall in emissions from the manufacturing and construction sector by 71%, from 46.7 $MtCO_2$ to 13.5 $MtCO_2$. Consumption of solid fuels in the manufacturing industry and at construction sites is a contributor, but use of these fuels has decreased over time compared with other fuels. Use of coal in industry decreased by 78% and use of oil decreased by 48.6%, while biogas use has increased since become commercially viable. Although iron and steel manufacturing and the chemical industry remain high CO_2-emitting sectors, the pulp, paper and print industry (12% of emissions of the manufacturing sector) are changing and are consuming waste wood from production processes. The food processing, beverages and tobacco sector, which accounts for 8% of emissions in the manufacturing sector, utilises a relatively high fraction of biofuels.

Figure 3.1 CO_2 emissions by sector, 1973-2014



* *Other energy industries* includes other transformations and energy own use.

** *Commercial* includes commercial and public services, agriculture/forestry and fishing.

Source: IEA (forthcoming), *CO_2 Emissions from Fuel Combustion 2016*, www.iea.org/statistics/.

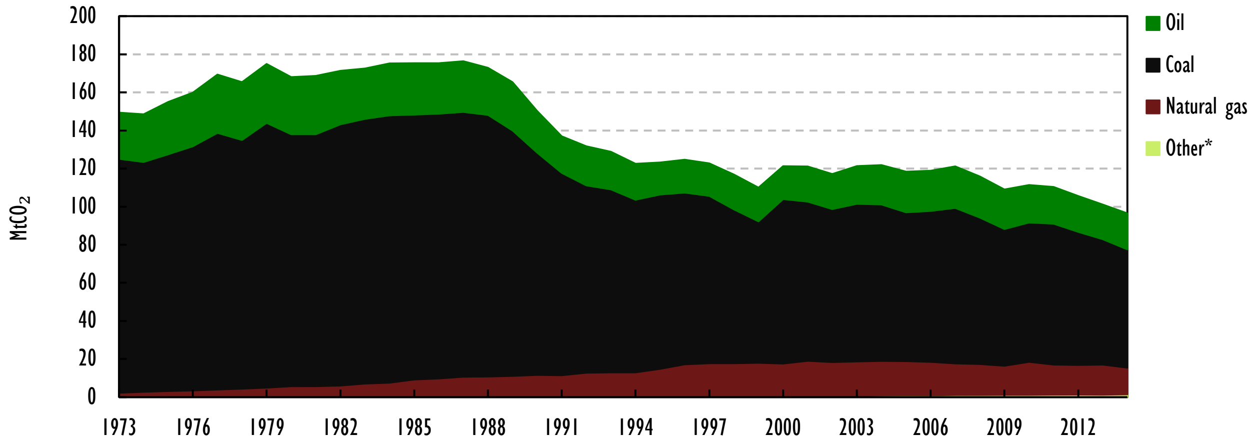
Emissions from the power generation sector also decreased, by 15.5% over since 1990, from 64.1 $MtCO_2$ to 54.2 $MtCO_2$. The amount of coal used in the power sector has remained relatively stable for decades, while emissions have fallen owing to the gradual application of clean-coal technologies. The power sector has also experienced some volatility in emissions over the 1990-2014 period, the result of variations in coal-fired power production and greater use of nuclear and biofuels.

Emissions from households have decreased by 61.2% (from 15.6 $MtCO_2$ to 6 $MtCO_2$), and those from the commercial sector have decreased by 70.5% (from 13.4 $MtCO_2$ to 4 $MtCO_2$) compared with 1990. The main driving force in these sectors is primarily energy-saving measures in space heating. A majority of households in the Czech Republic used solid fuels (mainly brown coal and lignite) as a source of heating fuel in the past, and coal-based heat supply systems still represent a considerable price-competitive advantage over other systems.

In contrast, emissions from the transport sector steadily increased by 136.6% (from 6.9 $MtCO_2$ to 16.4 $MtCO_2$) during 1990-2014. Transport emissions peaked at 18.4 $MtCO_2$ in 2007 and have fallen gradually since. The gradual increase was a result of rapid developing individual automobile and road freight transport. According to the UNFCCC data, emissions from gasoline use increased by 95% and from diesel oil use by 294% during 1990-2007, increasing road transportation emissions by 195% in total. By contrast, liquid oil demand significantly dropped from civil aviation by 93% and from railways by 54% for the same period. Over the last decade, overall emissions started to decrease, particularly in road transportation, as liquefied petroleum gas and biofuels are replacing conventional fuels used in road transportation. Bio-ethanol is currently consumed in motor fuels in the form of a low-percentage additive to motor fuels or in the form of high bio-ethanol mixtures to drive motors, representing around 35% of GHG emissions compared with the emissions from alternative fossil fuels.

Other energy sector, including the refining sector, emitted 32.8% less in 2014 compared with 1990, with a relatively consistent level of emissions over the past 30 years.

Figure 3.2 CO_2 emissions by fuel, 1973-2014



* *Other* includes industrial waste and non-renewable municipal waste (negligible).

Source: IEA (forthcoming), *CO_2 Emissions from Fuel Combustion 2016*, www.iea.org/statistics/.

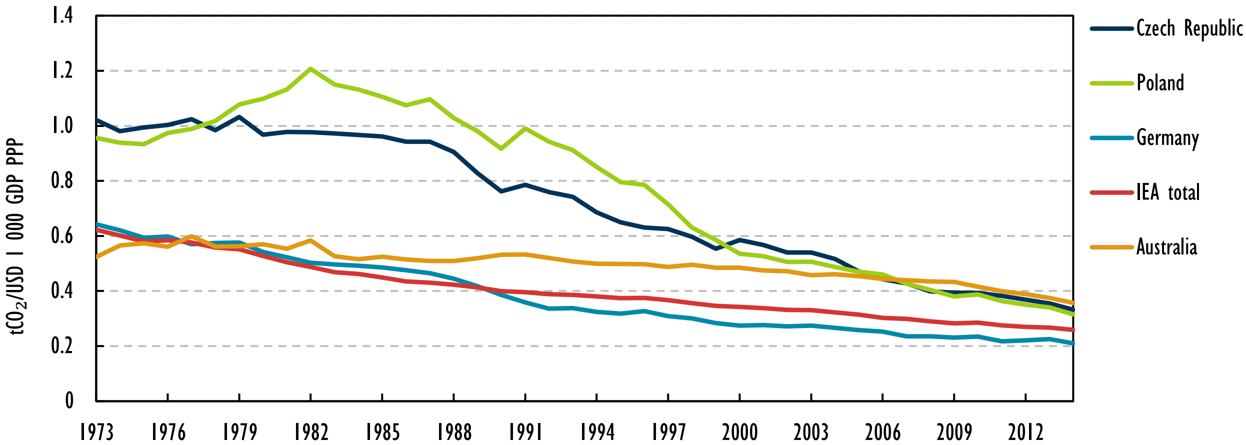
In 1990, most emissions came from coal (77.6%) and oil (14.7%), with gas (7.7%) and no emissions from waste. During 1990-2014, emissions from coal declined by 46.8% and from oil by 13.4%, while emissions from natural gas were up by 21.7%. Less use of coal in industry, households and the commercial sector significantly reduced total emissions, while marginal emissions from biofuels were introduced. In 2014, 65.1% of CO_2 emissions from fuel combustion were from coal. Oil accounted for 18.1% and natural gas accounted for 15.6%, while industrial waste and non-renewable waste made up 1.2% (Figure 3.2).

CARBON INTENSITY

The Czech Republic's carbon intensity, measured as CO_2 emissions by real gross domestic product (GDP) adjusted for purchasing power parity (PPP), amounted to 0.33 tonnes of CO_2 per 1 000 United States dollars (USD) at 2010 prices and PPP (tCO_2/USD 1 000 PPP) in 2014. The Czech Republic has the fifth-highest level of carbon intensity within the International Energy Agency (IEA), similar to Korea (0.33 tCO_2/USD 1 000 PPP) (Figure 3.3).

The Czech Republic's carbon intensity has been rapidly falling over time, down by 35.6% compared with 0.52 tCO_2/USD 1 000 PPP in 2004. The average intensity among IEA members was 19.8% lower in 2014 than in 2004.

Figure 3.3 Energy-related CO_2 emissions per unit of GDP in Czech Republic and in other selected IEA member countries, 1973-2014



Source: IEA (forthcoming), *CO_2 Emissions from Fuel Combustion 2016*, www.iea.org/statistics/.

INSTITUTIONS

Climate change policies and legislation, including the EU-ETS, are the responsibility of the Ministry of the Environment (MOE). MOE also co-ordinates the activities of other ministries and central state administrative authorities on matters relating to the environment.

The Czech Hydrometeorological Institute, which is supervised by the MOE, is responsible for the national inventory of GHGs. OTE, the electricity and gas market operator, is the administrator of the EU-ETS registry. Regional and local governments have no direct responsibility for fulfilment of the climate goals coming from national legislation. They could, however, adopt their own targets, i.e. within the context of the Covenant of Mayors.

POLICIES AND MEASURES

EU TARGETS AND POLICIES

The Czech Republic's GHG targets (including for the second Kyoto commitment period) are derived from the European Union's 2020 targets. As a result of the effort sharing of the EU GHG target of -20% from 2005 to 2020, the Czech Republic is allowed to increase its emissions by 9% in the non-ETS sectors by 2020, and in 2012 the non-ETS emissions were 0.9% below 2005 levels. According to projections with existing measures, the government expects non-ETS emissions to be 8% below 2005 levels in 2020 and 14.5% below 2005 levels in the scenario with additional measures.

The ETS sector in the European Union as a whole will have to cut emissions by 21% from 2005 to 2020. For the first Kyoto commitment period (2008-12), the Czech Republic's target was 8% from the base year (1995 for F-gases, 1990 for the other gases).

Beyond 2020, the European Union is pledging a -40% GHG target from 1990 to 2030, as agreed by the European Council in October 2014. From 2005 levels, emissions reductions below 2005 levels would be 43% in the EU-ETS sector and 30% in the non-ETS sector.

The level of effort to be made by each member state to achieve this EU target has not yet been decided. Importantly, however, the plan is to meet the target with EU measures alone, without contribution from international credits. This would arguably increase compliance costs from today's levels. By 2050, the European Union is aiming to reduce GHG emissions by 80% to 95% below their level in 1990.

EUROPEAN UNION EMISSIONS TRADING SCHEME

The European Union Emissions Trading Scheme (EU-ETS) is a mandatory cap-and-trade system covering CO_2 emissions from energy-intensive industry. It was launched in 2005, and its first commitment period ran until the end of 2007. The second phase covered the period 2008-12. Installations under the EU-ETS can meet their obligations either by reducing emissions on their own, or by purchasing allowances from other installations covered by the scheme, or by purchasing credits under the Kyoto Protocol's flexible mechanisms (joint implementation or the clean development mechanism) up to an established limit.

From 2005 to 2012, emissions allowances were allocated to the facilities on the basis of a national allocation plan (NAlP). The NAlP was prepared by the central government following criteria set out in the ETS Directive (2003/87/EC, later amended by 2009/29/EC) and approved by the European Commission. More than 95% of the allowances in the European Union were allocated to the companies free of charge. Over-allocation of allowances as well as a decline in economic activity led to a large surplus of allowances, a steep decline in their prices and a need to reform the ETS scheme.

The third phase of the EU-ETS runs from 2013 to 2020. It is significantly different from previous phases. National allocation plans are no longer required, and a single EU-wide ETS cap is introduced. The cap is reduced by 1.74% per year from 2010 onwards, resulting in a total reduction of 21% by 2020 below the 2005 levels. More than 40% of allowances will be auctioned, and electricity generation will no longer receive free allowances. For the sectors where allowances will still be given away for free, such as the manufacturing industry and heat sectors, harmonised allocation rules apply, based on EU-wide benchmarks of emissions performance. A separate cap applies to the aviation sector. From 2021 to 2030, the number of allowances will be reduced by 2.2% per year, and a market stability reserve of allowances to be introduced from 2019.

National Allocation Plan (NAlP)

The government set an emissions cap in the NAlP for the trading period 2008-12 in line with the Directive 2003/87/EC; the NAlP was approved by the European Commission. The NAlP covered the power and heat sector and energy-intensive industry sectors such as steel, clinker, glass and paper. During the trading period, there were approximately 400 stationary installations in the Czech Republic. The annual allocation was set at 86.078 million allowances.

For the allocating allowances, the Czech Republic chose a grandfathering mechanism (where the allocation was based on historical emissions). The method was applied to all installations. The NAlP set aside 3.5 million allowances as a New Entrance Reserve for new installations and significant capacity increases. The annual allocation decreased by 10.7 million allowances between the first and second trading periods. The third trading period, 2013-20, is significantly harmonised at the EU level. There are no national caps or national plans, just one EU cap. Installations are entitled to free allocation based on harmonised rules and calculated on the basis of pre-ante emissions efficiency.

STATE ENVIRONMENTAL POLICY

The State Environmental Policy (SEnvP) of the Czech Republic 2012-2020 established a very broad framework for the protection of the environment until 2020 (see Table 3.1). The main objective of this policy is to ensure a healthy and high-quality environment in the Czech Republic, to significantly contribute to a more effective use of resources and minimise negative impacts of human activities on the environment, including cross-border impacts. The SEnvP also identified the most important and urgent problems to be tackled in the short and medium term and those to be addressed over the longer term. The policy also commits the country to fulfilling its commitments to EU environmental legislation, and to remain an active and reliable partner in formulating new legislative, non-legislative and strategic EU documents.

Table 3.1 Key policy areas and objectives: protection of climate and improvement of ambient air quality in Czech Republic

Protection of climate and improvement of ambient air quality.		
Reduction of GHG emissions and negative impacts of climate change.	Reduction of ambient air pollution levels.	Effective use of nature-friendly renewable sources of energy.
Improvement of adaptation to climate change.	Improvement of ambient air quality in locations with exceeded emissions limits and maintenance of air quality where the limits are not exceeded.	Fulfilment of the 13% contribution of energy from renewable sources on the gross total energy consumption by 2020.
Reduction of GHG emissions within EU-ETS by 21% and limiting emissions growth outside the EU-ETS to 9% by 2020 in comparison with 2005.	Fulfilment of the national emissions ceilings in force from 2010 and reduction of the total emissions of sulphur dioxide, nitrogen oxides (NO_x), volatile organic compounds (VOCs), ammonia and fine dust particles (PM2.5) by 2020 in line with commitments of the Czech Republic.	Fulfilment of the 10% share of energy from renewable sources in the transport sector by 2020 while reducing NO_x, VOCs and PM2.5 emissions from transport.
	Maintenance of emissions levels of heavy metals and persistent organic substances below the 1990 levels and their further reduction.	Compliance with commitments to increase energy efficiency by 2020 (note: for European Union as a whole this represents 20%).

Source: MOE (2012), *State Environmental Policy of the Czech Republic 2012-2020*.

A key objective of the SEnvP is to reduce emissions per inhabitant to at least the average value for the EU-28 in 2005 by 2020, which was at the level of 10.5 tonnes of CO_2-equivalent (tCO_2-eq). Given the specific emissions of 12.7 t CO_2-eq per inhabitant in the Czech Republic in 2009, this objective corresponds to the reduction of specific emissions per inhabitant by approximately 17% by 2020.

The policy focuses on the protection and sustainable use of resources, climate protection and improvement of ambient air quality, protection of nature and landscape and safe environment.

Regarding climate protection and air quality, the SEnvP highlights three objectives: reduction of GHG emissions and the negative impacts of climate change, reduction of ambient air pollution levels and the effective use of renewable energy sources.

The SEnvP also highlights the need to protect the environment against the negative impacts of environmental disasters. It also highlights the need for a system of preventive mitigation and especially adaptation measures that are most effective and economically efficient.

OTHER POLICIES

The National Programme to Abate the Climate Change Impacts in the Czech Republic sets out the climate protection strategy of the country. The programme has been developed in accordance with the requirements of EU Council Decision 99/296/EC and approved by Czech Government Resolution No. 187 of 3 March 2004.[1] The programme was reviewed in 2007, and a new climate protection policy of the Czech Republic will be introduced in 2016. In addition, in October 2015 the government adopted the Strategy on Adaptation to Climate Change in the Czech Republic. This document is the national adaptation strategy, and it includes an assessment of the climate change impacts and proposals for specific adaptation measures, legislative and partial economic analysis, etc.

The National Emission Reduction Programme of the Czech Republic was adopted in December 2015. It comprises 23 key measures, mostly for transport, but also for the industry, agriculture and households sectors, to contribute to an improvement in the current state of the environment and environmental and health protection.

DOMESTIC MEASURES OUTSIDE THE EU-ETS

The State Environmental Fund (SEF) is a specifically targeted institution that was established by Act No. 388/1991 Coll. It grants direct financial support in the form of subsidies and indirect financial support through loans or contributions to partial coverage of interest. Direct financial support is drawn from national resources and from the EU funds, specifically from the Cohesion Fund (CF) and the European Regional Development Fund (ERDF). It provides grants to applicants from several grant programmes, which vary both with the source from which they are financed, and the target group for which they are intended. In 2013, the SEF provided grants to applicants from the Operational Programme Environment and other national programmes such as the Green Savings Programme (GSP).

1. Council Decision 99/296/EC amending Council Decision 93/389/EEC for a Monitoring Mechanism of Community CO_2 and other Greenhouse Gas Emissions.

Box 3.1 Coal use and local air quality in the Czech Republic

The Czech Republic pays particular attention to the elimination of air pollution, because air quality has a direct impact on public health. Each year, the Czech government publishes its State of the Environment Report of the Czech Republic. While the most recent report, published in 2015, indicated that the state of the environment in the Czech Republic is improving, it did highlight a number of specific problems, some of which are related to coal use.

Air quality in certain regions and localities still remains unsatisfactory. Household heating is a major, and difficult to regulate, source of emissions of particulate matter (PM10). It produces roughly 40% of particulate matter emissions. The main issues are obsolescence and low efficiency of combustion in heating units and to some extent behavioural traits of households (EEA, 2015).

The main problems of air quality in the Czech Republic are benzo(a)pyrene, PM2.5, PM10 and surface ozone.* Besides transport, the main source of benzo(a)pyrene and PM2.5 is residential fuel combustion. According to the Czech Hydrometeorological Institute, 15% of households use solid fuels for heating. This percentage is declining only very slightly. Local heating represents a significant source of primary particulate matter, especially PM2.5, and produces over 80% of the Czech Republic's benzo(a)pyrene emissions. Air quality deteriorates considerably during the winter as a result of poor dispersion conditions.

In 2013, a number of towns and villages were assessed for benzo(a)pyrene concentrations. In 2013, the benzo(a)pyrene limit value was exceeded in 17.3% of the territory of the Czech Republic. (In 2012 it was exceeded in 26.5%.) The percentage of inhabitants exposed to the above-the-limit benzo(a)pyrene concentrations in 2013 is estimated at 54.5%; in 2012 it was approximately 66.3%. The highest annual average concentration in 2013 was measured in Ostrava-Radvanice ZÚ (9.4 microgrammes per cubic metre [$\mu g/m^3$]). Above-the-limit concentrations are also reached in traffic localities as well as in the background urban and suburban locations.**

The Czech Republic has acknowledged the problems caused by poor domestic heating installations and has implemented a programme to support the boiler replacement to reduce air pollution from small combustion sources of heat output, i.e. local heating systems using solid fuel. The object of the subsidy is to exchange existing low-efficient manually filled solid fuel boilers with new high-efficient low-carbon heat sources.

*Benzo(a)pyrene is a polycyclic aromatic hydrocarbon found in coal tar.

**http://portal.chmi.cz/files/portal/docs/uoco/isko/grafroc/14groc/gr14e/Obsah_GB.html last accessed on 1 February 2016.

The GSP, in the form of the so-called Green Investment Scheme, was introduced in April 2009. The Czech Republic obtained significant financial resources for this programme by selling its surplus of Assigned Amount Units under the Kyoto Protocol. A total allocation of up to CZK 20.5 billion (EUR 74 million) was envisaged for the programme, which was successfully concluded at the end of 2014. The programme supported energy-saving measures in family homes and apartment buildings; installations of low-carbon sources, i.e. biomass boilers, efficient heat pumps and solar-heat collectors; and the construction of new houses to passive energy standards. As a result of implementation of the programme, an annual emissions reduction of almost 1.0 million tonnes of CO_2

emissions was achieved. In total, 74 056 applications were approved by the programme and received support of CZK 20.3 billion (SEF, 2015).

In June 2013, the New GSP 2013 was established by the MOE, when it announced the first call for applications. In August of the same year, the MOE opened the household segment. The resources were provided by the SEF, with a funding allocation of CZK 1.0 billion to cover the call. The objectives of the programme were similar in comparison with its predecessor, i.e. to lower GHG emissions by implementing measures leading to lower energy intensity in households by supporting the construction of family homes with low energy standard, and more efficient use of energy. In total, 7 100 applications were accepted by the programme. Of these, 4 213 applications were approved and received support of CZK 0.7 billion (SEF, 2015). The MOE expects that the GSP will be implemented at least by 2020 and that the total allocation in this period may achieve the equivalent of almost EUR 1.0 billion. An exact amount of funding depends on EU-ETS revenues, which are the main source of GSP funding.

The aim of the Operational Programme Environment is the protection and improvement of the quality of the environment as a basic principle for sustainable development. Operational Programme Environment projects are financed from the ERDF and the CF. There is EUR 5.2 billion available, which is 18.4% of the total support of European funds for the Czech Republic. It was the second largest operation programme after the Operational Programme Transport over the programme period (2007-13).

The Swiss-Czech Co-operation Programme (Swiss Funds) enables the Czech Republic to receive financial assistance from Switzerland until 2017, in the amount of 109.78 million Swiss francs, which is approximately CZK 2.6 billion. Disbursement of the funds is expected to concentrate on three peripheral and less developed regions (Moravia-Silesia, Olomouc and Zlín).

TRANSPORT

In 2015, the government adopted a White Paper: Public Transport Concept for 2015-2020 with the Perspective to 2030, a policy paper that represents a new strategy for public transport in the Czech Republic. The main goal of this policy document is to establish framework conditions that would enable public transport to be perceived as a quality alternative to individual transport. A fundamental concern for government is the integration of public transport services in regions, and ensuring compatibility at regional borders forms an important role in extending the use of public transport. The policy will direct all public authorities responsible for public transport services to develop medium-term public transport plans. The policy document also includes proposals for more effective organisation of public transport and its funding.

The government is also developing a policy for encouraging a shift to alternative fuels. The National Action Plan for Clean Mobility was adopted in 2015 and contains a package of measures for the expansion of the use of alternative fuels such as the utilisation of EU grants to support the development of recharging/refuelling points or to increase the share of buses running on alternative fuels within the public transport fleet.

INTERNATIONAL MEASURES

Operators were allowed to use Certified Emission Reductions and Emission Reduction Units, which are credits from the flexible mechanisms, i.e. Clean Development Mechanism and Joint Implementation, up to 10% of their total individual allocation to meet their commitments under EU-ETS. Out of the maximum of 43 million credits, 19.8 million CERs and 18.7 million ERUs (total of 38.6 million) were used in the trading period 2008-12.

ASSESSMENT

GHG emissions in the Czech Republic have been falling since 2000, but GHG emissions per capita and the carbon intensity of the economy are high compared with the average among European members of the Organisation for Economic Co-operation and Development (OECD). Emissions are expected to increase alongside economic recovery, but as emissions from sectors outside the EU-ETS should be 8% below their target value in 2020, according to the latest emissions projections with existing measures, the Czech Republic should have no difficulty in meeting its EU 2020 emissions target of a 9% increase relative to 2005. There is an ongoing process of refurbishment and modernisation of the coal-fired power generating fleet in order to comply with EU legislation including investment targeted at denitrification, desulphurisation and other technical modifications to deliver lower emissions. Nonetheless, the Czech Republic is struggling with pollution from local sources, notably domestic heating systems, and air quality in certain regions and cities remains unsatisfactory.

While the decline of GHG emissions in the Czech economy is welcome, there appears to be little analysis of the factors driving this decline. In other economies, some portion of the decline in GHG emissions can be attributed to structural factors such as the economic crisis or the fall in industrial output as heavy manufacturing moves elsewhere. It is clear, however, that the closure and modernisation of old coal-fired generating capacity and take-up of energy efficiency polices is having a positive impact. It would be helpful if the authorities could demonstrate a greater understanding of the factors driving GHG emissions reductions and use this analysis to inform further decision making, such as developing policies in the non-traded sector.

The previous in-depth review recommended that the government establish separate but co-ordinated GHG emissions reduction strategies and targets for both the EU-ETS and the non-ETS sectors. To date, no specific strategy for non-ETS sectors has been adopted, but it is expected that it will be included in the Climate Protection Policy was approved by government in July 2016. One option available to the Czech Republic is the possibility of introducing a carbon tax for those sectors of the economy outside the EU-ETS. Effective tax rates on carbon emissions (apart from transport fuel) are among the lowest in the OECD, which dulls the incentives to transition towards a low-carbon economy. A previous tax reform proposed moving the tax burden towards taxation of environmental negatives and away from income taxes (that weigh on growth). This would increase incentives to increase energy efficiency and would have a broader reach than subsidies and potentially with a lower fiscal cost, depending on the overall package. This carbon tax could be first set at a low level, for example, the purpose being raising revenue for energy efficiency or renewable energy programmes, rising over time to a level that will directly influence behaviour by the price itself. There are a number of examples of countries where such a tax has been successfully introduced, and these present useful learning experiences for the country.

Household heating is a major source of local air pollution in the country, and emissions from this sector are difficult, if not impossible, to regulate. The European Environmental Agency estimates that it produces approximately 40% of particulate matter emissions. The key factors are obsolescence and low efficiency of combustion in heating units, and to a lesser extent, the behaviour of household consumers. The government, with the backing of the European Union, has offered financial support and incentives for the replacement of old boilers with cleaner, more efficient boilers alongside financial support for people to install domestic insulation. Furthermore, low-quality boilers are being banned gradually with a complete ban likely. The government should examine present incentives in the household space-heating sector to ensure the mechanism provides less-well-off householders with the means to switch away from coal use to cleaner solutions, such as natural gas or district heating where available. In addition, all programmes, including national programmes, should be evaluated *ex ante* and *ex post* and monitored during implementation with amendments made as required.

The Czech Republic is considering the matter of the climate resilience of the energy system within the broader context of energy security, generation adequacy and protection of critical energy infrastructure. A national Adaptation Strategy was adopted in October 2015 and a National Action Plan for Adaptation is planned. The government expects that the flow rate of rivers is expected to decrease over the medium term, and this could affect the supply of water to nuclear power plants and also to hydropower generation. While government efforts will favour passive cooling measures, demand for electricity for cooling is also likely to increase over the medium term, and this may increase stress on the electricity system alongside higher levels of domestic photovoltaic. The new Adaptation Strategy should include measures to assess the climate resilience of existing energy infrastructure. The Czech Republic has also developed a National Action Plan for Smart Grids, and climate resilience should be incorporated in this plan.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Conduct a detailed analysis of the feasibility and effectiveness of introducing a carbon tax that increases gradually over time for those sectors of the economy outside the EU-ETS to incentivise energy savings and switching to cleaner energy consumption and to use the revenues generated to stimulate these switches.*
- ☐ *Ensure that the forthcoming National Action Plan for Adaptation includes an assessment of the climate resilience of existing energy infrastructure and ensure that climate resilience is incorporated into the National Action Plan for Smart Grids.*
- ☐ *Introduce measures and incentives to accelerate the phase-out of coal boilers in households and replace them with cleaner and more efficient heating solutions such as biomass and natural gas.*

References

EEA (European Environment Agency) (2015), *Air Quality in Europe 2015 Report,* EEA, Copenhagen.

IEA (International Energy Agency) (forthcoming), *CO_2 Emissions from Fuel Combustion 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

MOE (Ministry of the Environment) (2012), *State Environmental Policy of the Czech Republic 2012-2020*, MOE, Prague.

SEF (State Environment Fund of the Czech Republic) (2015), *Annual Report 2014*, SEF, Prague.

UNFCCC (United Nations Framework Convention on Climate Change) (2015), *GHG Emission Profiles* data series, http://unfccc.int/ghg_data/ghg_data_unfccc/ghg_profiles/items/4625.php (accessed 1 February 2016).

4. ENERGY EFFICIENCY

Key data (2015 estimated)

Energy supply per capita: 3.9 toe (IEA average: 4.5 toe), -12.2% since 2005

Energy intensity: 0.13 toe/USD 1 000 PPP (IEA average: 0.11 toe/USD 1 000 PPP), -24.8% since 2005

TFC (2014): 24.9 Mtoe (oil 34%, natural gas 19.8%, electricity 19.4%, biofuels and waste 9.3%, coal 8.8%, heat 8.7%, solar 0.1%), -10.8% since 2004

Consumption by sector (2014): industry 39%, transport 23.6%, residential 22.8%, commercial and public services and agriculture 14.6%

FINAL ENERGY USE

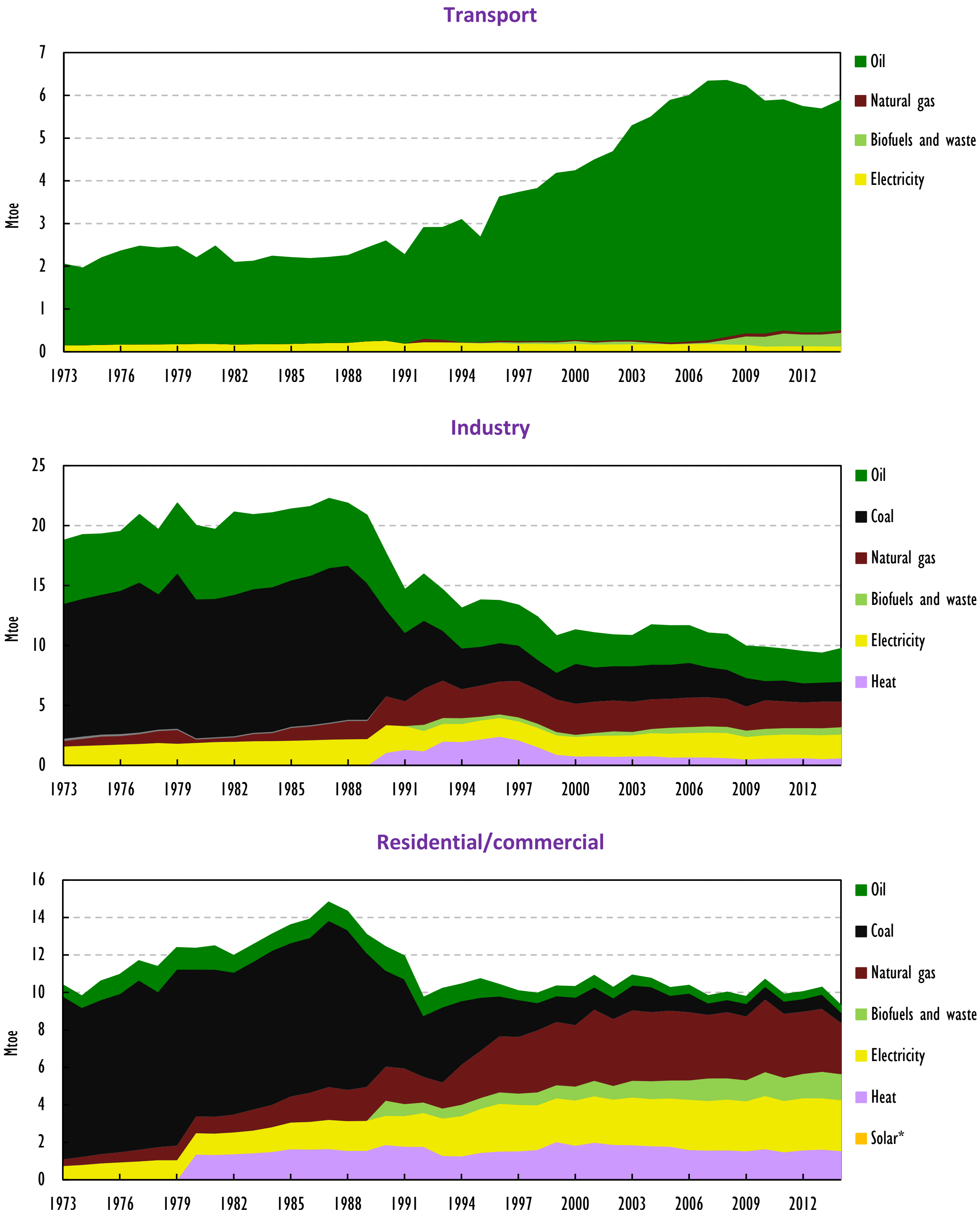
FINAL CONSUMPTION BY SECTOR

The Czech Republic's total final consumption of energy (TFC) was 24.9 million tonnes of oil-equivalent (Mtoe) in 2014. Consumption decreased by 1.5% compared with 2013, and was 10.8% lower compared with 2004. TFC has been on a slow downward trend since the mid-2000s, and since independence, TFC has averaged 26.6 Mtoe, without much volatility (Figure 4.1).

Industry is the largest consuming sector in the Czech Republic, accounting for 9.7 Mtoe, or 39% of TFC in 2014. Industry consumption was 16.9% lower in 2014 compared with 2004, with its share in TFC down from 41.9%. The fuel mix in the industry sector is diverse with oil (28.1% of the total), natural gas (21.8%), electricity (20.3%), coal (17%), biofuels and waste (6.4%) and heat (6.4%). Over the past ten years, coal use has declined by 42.5% and heat use by 21.8%, while demand for oil contracted by 16.7% and gas by 14.4%. Conversely, industry's demand for biofuels and waste grew by 75.1% and electricity demand grew by 2.9% over the last decade.

The residential sector accounted for 22.8% of TFC, or 5.7 Mtoe, in 2014, while the commercial and public services sector (including agriculture) accounted for 14.6%, or 3.6 Mtoe. Overall energy demand from these two sectors has been relatively stable, ranging from 9.3 Mtoe to 10.8 Mtoe since 2004. These sectors are fuelled by natural gas (29.5% of the total), electricity (29.2%), heat (16.5%), biofuels and waste (14.9%), coal (5.8%), and oil (3.9%). The fuel mix in residential and commercial TFC has changed over the past decade, with a substantial decline in the use of coal (59.2% lower since 2004), followed by natural gas (25.6% lower), oil (17.4% lower) and heat (15.2%) in favour of biofuels and waste (45.7% higher), electricity (8% higher) and solar (700% higher), transforming the fuel mix in residential and commercial TFC over the past decade.

Figure 4.1 TFC by sector and by source, 1973-2014



* Negligible.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

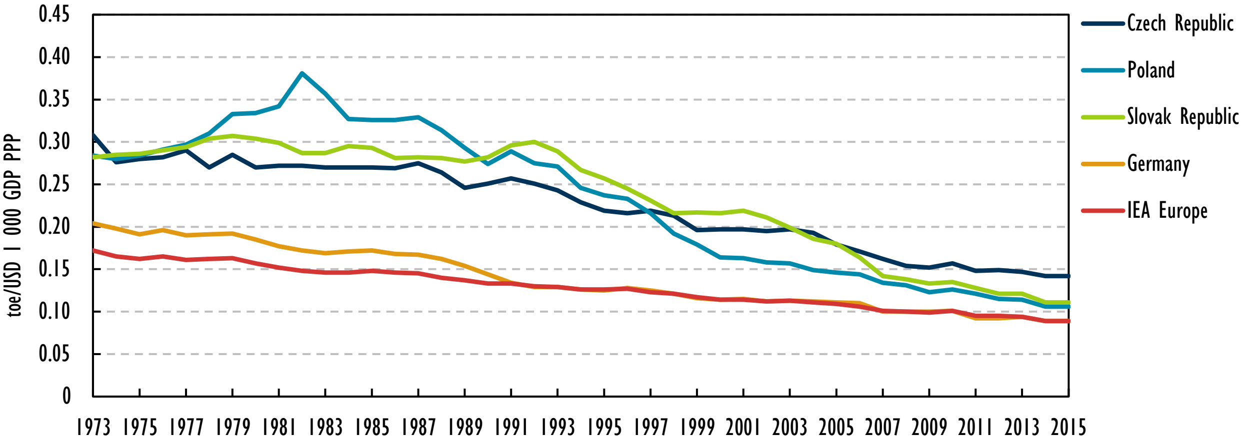
The transport sector accounted for 23.6% of TFC, or 5.9 Mtoe, in 2014. Transport is mainly fuelled by oil (91.3% of total fuel demand), with the remainder made up of biofuels and waste (5.4%), electricity (2.3%) and natural gas (1%). Unlike the other sectors, energy demand from transport was growing for decades and peaked at 6.3 Mtoe in 2008 but has since contracted by 7.4%. Oil consumption peaked in 2007 at 6.0 Mtoe and has declined by 11.3% since. Conversely, the use of biofuels and waste is growing year-on-year and was 890.6% higher in 2014 compared with 2004. The use of natural gas grew by 74.3% over the ten years while electricity use was down by 28%.

ENERGY INTENSITY

Energy intensity, measured as the ratio of total primary energy supply (TPES) per unit of real gross domestic product (GDP) adjusted for purchasing power parity (PPP), was 0.13 tonnes of oil-equivalent per 1 000 United States dollars (USD) PPP (toe/USD 1 000) in 2015 (Figure 4.2). The ratio is above both the International Energy Agency (IEA) average of 0.11 toe/USD 1 000 PPP and the IEA Europe average of 0.09 toe/USD 1 000 PPP. The Czech Republic's energy intensity is ranked fifth-highest among IEA member countries, behind Canada, Estonia, Finland and Korea. Energy intensity is high as a result of energy use in the heavy machinery and iron and steel industries in the country. The GDP to TPES ratio declined by 24.8% from 2005 to 2015, while the average IEA energy intensity declined by 16.5%. According to a study by the European Commission, improvements in energy intensity were largely attributable to energy efficiency until 2008, while restructuring of the industrial sector has taken a greater role since then. While industrial energy intensity has been on a downward trend, transport energy intensity has been on the rise since 2002 as a result of greater use of road transport (EC, 2016).

A further common indicator for international comparisons is energy supply per capita, which was 3.9 toe in 2014, a median level among IEA member countries and lower than the IEA average of 4.5 toe (Figure 4.3).

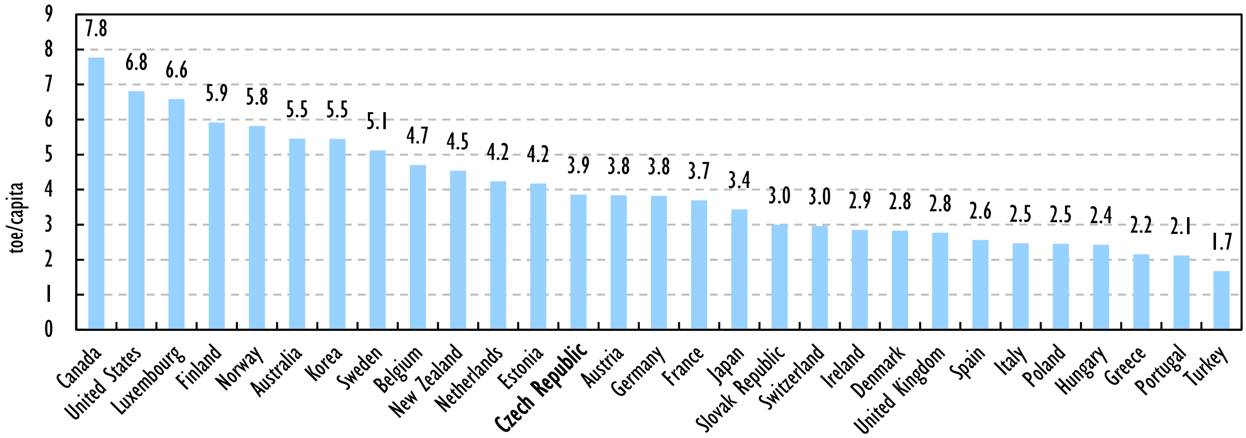
Figure 4.2 Energy intensity in the Czech Republic and in other selected IEA member countries, 1973-2015



Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

Figure 4.3 TPES per capita in IEA member countries, 2015



Note: Data are estimated.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

INSTITUTIONS

The Ministry of Industry and Trade (MIT), through the Department of Energy Efficiency and Savings, is responsible for planning, developing and implementing the energy efficiency policy in the country. These policies are determined by the State Energy Policy (SEP) and the National Energy Efficiency Action Plan (NEEAP).

The Ministry of Environment (MOE), through the Department of Energy and Climate Protection, plays a key role in funding and implementing a wide range of energy efficiency programmes in line with national climate-related policies and priorities. The MOE has currently the largest budget for energy efficiency programmes by means of the State Environmental Fund (SEF).[1]

The Ministry of Regional Development (MRD) is involved in the development of regional policies including housing and building regulations. MRD implements and finances energy efficiency-related projects, particularly aimed at the residential sector. Some regions, such as Prague, also have established their own development programmes, which also include energy efficiency measures.

The Energy Regulatory Office is responsible for determining incentives for combined heat and power (CHP).

The State Energy Inspection (SEI) is responsible for monitoring and verifying energy audits conducted by high-energy-consuming buildings and large enterprises.

In addition, there is a co-ordination committee that comprises MIT, MOE, MRD, the Ministry of Transport and the Ministry of Agriculture to take into account that energy efficiency activities fall under several sectors and ministries. The committee was established by the MIT, and the aim is to monitor and co-ordinate the implementation of the measures of the NEEAP.

1. The SEF is funded by the European Union (i.e. Cohesion Fund and European Regional Development Fund) as well as the state budget and other fees. Total fund size for energy efficiency alone is a combination of the Operational Programme Environment (2014-20) worth 27.0 billion koruny (CZK), and the New Green Savings Programme (2014-20) worth CZK 23.4 billion.

POLICIES AND MEASURES

The Czech Republic's energy efficiency policies, programmes and measures originate from both the European Union and national government. European Union (EU) regulations are directly applicable in all member states, while EU directives leave the member states room to decide how to implement them.[2]

NATIONAL POLICIES AND MEASURES

State Energy Policy

The State Energy Policy (SEP) prioritises the need to increase the overall energy efficiency of the national economy throughout all end-use sectors. The aim is to increase energy savings in 2020 by 20% against business-as-usual, and to continue increasing energy efficiency with the aim of reducing energy intensity and average energy consumption per capita to below the average of the 28 EU member states (EU-28). This target is to ensure that net total final energy consumption is at the level of 1 020 PJ (by IEA methodology), or 1 060 PJ (by Eurostat methodology) by 2020.

National Energy Efficiency Action Plan

The third National Energy Efficiency Action Plan (NEEAP) was established pursuant to the EED 2012/27/EU equivalent to achieving new savings of 1.5% of the annual energy sales by 2020. The Czech Republic opted for an alternative approach to Article 7, Paragraph 9, of the EED, to allow for a greater focus on energy efficiency measures in the buildings sector.

The national indicative target was set at 47.78 PJ (13.27 terawatt-hours) of new final energy savings by 2020. The highest projected energy savings are expected in the residential sector (25.1 PJ) followed by the industrial sector (22.8 PJ) by 2020. Although included in the NEEAP, there are no estimates available for the transport sector.

Table 4.1 NEEAP estimated energy savings, investment and costs by sector

Sector	Total final energy consumption in 2013 (TJ)	Energy savings in 2014-16 (TJ)	Energy savings in 2017-20 (TJ)	Total energy savings 2014-20 (TJ)	Total investment (billion CZK)	Cost-efficiency of measures (TJ/CZK)
Residential	263 849	6 662	18 408	25 070	60.5	414.4
Services	130 084	3 304	3 875	7 179	19.6	366.3
Industry	281 831	11 451	11 429	22 880	16	1430
Transport	239 285	Not available				
Total	**915 049**	**21 417**	**33 712**	**55 129**	**96.1**	**573.7**

Note: TJ = terajoule.

Sources: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/ and information from Czech Republic Questionnaire.

Other alternative "political" measures were added to the updated NEEAP. The measures were designed across different sectors. Each additional alternative measure is targeted to more than one sector in order to maximise the multiplying effect in achieving energy

2. Details of EU directives ad regulations applicable to the Czech Republic are found in Annex E to this document.

efficiency. These measures were designed by the MIT in co-operation with various stakeholders such as industrial associations, municipalities, and private industrial and services companies. These additional alternative measures are going to support the existing alternative policy measures and ensure that the EU energy efficiency target will be fulfilled by 2020. The reason for adding other measures is that the deployment of the operational programmes under the programming period 2016-20 was delayed.

The third progress report on the NEEAP 2014 was published in 2015, indicating that only 10% of the final energy savings of 665.3 TJ were achieved by 2014. Delays in the start and deployment of certain energy efficiency programmes have hampered the achievement of these targets.

EFEKT programme

The State Programme for Support of Energy Savings and Use of Renewable and Secondary Energy Sources (EFEKT) promotes energy efficiency and use of renewable and secondary energy sources through an annual call for proposals. It is administered by the MIT with funding of approximately CZK 30 million per year. It is applicable to small-scale projects, energy efficiency in small and medium enterprises, energy counselling and education, and energy efficiency in public buildings. The target is to achieve 250 TJ in cumulative energy savings from 2008 to 2016 and 51.7 TJ of annual energy savings by 2016. In 2014, the programme supported 131 projects with CZK 29 million, of which CZK 16 million was for projects with direct impact on energy savings and CZK 13 million for public awareness and capacity building. Total investments amounted to CZK 57 million, leading to annual savings of 7.0 TJ and 1 300 tonnes of carbon dioxide. Table 4.2 shows the investment and energy savings from 2010 to 2014 under this programme.

Table 4.2 Results of EFEKT Programme from 2010 to 2014

Year	Number of projects	Funding (million CZK)	Total investment (million CZK)	Annual energy savings (TJ)
2014	131	29	57	7.7
2013	154	28	44	6.6
2012	156	31	66	10.0
2011	144	32	76	7.5
2010	161	43	72	12.0
Total	**746**	**163**	**315**	**43.8**

Sources: EFEKT Programme Evaluation Reports, www.mpo-efekt.cz/cz/programy-podpory/, accessed 1 October 2016.

Energy audits

Since 2000, energy audits must be conducted in high-energy-consuming buildings and businesses with energy management systems that surpass a specific amount of energy consumption as defined by legislation as well as if the building is subject to a major renovation. Energy audits may also be required when requesting subsidy schemes from state aid programmes. In addition, energy audits are mandatory for all large enterprises (classified as non-small and medium enterprises).

Approximately 1 500 energy audits are conducted per year, and there are about 400 certified energy auditors in the country. If required, the SEI can establish an obligation to meet the energy efficiency measures proposed in a given energy audit.

BUILDINGS

The Energy Performance of Buildings Directive (EPBD) was transposed into Czech Republic law through Decree No. 78/2013 Coll.[3] The EPBD requires all member states to follow a similar framework for setting building energy code requirements based on the integrated performance of the whole building and all energy uses. The EPBD also requires member states to introduce mandatory energy performance certificates (EPCs) that provide clear information on buildings' energy performance to prospective tenants and buyers. EPCs must include reference values that allow consumers to compare and assess energy performance. They must also be accompanied by recommendations for cost-effective improvement options to raise the energy performance and rating of the building. The 2010 revision of the EPBD strengthens the role of EPCs by requiring that they be published at the time of advertising a building's sale or rental, rather than only at the time of signing a purchase agreement or rental contract.

Section 7 of the Energy Management Act No. 406/2000 Coll. sets out energy performance requirements and expected improvements in energy performance in buildings. This section also defines the cases in which the EPC obligation is applicable such as new building construction, major renovation of existing buildings, sale and rental.

Under the EED, the Czech Republic is also required to establish strategies for the renovation of its building stock. It is also required to improve the energy performance by 3% per year of the total floor area of heated and/or cooled buildings owned and occupied by the central government.

Energy efficiency programmes for buildings

In line with the above legislation and to meet the respective objectives, the Czech Republic is implementing several similar energy efficiency programmes in the building sector.

The New Green Savings Programme (2014-20), under the MOE and administered by the SEF, was created to promote energy savings in single-family and multifamily buildings in Prague through the use of efficient energy sources in structures. This includes improvement of energy performance of existing single-family buildings, construction of single-family buildings with very high performance and efficient use of energy sources. A total of CZK 27 billion has been allocated for this period, starting at CZK 1.9 billion in 2014 with a gradual increase per year thereafter. The total savings forecast from 2014 to 2020 is 14.3 PJ. The previous New Green Savings Programme 2013, which covered the replacement of inefficient heating sources with efficient or renewable energy heating sources, achieved 50 TJ of savings from measures implemented by 2014.

In the public sector, the MOE established the Operational Programme Environment (2014-20) to improve the energy performance of public buildings through insulation and

3. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

building renovation, recovery of waste heat, and other non-energy efficiency-related measures. Eligible stakeholders can apply for grants that can cover up to 90% of the total project costs. All projects are required to have public co-financing. The programme also includes grants for the replacement of boilers (see appliances and equipment section below). The budget for the energy efficiency component of this programme is CZK 23.4 billion. The previous Operational Programme Environment (2007-13) achieved savings of 84.5 TJ for a total investment of CZK 45.9 billion.

The Integrated Regional Operational Programme (IROP) 2014-20 was established by the MRD in line with the Czech Republic's Regional Development Strategy for 2014-20. The IROP includes a component on energy efficiency and smart energy management for public and residential multifamily buildings. The aim is to reduce energy consumption by improving thermal performance of buildings, replacement heating and hot water equipment, and trigger the transition to low-carbon energy sources. The total budget allocated is CZK 16.9 billion (for all components including energy efficiency). The government expects to reach 7.5 PJ in total final energy consumption savings.

The PANEL Programme, under the MRD, was created to provide financial support for the reconstruction and modernisation of multifamily buildings throughout the country (e.g. appliances and equipment upgrades and elevator replacement). The programme provides subsidies to cover interest on loans as well as secure loans. It is funded by the State Housing Development Fund, and the budget for 2015 was approximately CZK 1.0 billion. Based on the latest available data, with approximately the same budget, in 2011, a total of 29 644 dwellings were successfully renovated. The government is expecting this programme to deliver savings of 0.486 PJ from 2014-16 and 0.648 PJ from 2017-20.

TRANSPORT

The transport sector accounted for 22.5% of TFC in 2013, of which road had a share of 94.6% followed by rail with 3.3%. Energy demand in the transport sector grew significantly until 2008 and since then has been following the overall decreasing TFC trend, particularly for road transport. As part of the implementation of the SEP, the Czech Republic is planning to introduce a National Action Plan for Clean Mobility (NAP CM) to improve mobility through better infrastructure and alternative fuels with the aim of:

- Reducing the negative impact of transport on the environment (i.e. emissions).
- Reducing dependence on liquid fuels, diversification of fuel sources and higher efficiency in transport.

The NAP CM is being developed to fulfil the requirements from Directive No. 2014/94/EU on the Deployment of Alternative Fuels Infrastructure.

In terms of incentives, the Czech Republic offers tax reduction for vehicles running on compressed natural gas (CNG) until 2020, and there is a tax reduction also for cars running on liquefied petroleum gas. Electric cars are exempt from the excise tax on electricity, and companies owning vehicles up to 12 tonnes fuelled by any kind of alternative fuel (e.g. CNG/electric) are also exempt from the obligation to pay the road tax.

APPLIANCES AND EQUIPMENT

Requirements for minimum energy efficiency standards and energy labelling of appliances are based on EU law, in particular Directive 2009/125/EC and related product-specific regulations, and Directive 2010/30/EU on energy labelling.

Under the Ecodesign Directive, the European Union introduces product-specific regulations that apply directly in all EU member states. To date, minimum energy performance standards (MEPS) have been developed for around 20 product groups. In addition to household appliances, the Ecodesign Directive is also applied to industrial equipment. The first four regulations under the directive were on industrial products (motors, circulators, fans and water pumps).

Both of these directives were adopted into Act No. 406/2000 Coll. on Energy Management and Decree No. 337/2011 Coll. on Energy Labelling, and are an integral part of the energy efficiency objectives set under the SEP. The energy management act also sets technical energy efficiency requirements for public procurement.

As mentioned above, the Operational Programme Environment (2014-20) provides grants for the replacement of boilers running on solid fuels by new efficient boilers running on solid fuels or liquid fuels or by heat pumps. The programme is mainly aimed at public-sector buildings.

The Joint Boiler Replacement Promotion Programme is a subsidy for the replacement of manually filled boilers running on solid fuel with new efficient low-carbon heat sources in households. The aim is to reduce the emissions generated by small combustion sources up to 50 kilowatt thermal capacity. It applies to owners of single-family buildings and only to boilers certified by the SEF. The subsidy amount depends on the new boiler type and ranges from CZK 15 000 to CZK 60 000. The annual savings projected by each replacement is 25 gigajoules. The budget allocated is CZK 300 million, with the aim of replacing 7 500 boilers resulting in expected annual savings of 188 TJ.

INDUSTRY

Industry is the highest energy-consuming sector in the Czech Republic. In 2013, iron and steel had a share of 19.0% of TFC, followed by chemicals and petrochemicals with 15.0%, non-metallic minerals with 14.3%, and machinery with 10.8%.

The EED requires large enterprises to carry out an energy audit at least every four years, with the first one to be completed by December 2015. These audits should take into account relevant European or international standards, such as EN ISO 50001 (Energy Management Systems), or EN 16247-1 (Energy Audits). Under the EED, member states should also encourage the development of training programmes for energy auditors. The EED also encourages member states to offer incentives for small and medium-sized enterprises to undergo energy audits.

The Czech Republic adopted this requirement in its Energy Management Act No. 406/2000, Energy Act No. 458/2000 and the Supported Energy Sources Act No. 165/2012. As of December 2015, approximately 2 100 large enterprises will be required to conduct an energy audit every four years. Alternatively, these enterprises can opt for an energy management system according to EN ISO 50001.

The Operational Programme Enterprise and Innovation for Competitiveness (2014-16), under the MIT, promotes energy efficiency investment in industry, through the modernisation or replacement of existing energy production facilities such as improvement of the energy performance of manufacturing processes, improvements in the thermal and technical properties of buildings, and CHP. It also includes a component on renewable energy. Overall a total of CZK 20 billion has been allocated for this programme, and the estimated energy savings are 20 PJ. The Operational Programme Enterprise and Innovation (2007-13) provided the highest energy savings in 2014 with 441.8 TJ.

ENERGY SERVICE COMPANIES

The energy service companies (ESCOs) market is relatively small with 15 to 20 ESCOs. The majority of these ESCOs use the Energy Performance Contract approach with approximate annual investments of around 10 million euros with 10 to 15 projects implemented every year. An ESCO association was established in 2010.

COMBINED HEAT AND POWER

Combined heat and power (CHP) represented 27% of total electricity output in 2014.Brown coal represented 47.8% of total CHP electricity generation, followed by biofuels and waste with 19.9%, hard coal with 13.2% and natural gas with 7.0%. Most CHP plants are linked with the industrial sector and district heating systems.

The contribution of CHP plants to heat and electricity generation has a long tradition in the Czech Republic. The electricity generation from CHP plants fluctuated slightly in the last ten years but remains an important part of the country's electricity and heating system.

There is a legal framework to support CHP based on Act No. 165/2012 Coll., on supported energy sources, and Decree No. 453/2012 Coll., on electricity from highly efficient CHP generation and electricity from secondary sources. These reflect the provisions in the EED 2012/27/EC. CHP plants are entitled to a certificate of origin, and high-efficiency CHP receives annual green premiums according to the electricity generated. The green premium is composed of two rates: a basic rate and an extra rate. The rates vary according to fuel source, total installed capacity, efficiency levels, operating hours per year and commission date.

Investment support for new CHP installations and replacement of existing heating systems with CHP plants is available through the Operational Programme for Environment, Operational Programme of Rural Development and the Operational Programme Enterprise and Innovation for Competitiveness. These programmes also provide grants for projects that reduce energy losses in the heat distribution systems.

ASSESSMENT

Since the last IEA In-Depth Review of the Czech Republic in 2010, energy demand and energy intensity have decreased significantly, enabling a decoupling of GDP from TPES. Since 2010, there have been important improvements in developing an integrated strategy and planning for energy efficiency. The SEP and the NEEAP 2014 play a new and enhanced role and prioritise the need for greater energy savings and reduction of the country's energy intensity. This has been complemented by the creation of both the

Energy Efficiency and Savings Department at the MIT and the cross-government co-ordination committee on energy efficiency.

The Czech Republic should continue its effort to strengthen co-ordination and co-operation between ministries on energy efficiency activities. In addition, based on the Czech Republic's commitment to energy efficiency and its existing energy efficiency programmes, it is important to ensure there are capacity and resources to plan, implement, monitor and evaluate the energy efficiency policies and programmes set by EU and national governments.

Government funding for energy efficiency programmes has increased significantly in the last five years. The total expected funding for energy efficiency measures is CZK 192.2 billion from 2014 to 2020.

The majority of the energy efficiency funding (grants and subsidies) originates from the government budget and European Commission. As stated in the SEP, it is unclear what will happen to funding after 2020, depending on whether the Czech Republic can or cannot use the European structural and investment funds. It is important for the Czech Republic, therefore, to start leveraging other sources of funding including those from the private sector (e.g. banking sector and energy providers). The New Green Savings Programme (2014-20) is a great example of how local banks can support the implementation of energy efficiency measures.

The SEP also states the need to raise awareness on energy efficiency to the general public. Energy efficiency information dissemination is generally tied exclusively to the energy efficiency programmes being implemented. Accordingly, the Czech Republic should consider creating a national energy efficiency awareness and education plan.

The Czech Republic is making a strong effort to improve energy efficiency in new and existing buildings with a series of investment programmes that aim to provide significant long-term benefits to consumers in the residential, commercial and public sectors. The Czech Republic has also implemented the energy performance certificates for buildings based on the EPBD. The overall effectiveness of this mechanism, however, has been relatively low. One of the key challenges is that if the dwelling owner opts not to have the certificate, the dwelling will be given the lowest energy performance rating (i.e. G). As a result, approximately 75% of dwellings have the lowest rating, which is misleading and leads to little or no action by consumers. Based on experience in other European countries, greater awareness on available incentives and multiple benefits of energy efficiency (e.g. economic, health, property value) to consumers could help trigger greater interest in the EPCs as well as penalties for non-compliance.

Improving energy efficiency of the transport sector is a key part of the Czech Republic's SEP. There is a special focus on fuel economy standards, procurement of high-efficiency equipment, and increase of the overall energy efficiency of national, regional and local transport systems. There are also incentives to promote shifts of passengers and freight to more efficient modes. TFC of energy in the transport sector increased by 38.9% between 2000 and 2014, the largest sector increase recorded. This illustrates the need to continue to expand energy efficiency measures in this sector. Currently the transport sector plays a small part in the NEEAP 2014 and in existing energy efficiency programmes. Consequently, it is necessary to strengthen communication and co-ordination among the Ministry of Transport, MOE and MIT on existing and future energy efficiency actions. It is worth noting, however, that the transport sector will be integrated into the NEEAP in the second half of 2016.

The Czech Republic has implemented a series of energy efficiency programmes that support the replacement of existing inefficient heating appliances and equipment with high-efficiency ones such as condensing boilers and heat pumps. These programmes also provide incentives for heating appliances running on solid fuels. The Czech Republic should consider the introduction of higher MEPS for heating appliances running on solid fuels in the building sector, or consider their gradual phase-out. This measure would enable not only reduction in greenhouse gas emissions but also a substantial increase in efficiency for consumers and a reduction in operation costs.

The Czech Republic adopted an alternative approach to Article 7 of the EED – Energy Efficiency Obligation Schemes. The alternative approach focuses on energy efficiency measures in the buildings sector that are important for delivering long-term energy savings in this sector. Nevertheless, without the obligation scheme, energy providers have been slow at addressing demand-side energy efficiency. The NEEAP allows for the reintroduction of the obligation scheme if the financial resources of the alternative approach are depleted and are insufficient to achieve the savings target set by the EED.

RECOMMENDATIONS

The government of the Czech Republic should:

General

- ☐ *Strengthen co-ordination among ministries on energy efficiency activities and strengthen cross-government capacity and resources to rationalise, plan, implement, monitor and evaluate national and regional energy efficiency policies and action plans.*
- ☐ *Support and build the capacity of the private and local banking sector to leverage further investment in energy efficiency.*
- ☐ *Design and implement a national energy efficiency awareness plan, in collaboration with relevant ministries and energy providers, to ensure regular dissemination and information on energy efficiency measures and incentive schemes for all sectors and consumers.*

Buildings

- ☐ *Improve the effectiveness of the EPCs for buildings.*

Transport

- ☐ *Ensure that the transport sector is an integral part of the NEEAP.*

Appliances and equipment

- ☐ *Set higher MEPS for heating appliances running on solid fuels and/or consider the gradual phase-out of these appliances.*

Energy providers

- ☐ *Reconsider the introduction of an Energy Efficiency Obligation Scheme to enable greater demand-side energy savings and energy efficiency investment to help achieve the proposed energy efficiency targets for 2020 as well as beyond this period.*

References

EFEKT (State Programme for Support of Energy Savings and Use of Renewable and Secondary Energy Sources) (2016), *Programme Evaluation Reports from 2010 to 2014*, www.mpo-efekt.cz/cz/programy-podpory/, last accessed 1 October 2016.

EC (European Commission) (2016), *Decline in Energy Intensity in the Czech Republic: Due to Structural Change or Energy Efficiency Improvement*, EC, Brussels.

IEA (International Energy Agency) (2016), *Energy Balance of OECD Countries 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

PART II
SECTOR ANALYSIS

5. RENEWABLE ENERGY

Key data (2015 estimated)

Total supply: 3.8 Mtoe (9.4% of TPES) and 8.9 TWh (9.4% of electricity generation), IEA average: 10% of TPES and 23.5% of electricity generation

Biofuels and waste: 3.5 Mtoe (8.6% of TPES) and 5.2 TWh (6.3% of electricity generation)

Solar: 0.2 Mtoe (0.5% of TPES) and 2.3 TWh (2.7% of electricity generation)

Hydro: 0.1 Mtoe (0.2% of TPES) and 0.8 TWh (1% of electricity generation)

Wind: 0.05 Mtoe (0.1% of TPES) and 0.6 TWh (0.7% of electricity generation)

OVERVIEW

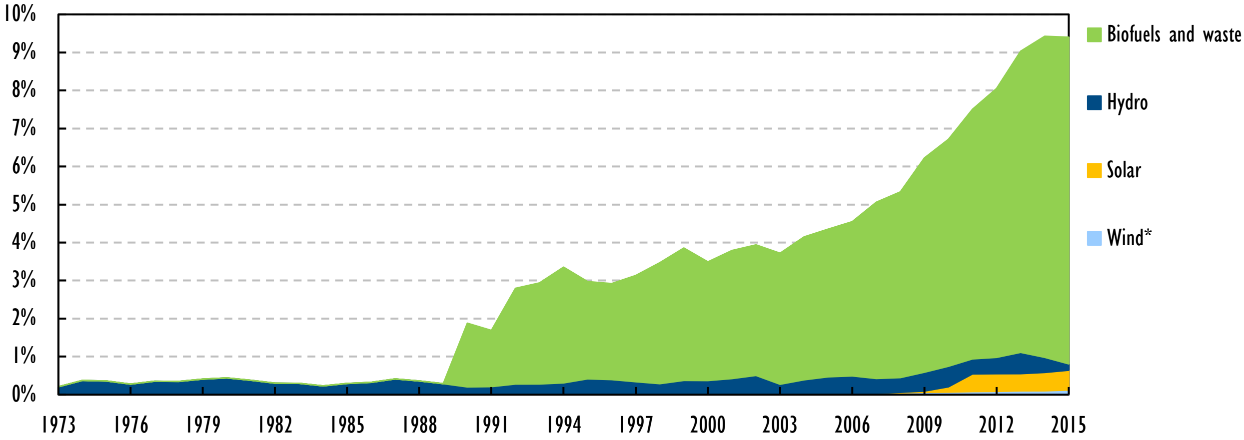
The Czech Republic's renewable energy policy is aligned with the European Union (EU) 2020 targets. Its targets on renewable energy for 2020 and the policies and measures to meet them were initially laid out in the National Renewable Energy Action Plan 2011-20 (NREAP), which was first published in 2010 and revised in 2012. For 2020, the Czech Republic has a binding national target for renewable energy to equal 13% of gross final consumption of energy. In addition to this overall target, the Czech Republic and other EU member states have a separate binding national target for renewable energy to cover 10% of transport fuel demand in 2020. In 2015, renewable energy sources (RES) accounted for 9.4% of total primary energy supply (TPES), and this share is unlikely to increase in the medium term following the abolition of support mechanisms for renewable electricity.

SUPPLY AND DEMAND

Renewable energy accounted for 3.8 million tonnes of oil-equivalent (Mtoe), or 9.4% of the Czech Republic's TPES, in 2015. Biofuels and waste were the main source, accounting for 3.5 Mtoe, or 8.6% of TPES, in 2015, with marginal use of solar power (0.2 Mtoe or 0.5%), hydropower (0.1 Mtoe or 0.2%) and wind power (0.05 Mtoe or 0.1%) making up the balance (Figure 5.1).

Renewable energy production has more than doubled over the past decade, and its share in TPES increased from 4.4% in 2005 to 9.4% in 2014. Biofuels and waste grew at a rate of 7.2% per year between 2005 and 2015 with the share in TPES increasing from 3.9% to 8.6% over the same period. Solar grew from a negligible amount to 0.5%, at an annualised rate of 53.1%, while wind energy remains negligible. There is no geothermal energy production in the country, but there are research and development (R&D) activities.

Figure 5.1 Renewable energy as a percentage of TPES, 1973-2015



Note: Data are estimated for 2015.

* Negligible.

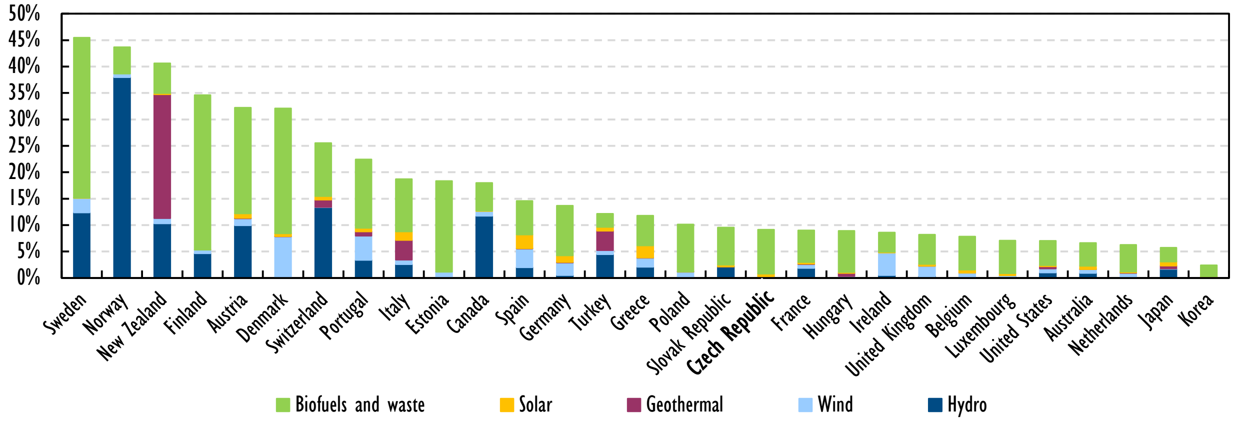
Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/,

In 2014, biofuels and waste were mainly consumed in households and commercial buildings for space heating (59.8%,) largely as a fuel for biomass boilers, which are starting to replace existing coal-based heat supply systems in some areas. Industry accounts for 26.6% of biofuel and waste consumption, particularly biofuels used in space heating and waste wood used in production processes in the pulp, paper and print industry. In addition, in all manufacturing processes related to the production of food products, beverages and tobacco, the nature of the production processes permits the use of a relatively high fraction of biofuels. The remainder is used in transport. Wind, hydro and solar energy are used to generate electricity, while 81.3% of solar power is used in the residential sector.

Electricity from renewable sources amounted to 8.9 terawatt-hours (TWh) in 2015, or 10.7% of total generation. It has increased by more than threefold over the past decade (3.1 TWh in 2005). Renewables in electricity generation include biofuels and waste (5.2 TWh or 6.3%), solar power (2.3 TWh or 2.7%), hydropower (0.8 TWh or 1%) and wind power (0.6 TWh or 0.7%).

Renewable power capacity increased from 2 309 megawatts (MW) to 5 366 MW during the same period (Table 5.1). Hydropower remains the largest contributor to renewable power capacity; however, there is limited potential for further development. Solar power experienced robust growth with capacity increasing to 2 068 MW from negligible levels in 2004. Wind advanced at 32.2% per year from negligible levels in 2004 to 278 MW in 2014. Both of these increases are the result of generous levels of feed-in tariffs (FITs), which have been abolished since. During the same period, biofuels electricity capacity (biogases and solid biofuels) increased from 128 MW to 722 MW, and the Biomass Action Plan for the Czech Republic has identified further potential for development of biogas and solid biofuels power plants.

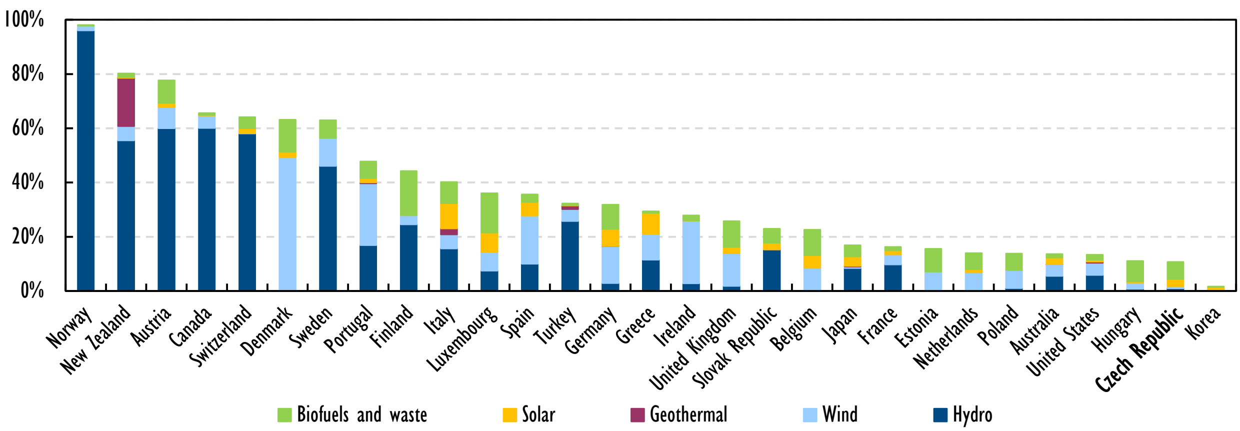
Figure 5.2 Renewable energy as a percentage of TPES in the Czech Republic and IEA member countries, 2015



Notes: IEA = International Energy Agency. Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

Figure 5.3 Electricity generation from renewable sources as a percentage of all generation in the Czech Republic and IEA member countries, 2015



Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

Among IEA member countries, the Czech Republic has the second-lowest share of renewables in electricity generation, higher than only South Korea (Figure 5.3). Its share of solar power, however, at 2.7%, is seventh-highest.

INSTITUTIONS

The Ministry of Industry and Trade (MIT) is responsible for the development and implementation of renewable energy policy in the Czech Republic. OTE, the market operator, is responsible for determining amounts of support, FITs and feed-in premiums (FIPs) (green bonuses) for electricity produced from RES. The energy sector regulator, Energy Regulatory Office, is responsible for the calculation of an annual regulated levy to recover a portion of costs of supporting renewable energy.

Table 5.1 Renewable electricity generating capacity, 1990-2014 (MW)

Technology	1990	2000	2004	2008	2009	2010	2011	2012	2013	2014	Share in 2014
Hydro	1 410	2 097	2 160	2 176	2 184	2 196	2 197	2 212	2 252	2 252	42%
Below 1.0 MW	-	52	120	132	135	141	142	149	155	150	-
Between 1.0 MW and10 MW	-	90	142	144	149	155	155	163	172	177	-
Over 10 MW	-	810	753	753	753	753	753	753	753	753	-
Mixed plants	-	450	450	450	450	450	450	450	475	475	-
Pure pumped storage	-	695	395	697	697	697	697	697	697	697	-
Solar photovoltaic	-	-	-	40	465	1 727	1 913	2 022	2 064	2 068	38.5%
Biogases	-	-	25	71	96	118	177	300	361	367	6.8%
Solid biofuels	-	-	103	213	254	271	306	330	306	355	6.6%
Wind	-	1	17	150	193	213	213	258	262	278	5.2%
Waste	-	3	4	4	4	44	44	46	46	46	0.9%
Total capacity	**1 410**	**2 101**	**2 309**	**2 654**	**3 196**	**4 569**	**4 850**	**5 168**	**5 291**	**5 366**	**100%**
Solar collectors surface (1 000 square metres [m^2])	-	-	70	165	217	309	375	425	470	530	-
Capacity of solar collectors (megawatt thermal capacity)*	-	*	49	116	152	216	263	298	329	371	-

* Converted at 0.7 kilowatt thermal capacity per m^2 of solar collector area, as estimated by the IEA Solar Heating & Cooling Programme.

Source: IEA (2015), *Renewables Information*, www.iea.org/statistics/.

POLICIES AND MEASURES

NATIONAL PLANS

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources lays down a 20% target for the overall share of energy from renewable sources and a 10% target for energy from renewable sources in transport for the European Union as a whole. Pursuant to this directive, member states' targets vary, in order to mirror the different situations and national possibilities of increasing renewable energy production. Therefore, a mandatory target of a 13% share of energy from renewable sources in gross final energy consumption by the Czech Republic by 2020 was established. The mandatory target of a 10% share of energy from renewable sources in the transport sector is in place in the Czech Republic as well.

The NREAP for the Czech Republic was submitted to the European Commission in July 2010. The plan projected a target of a 13.5% share of energy from renewable sources in gross final energy consumption and the fulfilment of a target of a 10.8% share of energy from renewable sources in transport in gross final energy consumption by 2020

(Table 5.2). The NREAP was first revised and updated in August 2012 and again in 2015. The 2015 update, which was approved by the Czech government in January 2016, proposes achieving a 15.3% share of energy from RES in gross final energy consumption and a 10% share of energy from RES in gross final consumption in transport by 2020. In 2014, the share of energy from renewable sources had reached of 13.4% in gross final energy consumption.

Table 5.2 National overall target for the share of energy from renewable sources in gross final consumption of energy in 2005 and 2020

A. Share of energy from renewable sources in gross final consumption of energy in 2005 (%)	6.1
B. Target of energy from renewable sources in gross final consumption of energy in 2020 (%)	13.5
C. Expected total adjusted energy consumption in 2020 (kilotonnes of oil-equivalent [ktoe])	29 803
D. Expected amount of energy from renewable sources corresponding to the 2020 target (calculated as B × C) (ktoe)	4 168

Source: MIT (2012), *National Renewable Energy Action Plan of the Czech Republic*, Ministry of Industry and Trade, Prague

Act 165/2012 Coll., on supported energy sources, came into effect on 1 January 2013. This act merged support for alternative energy sources into a single legal document and it defines one source of support payments, the market operator OTE. In addition to renewable and secondary sources and support for combined heat and power, the law provides a legal framework for decentralised electricity generation as well as biomethane and heat produced from RES. The legislation retains both types of support, i.e. green bonuses (FIPs) and FITs. Support in the form of FITs is paid to energy producers by the "mandatory purchaser", i.e. currently the relevant last-resort supplier until the MIT determines a new purchaser (OTE, 2014).

The act on supported energy sources was amended by Act No. 310/2013 Coll. in 2013. The amendment significantly reduced support for energy sources commissioned after 31 December 2013. Another change was passed in 2014, specifically Act No. 90/2014 Coll. of 24 April 2014, amending Act No. 450/2000 Coll., on business conditions and state administration in energy sectors and on amendments to certain acts (Energy Act).

SUPPORT MECHANISMS

In 2005, the Czech Republic first introduced legislation to stimulate renewable energy production. The act on the promotion of electricity generation from renewable sources established the legislative framework for the provision of support for renewable electricity generation. FITs and FIPs are the two key support measures for incentivising electricity generation from RES. The FITs work by offering long-term power purchase agreements for the sale of renewable energy electricity at agreed prices while the FIP offers a fixed premium on top of the market price for electricity or heat.

Heating from RES is promoted through investment support or provision of a green bonus. There are also some fiscal measures available to investors, notably in biofuels. The FITs and FIPs are differentiated with respect to the type of renewable resource, date of the start of operations, size of the plant installed capacity and, in the case of electricity generated from biomass, the type of biomass.

In 2010, favourable market conditions, supported by a decline in the prices for solar panels and generous FITs for renewable electricity, resulted in the Czech Republic becoming the fourth-largest annual solar PV market. The government, therefore, deemed it necessary to take corrective measures to minimise the impact of the development of FITs on electricity prices. The implementation of these changes, which have significantly deteriorated market conditions for the deployment of RES, has had a dramatic impact on the industry in the Czech Republic. The 2012 revision of the act on promoted energy sources sets strict criteria for the eligibility for FITs for RES electricity, and the support has been limited to a maximum installed capacity of 100 kilowatts (kW), with an exception for small hydropower generators (up to 10 MW). The support for PV was limited to up to 30 kilowatt-peak, and only PV panels placed on building roofs or walls are eligible for the FIT support scheme.

The main changes may be summarised as follows:

- Additional profit taxes of 26% on FITs and 28% on FIPs were imposed on the PV installations retrospectively for those that became operational between January 2009 and December 2010 until December 2013. This was followed by an extension of a tax of 10% on FITs and 11% on FIPs from January 2014 onwards, for PV installations that entered into operation during 2010.
- In August 2013, the Czech government and Chamber of Deputies of the Czech Parliament adopted an amendment to Act No. 165/2012 stating that as of 1 January 2014, public support for new RES generators being provided through FITs/FIPs would be ended (with an exemption for wind, geothermal, biomass and hydropower if a building permit was secured before the entry into force of the legislation and in operation by 31 December 2015). After this date, support was channelled towards indirect support for small systems in the form of simplified administration procedures and access to the grid.
- ČEPS, the transmission system operator (TSO), in 2010 declared a temporary connection moratorium for variable RES plants, which was officially terminated at the end of 2011. Although renewable electricity producers are generally entitled to priority connection to the grid, the TSO argued that the grid capacity was not sufficient for additional renewable electricity installations. The TSO demanded several amendments to the legal framework, including the introduction of advance payments for grid connection and abolition of the priority access for electricity from variable RES.

The changes to the support mechanism have deteriorated market conditions to the extent that RES capacity is in decline and is unlikely to recover in the medium term.

ELECTRICITY FROM RES

Hydropower, pumped storage, solar PV, wind power and biomass are the principal renewable sources of energy in the Czech Republic used for power generation. Electricity producers with an installed capacity of less than 100 MW and hydro plants up to 10 MW can make their choice as to the form of support, i.e. between the FIT and the FIP. The FIP scheme also allows producers to consume electricity they produce and benefit from the FIP for this consumption.

Larger producers fall under the FIP regime. In case of FITs, produced electricity is purchased by OTE, the market operator, whereas the support under the FIP requires the producers to find a market for the electricity themselves. The FIPs have an advantage against the FITs because their level reflects the increased risks associated with the possibility of use of the produced electricity in the market.

GRID ACCESS

RES plant operators are entitled to priority connection to the grid. Should expansion of the grid be necessary, expansion is provided to satisfy the terms of a connection agreement as well as non-discriminatory use of the grid for the transmission or distribution of RES.

In some cases, the grid connection procedure presents a barrier to the development of RES in the Czech Republic. In 2010, ČEPS declared a temporary connection moratorium for variable renewable electricity (RES-E) plants despite priority connection to the grid. The TSO argued that the grid capacity was not sufficient for additional RES capacity and demanded several amendments of the legal framework, including the introduction of advance payments for grid connection to solve the problem of speculative applications and the abolition of the priority access for electricity from variable RES.

In addition, some stakeholders have argued that some proposals for the future expansion of the transmission grid are incompatible with supporting the integration of RES. Stakeholders have claimed that the TSO is more focused on connecting new nuclear capacity with the industrial regions in the northeast, rather than connecting new RES plants to the grid. The TSO strongly disagreed with this statement, pointing out that a number of substations are being planned in order to connect new wind power facilities (Zane, Brückmann and Bauknecht, 2012).

The connection charges for a RES installation are calculated in accordance with the deep-connection cost methodology. This means that the RES producer has to ensure the connection of their plant to the transmission or to the distribution grid at their own expense. As for the distribution grid, the distribution system operator (DSO) bears the costs for grid development in residential areas. In non-residential areas, the DSO obligation is limited to 50 metres of low-voltage lines.

FINANCING OF SUPPORT MECHANISMS

The promotion of RES-E in the form of FIP and FIT payments is financed via a regulated levy, set as a component of the electricity price, on final electricity consumption. All users pay the levy, but there is pressure from industry for an exemption from this payment. The levy is calculated each year by ERO. Following increases in electricity prices in 2013, a share of the costs was transferred to the state budget. In 2016, a new system of calculating the special levy will be introduced, which will be independent of the amount of electricity consumed.

Investment support for renewable energy production is financed from the state budget (Green Savings, State Programme for Support of Energy Savings and Use of Renewable and Secondary Energy Sources [EFEKT]) and the operational programmes are financed by the EU structural funds (Operational Programme Enterprise and Innovation, Operational Programme for Environment, National Programme of Rural Development, Integrated Regional Programme).

Fiscal measures include:

- Exemptions from income tax.
- Tax depreciations.
- Exemptions from taxes on electricity (the guarantees of origin of electricity from renewable sources are used).
- Exemptions from property tax.

Projections of electricity production from renewables and secondary sources

The government projects that total electricity production from renewable and secondary sources of energy will continue to rise between 2010 and 2040 despite the abolition of support mechanisms. Apart from hydro energy, the potential of which has been practically exhausted after more than a century of developing hydropower stations, there is clear potential for the further development of biogas stations and solar PV. Electricity generation from biomass and waste will continue to develop until domestic potential has been exhausted (according to the Action Plan for Biomass, statistics and forecasts concerning the production of waste and its fuel component).

HEATING

Conditions for obtaining operational support for heat are set out in Act No. 165/2012 Coll., on supported energy sources, which has been in effect since 2013. Until then, support was not provided for heat produced from RES. The law directly determines a fixed rate of the green bonus in the amount of CZK 50 per gigajoule for all thermal sources that meet the conditions for support. It applies to heat supplied to the heat distribution system that was produced from three primary renewable energy sources: biomass (including co-firing with a secondary source), sustainable bio-liquids and geothermal energy.

Other conditions must be met to obtain support for heat:

- The producer must be licensed to produce heat.
- The rated thermal output of the heat production plant must exceed 200 kW.
- Heat must be produced in installations that meet the minimum energy efficiency requirements set out in Decree No. 441/2012 Coll.
- Where heat is produced in the process of electricity and heat cogeneration, the installed electric capacity of the production plant must not exceed 7.5 MW and the plant must have obtained a guarantee of origin of electricity from high-efficiency electricity and heat co-generation or from secondary sources issued by MIT.
- Support for heat does not apply to heat from biogas stations, co-firing of renewable and non-renewable sources, or other sources.

The number of producers applying for operational support for heat in 2014 was 47 entities (compared with 43 in 2013), and 56 thermal energy sources benefited from support. The settlement and payment of green bonuses for heat were carried out quarterly on the basis of received reports. In 2014, support was paid for 3.663 terajoules (TJ) of heat from RES representing approximately CZK 183 million in payments.

Compared with 2013, the volume of heat from renewable sources climbed by 1.091 TJ, and the amount of support payments increased by CZK 55 million.

TRANSPORT FUELS

Directive 2009/28/EC established the target of 10% share of energy from renewable sources in transport.[1] In accordance with this directive, the updated NREAP projects that the Czech Republic will achieve a 10.8% share of energy from renewable sources in gross final energy consumption in transport by 2020. The main support scheme for RES used in transport is a quota system. This scheme obliges companies importing or producing petrol or diesel to ensure that biofuels make up a defined percentage of their annual fuel sales. Furthermore, biofuels are exempt from the consumption tax.

A retailer introducing gasoline or diesel fuel to the Czech market for the purposes of transport is required to ensure that these fuels include the following minimum quantity of biofuel: 4.1% by volume for gasoline and 6.0% by volume for diesel. Bio-ethanol is currently consumed in motor fuels either in the form of a low-percentage additive to motor fuels in accordance with applicable legislation or in the form of high bio-ethanol mixtures such as E85 (a fuel composed of 85% ethanol and 15% gasoline) for gasoline engines and E95 (a fuel composed of 95% ethanol and 5% gasoline) for diesel engines.

Table 5.3 Production, trade and consumption of bio-ethanol in the Czech Republic, 2010-14

	2010	2011	2012	2013	2014
Indigenous production	94 523	54 412	102 195	104 488	104 112
Imports	10 361	35 696	5 184	1 979	37 352
Exports	36 556	7 378	16 644	17 475	22 812
Stock changes	-710	3 769	1 144	2 561	-390
Gross consumption	69 037	78 961	89 592	86 432	119 042

Source: MIT (2015), *Liquid Biofuels Data in the Czech Republic for 2014*, www.mpo.cz/dokument156004.html.

Table 5.4 Production trade and consumption of FAME in the Czech Republic, 2010-14

	2010	2011	2012	2013	2014
Indigenous production	197 988	210 092	172 729	181 694	219 316
Imports	21 727	54 294	78 314	85 551	118 278
Exports	35 232	16 796	6 703	43 216	35 221
Stock changes	275	2 374	2 074	-4 055	1 960
Gross consumption	184 188	245 216	242 267	228 084	300 413

Source: MIT (2015), *Liquid Biofuels Data in the Czech Republic for 2014*, /www.mpo.cz/dokument156004.html.

Gasoline blended with bio-ethanol is widely distributed in petrol stations in the Czech Republic. Fatty-acid methyl esters (FAME), most commonly rapeseed-oil methyl ester (RME), are currently consumed in motor fuels either as a low-percentage additive to

1. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

diesel fuel (maximum 7% FAME/RME) or as mixed diesel oil (SMN 30, which contains minimum 30% FAME/RME), or in the form of pure FAME/RME used to drive diesel engines. A law on fuels, Act No. 91/2011 Coll., was introduced make available motor gasolines with a maximum share of bio-ethanol of 5% (E5) until the end of 2018 in at least 50% of operated filling stations.

In 2014, by means of Resolution No. 655 of 6 August 2014, the government approved a multi-annual programme to support the further expansion of sustainable biofuels in the transport sector for the period to 2020. The purpose of the regulation is to maintain existing supports for the use of clean biofuels and high-percentage blends of biofuels in transport. The new programme describes in detail the issue of the application of liquid biofuels in transport by technical and legislative aspects and constitutes a framework that for different types of biofuels sets the optimal amount of aid so as to prevent its financial overcompensation. Recently, the increase in excise duty on the two types of biofuels is CZK 0.50/litre of pure biodiesel B100 and CZK 0.20/litre for E85. Rates for other types of biofuels remain unchanged.

The Czech Republic has sufficient capacities for biofuel production, but they are currently underused. Feedstock for biofuel production is mostly local. Czech producers use locally grown rapeseed for biodiesel and sugar beet and grains as a feedstock for ethanol production. There is exportable surplus of feedstock available. Production capacities for biodiesel consist of five major plants and a few small-scale ones, totalling slightly over 400 000 million tonnes (Mt) per year. In 2014, only three of them produced biodiesel. Czech biodiesel production in 2014 was 219 316 Mt, with rapeseed being the main feedstock. There is one plant (Oleo Chemical) producing biodiesel from animal fat from a rendering plant. Its capacity is reported by media at 62 000 Mt per year. The production has been used mainly for export to other EU member states so far (USDA, 2015).

ASSESSMENT

The Czech Republic has experienced strong growth in the renewable energy sector with the share of RES in TPES increasing from 8.9% in 2010 to 10.9% in 2014 despite claims that the potential of RES is limited by natural conditions and environmental protection requirements. As a result of changes in renewable energy policy, it is unclear whether such a development will be sustained over the coming years. Biomass is the only widely available RES for the heating industry, and the RES sector is dominated by production from biofuels and biomass. The country is more than likely to reach its EU 2020 target of 13% renewable energy in gross final energy consumption, although it may be necessary to ensure that a new support mechanism is developed and in operation in 2016.

The renewable energy target for the transport sector is 10.8% by 2020, compared with 6% in 2014. It will be difficult to reach the 2020 goal owing to the lack of availability of second- and third-generation biofuels. This is further complicated by the July 2015 decision to end biofuel tax subsidies, although cuts in excise duty or refunds to favour pure or highly concentrated biofuels will continue to 2020. This has resulted in uncertainty in the industry.

The SEP established RES corridor targets for 2040, which projects up to 25% renewable energy in total energy consumption. The SEP continues to place a strong focus on biomass. Reaching the envisaged share of RES by 2040 will require more focus on developing the renewable energy sector and examining the potential of all RES such as PV, wind, geothermal and biomass as well as opportunities in the heating sector (heat pumps, biomass). Each option will need to contribute if the country is to reach the targets for 2040. The most promising options, also in terms of comparative advantage for the Czech Republic, should be identified and supported with adequate R&D programmes.

Between 2010 and 2014, growth of RES output in the electricity sector was supported by a number of different mechanisms: a FIT system (guaranteed price), green bonuses (an amount paid on top of the market price for electricity), investment subsidies and fiscal measures. The expanding costs of the FIT system, notably support for solar PV energy, required a change in the support mechanism. Two-thirds of the subsidies for RES were going to solar PV, which produces only 5% of renewable electricity. In 2014, access to the FIT system was ended for new capacity with the exception of hydropower, and there is no longer a FIT support mechanism for wind, PV, biomass, etc. This has created uncertainty in the market. Predictability of government policy is very important for the investment climate, and a gradual revision of the FIT mechanism would have been more supportive of investor confidence.

With technological progress, investment costs in solar PV falling and production expanding, many IEA member countries have reformed or started a reform of their support schemes for renewables. While the IEA agrees that support levels should reflect technology improvement and cost reductions, retrospective changes to the support schemes must be avoided at all times. The Czech Republic's modifications to the support schemes, with possible retrospective effects, have undermined investor confidence and arguably resulted in a higher cost of capital for future investments.

Alternative approaches available to the government could include renewable capacity or generation auctions for certain or multiple technologies; quota obligations where energy suppliers have to ensure that a certain share/quota of the electricity they supply comes from renewable or green certificates in line with the country's long-term goals; and co-operation mechanisms where countries may take renewable electricity produced in another country into account for the achievement of their renewable energy target. Other options for financial sustainability are broadening the base on which costs for renewable energy incentives are recovered, as well as long-term refinancing of financial commitments on capital markets. Policies, however, will need to increasingly focus on bringing down deployment costs towards international benchmarks.

The green bonus system has replaced the FIT mechanism as a more cost-effective market-driven instrument. This mechanism ensures investors a reasonable and safe return while exposing them to market price signals.

The Czech Republic has several investment support subsidies and fiscal measures. These are effective when combined with capacity auctions or quotas in that they help avoid production of excess energy and in some cases may be favoured over operating support. Another effective alternative could be a carbon tax for those sectors outside the EU Emissions Trading Scheme, notably coal consumption. Since the Czech Republic has a large coal sector, some form of a carbon tax could be an efficient tool to stimulate greater investment in RES and energy efficiency measures.

The Czech Republic has a reliable and stable electricity network. It has been successful in integrating variable renewable resources into the network to date, mainly with the result of a stable power system with sufficient capacity reserves. Over the past few years, however, the Czech transmission system has faced significant overflows of RES from neighbouring states (particularly from Germany). There is a need to effectively reduce this overload and to increase grid flexibility. Maintaining existing flexibility should remain a priority should RES grow as the government projects.

RECOMMENDATIONS

The government of the Czech Republic should:

- *Assess the full potential of all available forms of RES in order to meet the long-term targets set out in the SEP. Avoid unsustainable reliance on any single source of energy.*
- *Develop and implement a new support mechanism for electricity and biofuels, to diversify and promote RES options in the transport sector, and encourage greater use of biofuels and biogas.*
- *Avoid any policy uncertainties – especially retrospective changes – that can create higher risk premiums undermining the competitiveness of capital-intensive renewables.*

References

IEA (International Energy Agency) (2016), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2015), *Renewables Information*, http://www.iea.org/statistics, OECD/IEA, Paris.

MIT (Ministry of Industry and Trade) (2015), *Liquid Biofuels Data in the Czech Republic for 2014*, www.mpo.cz/dokument156004.html, last accessed 1 October 2016

MIT (2012), *National Renewable Energy Action Plan of the Czech Republic*, MIT, Prague.

OTE (2014), *Year Report on the Electricity and Gas Markets in the Czech Republic for 2014*, OTE, Prague.

USDA (United States Department of Agriculture) (2015), USDA Foreign Agriculture Service, Gain Report, USDA, Washington, DC.

Zane, E., R. Brückmann and D. Bauknecht (2012), *Integration of Electricity from Renewables to the Electricity Grid and to the Electricity Market: RES-INTEGRATION,* Final Report, eclareon and Öko-Institut for DG Energy, Berlin.

6. ELECTRICITY

Key data (2015 estimated)

Total electricity generation: 82.6 TWh, +0.8% since 2005

Electricity generation mix: coal 54%, nuclear power 32.5%, biofuels and waste 6.3%, solar 2.7%, natural gas 2.7%, hydro 1%, wind 0.7%, and oil 0.1%

Installed capacity (2014): 22.4 GW, +26% since 2004

Peak demand (2014): 10.8 GW

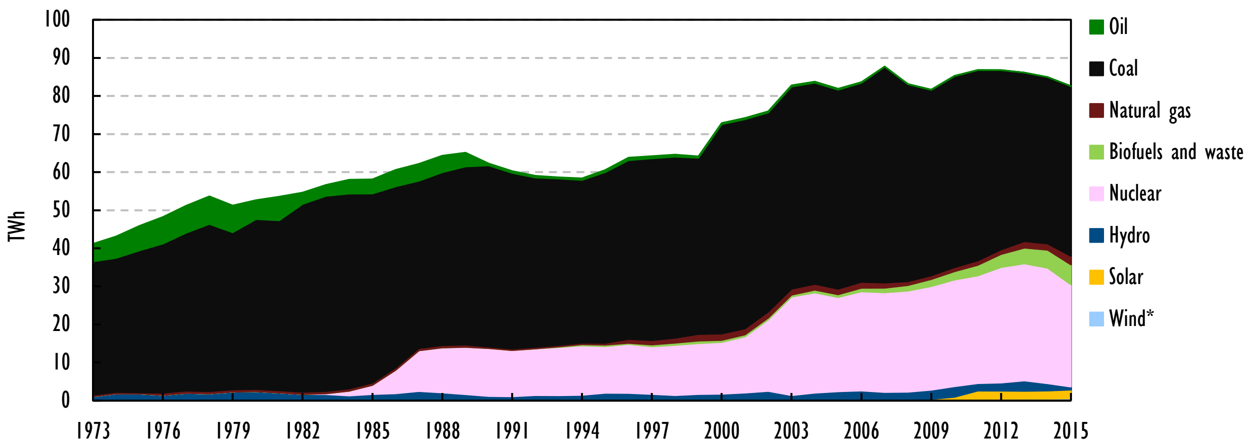
Electricity consumption (2014): 58.4 TWh (industry 39.4%, commercial and public services and agriculture 30%, residential 24.2%, energy sector 3.7%, transport 2.7%)

SUPPLY AND DEMAND

GENERATION

Electricity generation in the Czech Republic was 82.6 terawatt-hours (TWh) in 2015, a decline of 2.8% compared with 2014. The electricity mix is dominated by coal and nuclear. Coal accounted for 54% of electricity generation in 2015, while nuclear accounted for 32.5%. Over the past decade there has been a shift towards nuclear and renewables, with the total share of coal falling from 63.8% in 2005. Nuclear energy increased from a 30.1% share in generation in 2005, while renewables grew from 3.8% to 10.7% during 2005-15 (Figure 6.1).

Figure 6.1 Electricity generation by source, 1973-2015



Note: Data are estimated for 2015.

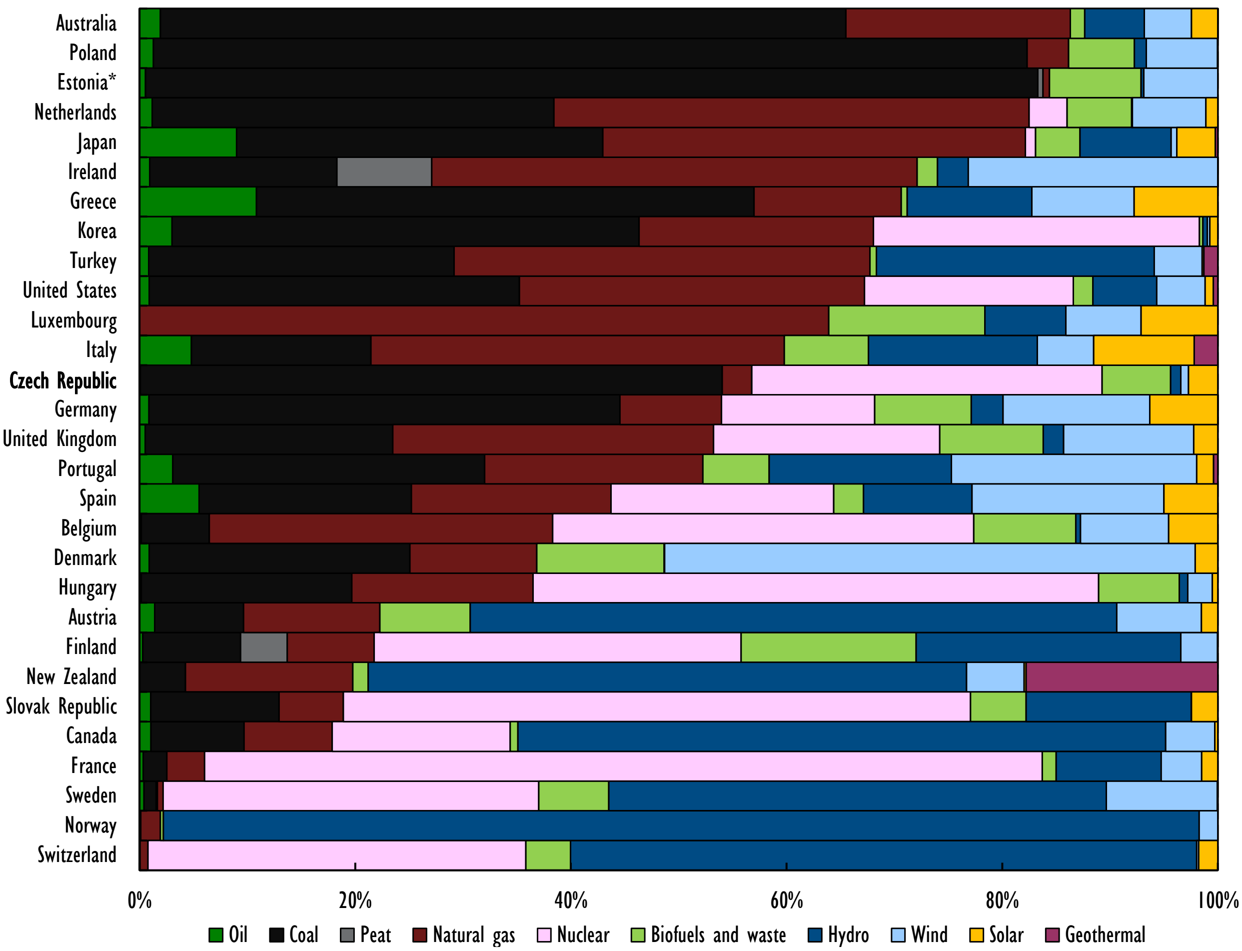
* Negligible.

Source: IEA (2016a), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

In comparison with other International Energy Agency (IEA) member countries, the share of fossil fuels in electricity generation was 13th-highest in 2015 (Figure 6.2). It had the fourth-highest share of coal use behind Estonia (oil shale), Poland and Australia, though the fifth-lower share of natural gas and the fourth-lowest share of oil. The nuclear share is the eight-highest among 16 IEA member countries that produce nuclear power.

At the end of 2014, there was 22 422 megawatts (MW) of installed generating capacity in the Czech power system (Table 6.1). Nuclear energy and brown coal (lignite) dominate the system, accounting for almost 65% of capacity between them. There has also been a significant increase in renewable capacity over the past decade, largely driven by generous subsidies.

Figure 6.2 Electricity generation by source in IEA member countries, 2015



Note: Data are estimated.

* Estonia's coal represents oil shale.

Source: IEA (2016a), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

Table 6.1 Czech Republic electricity generation capacity by fuel, 2014

Fuel	MW	%
Nuclear	4 166	18.6%
Brown coal	9 845	43.9%
Hard coal	1 378	6.2%
Natural gas	1 584	7.1%
Oil	48	0.2%
Renewables including waste	5 401	24.1%
Total	**22 422**	**100%**

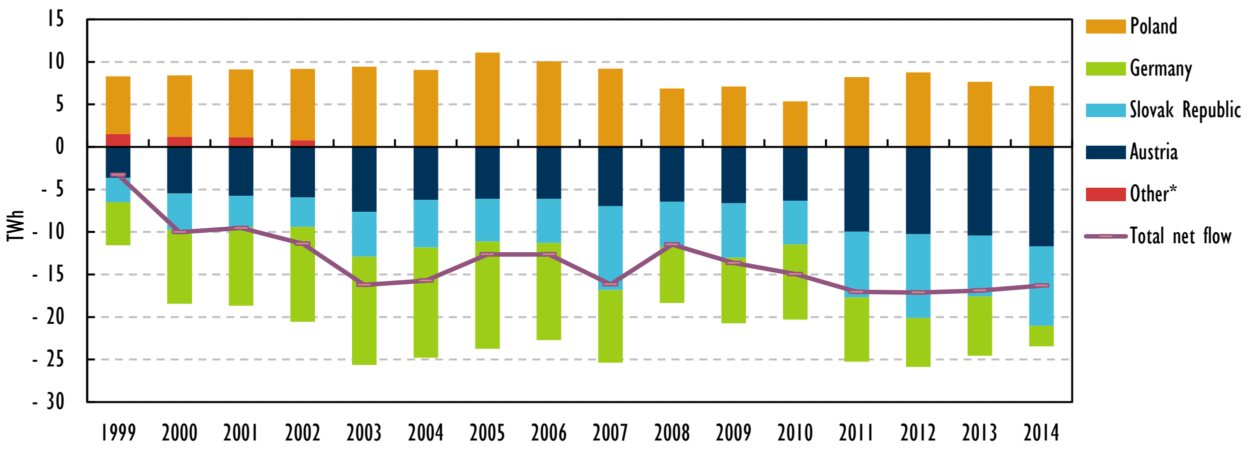
Source: MIT, IDR country submission.

IMPORTS AND EXPORTS

The Czech Republic has electricity interconnections with each of its neighbours: Austria, Germany, Poland and the Slovak Republic. Net exports were 12.5 TWh in 2015. Electricity exports were 28.7 TWh in 2015, 14.7% greater than in 2005. In 2014, exports were to Austria (41.5%), the Slovak Republic (33.2%) and Germany (19.2%), with 6% unspecified. From 2004-14, exports to Austria grew by 87.4% and to the Slovak Republic by 67.4%, while exports to Germany have contracted by 58.3% (Figure 6.3). Exports to Poland ceased in 2006.

Electricity imports totalled 16.2 TWh in 2015, which is 30.7% greater than in 2005. The Czech Republic imported 60% of electricity from Poland in 2014 and 25% from Germany, 14.6% from unspecified sources. Imports from Poland have declined by 21.2% over the ten years since 2004 while imports from Germany started again in 2011 after a nine-year absence. Imports from the Slovak Republic ceased in 2006.

Figure 6.3 Net electricity trade, the Czech Republic, 1990-2014



* Other represented trade from non-specified sources.

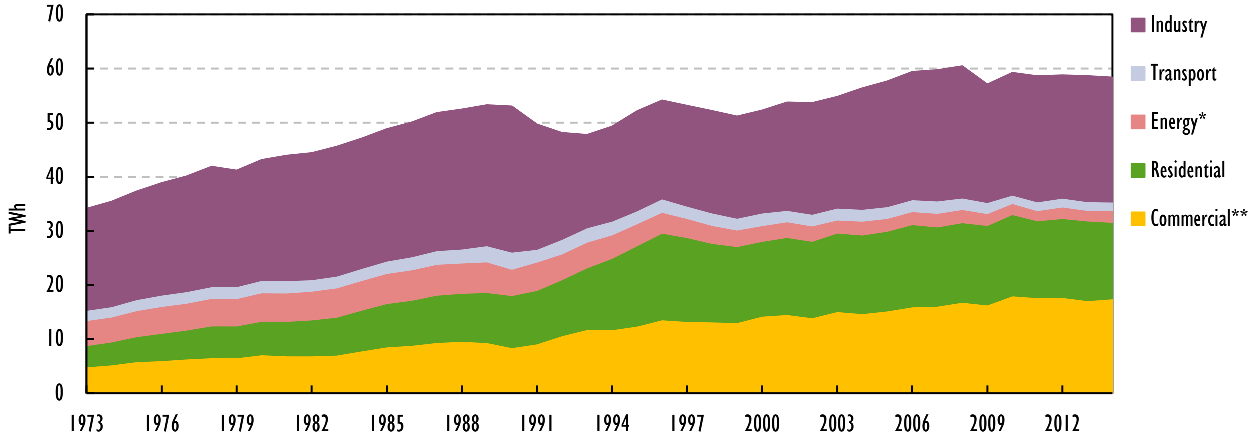
Source: IEA (2016b), *Electricity Information 2016*, www.iea.org/statistics/.

DEMAND

The electricity consumption in the Czech Republic was 58.4 TWh in 2014. Consumption peaked at 60.5 TWh in 2008 after a decade of growth. During 2008-09 demand fell by 5.6%, driven by the economic crisis, though it had a 3.8% recovery in 2010. Consumption has remained largely unchanged since 2011 (Figure 6.4).

Industry is the largest electricity-consuming sector; accounting for 39.4% of total demand or 23 TWh. Demand in this sector has increased by 2.9% since 2004 while total electricity consumption has grown at a slower rate at 3.5%. As such, the industry sector has decreased its share in electricity usage from 39.7% of the total in 2004.

Figure 6.4 Electricity consumption by sector, 1973-2014



* *Energy* includes coal mining, oil and gas extraction, and refining.

** *Commercial* includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2016b), *Electricity Information 2016*, www.iea.org/statistics/.

The commercial and public services (including agriculture) sector also has experienced a steady increase over the past decade. Demand from this sector made up 17.5 TWh, or 30% of the total, in 2014, which is 18.6% more than 2004. This has resulted in an increase in its share in total electricity consumption from 26.2% in 2004. Conversely, demand from the residential sector was 14.1 TWh in 2014, decreasing by 2.8% since 2004, with the contraction of the share from 25.8% in 2004 to 24.2% in 2014.

The transport sector consumed 2.7% of total demand in 2014, and the energy sector 3.7%. Demand from transport has contracted by 28.1% and demand from energy has dropped 14.8% over the ten years to 2014, with their shares in total demand falling from 3.9% for transport in 2014, and from 4.5% for the energy sector in the same year.

INSTITUTIONS AND REGULATORY FRAMEWORK

The institutions responsible for overseeing the electricity market include the Energy Regulatory Office (ERO), the Ministry of Industry and Trade (MIT), the State Energy Inspection (SEI) and the Office for the Protection of Competition (ÚOHS). The powers and scope of each vary. The Czech electricity and gas market operator (OTE) also plays an important role in the sector.

The Energy Act lays down the rights and obligations of the ERO and provides for co-operation among ERO and MIT, SEI and ÚOHS. The ERO's primary role in the sector is to regulate the activities of the natural monopolies of transmission and distribution. The ERO approves charges for transmission and distribution, the market operator's services and the tariffs charged by the supplier of last resort.

While its powers of regulation, inspection and decision making are independent, the ERO is required to submit its annual report for approval of the Chamber of Deputies of the Czech Parliament. Nonetheless, in performing its competences, the ERO cannot accept or request instructions from the president, the Parliament of the Czech Republic, the government or any other authority of executive power or from any natural or juristic persons. The budget of the ERO is subject to approval of the Ministry of Finance, the government and the Parliament of the Czech Republic, but is largely recovered from industry by means of a levy on energy consumed.

The MIT is a central authority of state administration for the energy sector. The Ministry of Finance is the exclusive administrator of value-added tax, and supervises the customs administration of the Czech Republic. The MIT develops energy policy, and monitors and administers its implementation. The SEI, a state body, is responsible for ensuring the compliance of, and issuing sanctions for non-compliance of, electricity market participants with relevant legislation in the energy sector such as electricity pricing. The SEI is obliged to take action upon requests from the ERO and the MIT, which it then notifies of the results of its inspections.

The ÚOHS is the independent central authority of state administration, with competencies relating to the protection of competition, oversight over public procurement, and state aid monitoring and co-ordination. Its mission is to ensure that markets function in accordance with the rules of competition and for the benefit of consumers.

OTE, the electricity and gas market operator, is a joint stock company established in 2001 that administers and reports on the electricity markets and, in co-operation with ČEPS, the electricity transmission system owner and operator performs an accounting function in the energy balancing market. OTE is at least 67% owned (100% at present) by the state and carries out its activities under a licence awarded by the ERO.

MARKET STRUCTURE

Over the past ten years, the Czech electricity market has been restructured in compliance with the European Union (EU) energy directives. Sales of electricity to consumers have been fully liberalised, while access to transmission and distribution networks remains regulated. The market forms part of the larger Central European market as a result of the country's cross-border transmission capacities.

While there is complete legal separation between the generation and transmission elements of the market, a large part of generation, distribution and supply remain part of integrated businesses owned by ČEZ and its subsidiaries (ČEZ Group). The largest shareholder of ČEZ is the Czech Republic with a nearly 70% stake in the company. Its shares are traded on the Prague and Warsaw stock exchanges, and the remaining stake is owned by a variety of institutional shareholders.

GENERATION

Coal-fired plants are the backbone of the generating fleet in the Czech Republic. ČEZ owns and operates most of the major coal-fired plants and all nuclear plants in the Czech Republic. In 2014, electricity production was 86 003 gigawatt-hours (GWh), of which ČEZ had a 67.7% share. Compared with 2008, ČEZ's share of total generating capacity has declined from nearly 75% to 61.5%. A rise in the share of renewables and sale of the ČEZ-owned coal-fired plant in Chvaletice to Severní Energetická have both contributed to the decline of ČEZ's share of total generating capacity. In 2014, the second-largest utility by capacity was EP Energy with a 4% share of total generating capacity, followed by Severní Energetická with a 3.7% share.

TRANSMISSION AND DISTRIBUTION

On 1 January 2015, the total length of the Czech electricity transmission network was made up of 5 554 kilometres (km) of power lines (400 kilovolt [kV]: 3 553 km; 220 kV: 1 917.3 km; and 110 kV: 83.7 km) and 41 substations (420 kV: 26; 245 kV: 14; and 1 at 123 kV). Only a small part of the transmission network forms a 110 kV grid for the purpose of supplying self-consumption to the nuclear power stations. The transmission network is interconnected, via cross-border lines, with transmission networks of neighbouring countries thus enabling a synchronous operation with the interconnected power systems of the rest of Continental Europe.

ČEPS, a state-owned company, owns and operates the electricity transmission system. It is the exclusive holder of the electricity transmission licence under the Energy Act (Act 458/2000, as amended). On 7 December 2012, the ERO issued ČEPS with an independence certificate, which stated that ČEPS is an entity fully unbundled in terms of ownership. The granting of the certificate of independence confirmed that ČEPS satisfied all the conditions for independence as stipulated by the Czech Energy Act, Article 24a.

Network access

Terms of access to the transmission system and use of system tariffs are defined by Decree No. 50/2006 of the ERO. This decree established procedures to be followed by transmission/distribution system operators and applicants when applying for grid access. Conditions for connections are defined by the system operator in accordance with results of the Study for Connection, which should be ensured by the applicant if asked by the system operator. All technical and organisational requirements and the place and date for connection are incorporated in the agreement (or prior agreement) for connection, which is signed between the system operator and the applicant. The connection fee that has to be paid by the applicant is also defined in the agreement in compliance with the decree.

System service, losses and outages

System services are provided by ČEPS in order to ensure the quality and reliability of electricity supply at transmission system level. Quality is primarily defined in terms of frequency and voltage parameters, which are specified in the Grid Code. Reliability concerns the stability of electricity supply at points of supply from the transmission system; this parameter is determined by the average number and duration of supply interruptions at individual connection points. The cost of system services are recovered via transmission charges which are included the final price of electricity paid by all consumers connected to the power system.

In 2014, the total annual amount of transmission losses in the transmission network was 831 GWh. ČEPS is entitled to purchase, at the lowest cost possible, electricity to cover transmission losses in the transmission system and to meet its own needs. It does this by means of tenders for defined time periods and on the short-term electricity market operated by OTE.

Table 6.2 Number of outages on the Czech transmission system in 2014

Number of outages	10
Total length of interrupted electricity transmission (minutes)	121
Average length of one outage (minutes)	12.1
Amount of non-delivered electricity (megawatt-hours [MWh])	250

Source: MIT, IDR country submission.

Transmission services

Transmission services ensure electricity transmission from generators to areas of consumption within the Czech Republic (domestic transmission) and export to/import from abroad (cross-border transmission). ČEPS, based on transmission services agreements, controls power flows across the Czech transmission system while respecting electricity exchange schedules agreed with neighbouring transmission system operators as well as co-operating with distribution system operators (DSOs).

Ancillary services

Ancillary services (AS) in the Czech Republic are defined as services provided by ČEPS for maintaining power system operation and high quality and security of electricity supply. AS allow any imbalance between electricity consumption and generation to be corrected by means of demand- or supply-side changes. ČEPS purchases AS on the AS day-ahead market or through tender for service, which can be divided into the following categories:

- primary frequency control
- secondary power control
- minute reserve available within 5 minutes
- minute reserve available within 15 minutes positive
- minute reserve available within 15 minutes negative
- minute reserve available within 30 minutes
- rapid unloading.[1]

1. A reduction or increase in electricity consumption effected by the provider of this service within 30 minutes of a dispatcher command.

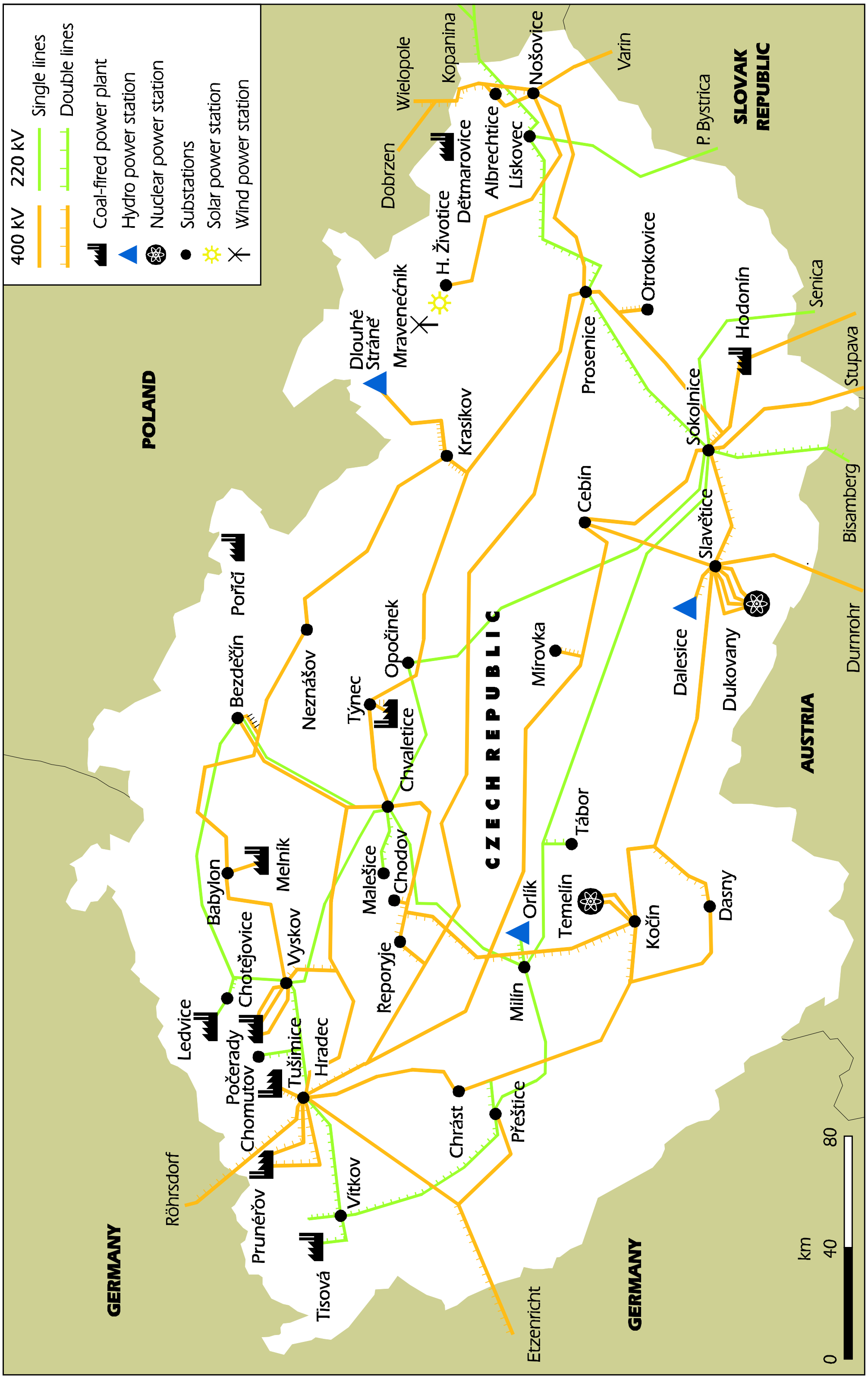
Cross-border transmission

ČEPS maintains 11 cross-border 400 kV interconnection lines and 6 cross-border 220 kV interconnection lines. The Czech transmission system is synchronised with the rest of Continental Europe (formerly the Union for the Co-ordination of Transmission of Electricity [UCTE] system). Cross-border interconnections exist with all neighbouring countries, i.e. Germany, Poland, Slovak Republic and Austria, and with five transmission systems: 50Hertz and TenneT (Germany), PSE (Poland), SEPS (Slovak Republic), and APG (Austria). At each cross-border point, transmission capacities are allocated on the basis of co-ordinated calculation within the Central and Eastern European region (known as Central Eastern Europe [CEE]), which also includes Slovenia and Hungary. Co-ordinated capacity allocation is organised by Central Allocation Office (CAO), a subsidiary of the eight regional transmission system operators. In mid-2014, the HOPS, the Croatian transmission system operator (TSO) became a new shareholder. In 2014, CAO and the Austrian TSO, APG, and the Swiss TSO, Swissgrid, entered into an agreement to support the calculation of cross-border transmission capacities on the interconnector with Italy, thereby expanding its operations in the region. Price convergence in the CEE region decreased from 10% in 2013 to 5% in 2014.[2] This was largely the result of increasing electricity wholesale prices in Poland and Hungary as opposed to the Czech and Slovak prices, which continued to fall (ACER/CEER, 2015).

Capacity allocation takes place under the Rules for Co-ordinated Auction of Transmission Capacity in the CEE Region, which set out the conditions for access to cross-border infrastructure. Informal co-ordinated assessments of the auction rules take place through the CEE regional co-ordination committee. The capacity allocation method is used for cross-border interconnections with the 50Hertz, TenneT, PSE and APG transmission systems. A transmission capacity reservation for long-term cross-border transfers is not required for the ČEPS/SEPS (Slovak) interconnector.

2. Austria, Czech Republic, Germany, Hungary, Poland, Slovak Republic and Slovenia.

Figure 6.5 Map of the Czech Republic's electricity network, 2015



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Table 6.3 Cross-border interconnection capacity

Interconnection		Voltage (kV)	Transmission capacity (MVA)
Czech Republic	Austria	220	655
Czech Republic	Austria	220	655
Czech Republic	Austria	400	2 235
Czech Republic	Austria	400	2 235
Czech Republic	Germany	400	2 000
Czech Republic	Germany	400	2 265
Czech Republic	Germany	400	2 000
Czech Republic	Germany	400	2 000
Czech Republic	Poland	220	1 050
Czech Republic	Poland	220	1 050
Czech Republic	Poland	400	2 000
Czech Republic	Poland	400	2 000
Czech Republic	Slovak Republic	220	580
Czech Republic	Slovak Republic	220	560
Czech Republic	Slovak Republic	400	1 740
Czech Republic	Slovak Republic	400	1 740
Czech Republic	Slovak Republic	400	1 968

Source: MIT, IDR country submission.

DISTRIBUTION

There are three large distribution companies in the Czech Republic:

- ČEZ Distribution, which includes the area of Western, Northern, Central and Eastern Bohemia and Northern Moravia
- E.ON Distribution, which includes the area of Southern Bohemia and Southern Moravia
- PRE Distribution, which includes the area of Prague.

ČEZ Distribution, with 3.5 million customers, accounts for some 62% of total distribution (34 TWh/year). E.ON Distribution is the second-largest distribution company, with 1.4 million customers and 14.3 TWh/year. PRE Distribution is owned by Pražská energetika Holding a.s., which is jointly controlled by the Capital City of Prague and EnBW Energie Baden-Württemberg AG (EnBW), and EnBW, and services 0.7 million customers. Distribution is 7.2 TWh/year. There are also 278 local distribution companies. The local DSOs are parts of vertically integrated companies and legally and accounting unbundled.

The DSOs are obliged to connect every network user if the network user meets relevant conditions and pays the connection fee. Connection fees express the network users' share on investment costs, and are different for consumers and generators. The connection process and conditions are based on the relevant acts (the Energy Act and the act on promoted energy sources) and decree on conditions for connection to the electricity grid.

Regarding quality of electricity supply, the regulatory methodology for determining allowed revenues for the DSOs includes an element to regulate quality. The purpose of this is to establish the required level of the quality of provided services in relation to their prices. The purpose of quality regulation is to reduce the number and duration of electricity distribution interruptions.

DISTRIBUTED AND VARIABLE RENEWABLE POWER INTEGRATION

In the Czech Republic, there are two predominant sources of variable power generation, wind and solar photovoltaic (PV) installations. These are currently connected to the grid at distribution level and there is limited impact on transmission grid operation at present. In an international context, however, the growing volume of variable renewable energy sources poses occasional difficulties for ČEPS, most notably loop flows from Germany (Box 6.1). In order to protect the Czech grid, ČEPS has undertaken a number of measures, including the decision to install phase-shifting transformers.

Box 6.1 Loop flows in Central Europe

Power loop flows, from Germany through its neighbours, appear to be causing significant difficulties in Central Europe, especially in Poland and the Czech Republic. These loop flows occur when Germany has insufficient grid infrastructure to connect production locations with demand centres, for example from wind, and the power is diverted through neighbouring countries' grids and then back into a different part of Germany. Such loop flows have become more common since Germany developed large amounts of wind power in its northern *Länder*, but did not develop the grid infrastructure to transfer the output south to where much of the demand is located. This difficulty was amplified by the shutdown of eight nuclear plants in 2011.

In its Ten-Year Network Development Plan for Electricity, the European Network of Transmission System Operators identified major flows in the south-east and south-central regions, including loop flows in the north-south direction, among the problems driving the need for significant investments in Central Europe.

To support the development of an integrated EU energy market, the European Commission has drawn up a list of 248 Projects of Common Interest (PCIs). These projects may benefit from accelerated licensing procedures, improved regulatory conditions and access to financial support totalling 5.85 billion euros (EUR) from the Connecting Europe Facility between 2014 and 2020.

Several electricity PCIs (five in all) are being developed in the Czech Republic. The aim of these projects is to increase capacity at the Czech Republic's north-western and southern borders and contribute to addressing the issues of loop power flows among Germany, the Czech Republic, Austria and the Slovak Republic. There is also an ongoing replacement and expansion project for the 400 kV grid. It is planned to be completed by 2030, but investment is slow and lead times are long (EC, 2014).

Table 6.4 Distribution continuity indicators in the Czech Republic (2014)

Indicator	ČEZ Distribution	E.ON Distribution	PRE Distribution	Czech Republic
System Average Interruption Frequency Index (interruptions per year)	2.77	2.27	0.74	2.38
System Average Interruption Duration Index (minutes per year)	281.42	409.3	43.37	283.22
Customer Average Interruption Duration Index (minutes)	101.55	180.3	58.73	119.21

Source: ERO (2015), *National Report of the Energy Regulatory Office on the Electricity and Gas Industries in the Czech Republic for 2014.*

SMART GRIDS

A smart grid is an electricity network that uses digital and other advanced technologies to monitor, manage and balance the transport of electricity from all generation sources to meet the varying electricity demands of end users. Smart grids include electricity networks (transmission and distribution systems) and interfaces with generation, storage and end users (IEA, 2011).

The Czech Republic has developed a National Action Plan for Smart Grids (NAP SG), which was approved by government in March 2015, to promote implementation of smart-grid technologies. The NAP SG sets out the expected development of the electricity sector of the Czech Republic for periods starting with the period until 2019, followed by two five-year periods until 2024, then until 2029, and finally, the last between 2030 and 2040. The period up to 2019 can be characterised as a period of preparation (analysis, solutions to individual problems, partial measures, drafting and final approval of the Target Model SG, the long-term plan for smart grids). The other periods identified, 2020-24 and 2025-29, focus implementation in accordance with the needs of the electricity system and the existing technological level at that time.

MIT in co-operation with other state agencies, which have the responsibility for implementation of the NAP SG, will evaluate the progress of implementation of smart grids as follows: MIT will submit the results of its ongoing evaluation on 31 December 2017; then it shall submit the proposal for an updated plan for the implementation of the NAP SG to the government by 31 December 2019.

WHOLESALE MARKET

In the Czech Republic, electricity is traded at Prague-based Power Exchange Central Europe (PXE) and in spot markets (day-ahead and intraday) organised by OTE. PXE, a subsidiary of the Prague Stock Exchange established in July 2007, offers trading in Czech, Slovak, Hungarian, Polish and Romanian electricity. PXE offers an organised market for electricity and natural gas futures and spot products. In 2014, there were 39 market participants, the total number of traded contracts was 6 040, and the volume of electricity traded was 17.7 TWh. PXE also offers products with physical settlement and delivery point in the Slovak and Hungarian electrical grids. Traders may sell and buy electricity through different options such as bilateral trades and stock products provided by the market operator and home and foreign stock markets.

The day-ahead short-term electricity market was launched in 2002. In 2014, there were 103 active market participants registered to trade, and the volume of electricity traded on the day-ahead spot market was 15.11 TWh. This represents a 16% increase compared with 2013 (12.99 TWh) (OTE, 2016). The average price of these trades was EUR 32.96/MWh.

In 2014, the day-ahead electricity market underwent a number of significant changes, such as the introduction of new types of bids and, in particular, the extension of the integrated Czech-Slovak-Hungarian day-ahead spot electricity markets to include the day-ahead spot market in Romania from 19 November 2014. Traded volumes also grew on the intra-day electricity market in 2014. The volume of electricity traded on the intra-day electricity market was 443 GWh, representing a 6% increase compared with 2013.

Coupling of Czech, Slovak, Hungarian and Romanian day-ahead electricity markets

On 19 November 2014, the Czech Republic-Slovakia-Hungary-Romania Market Coupling (4M MC) project was successfully launched, integrating day-ahead electricity markets of the Czech Republic, the Slovak Republic, Hungary and Romania. This project replaced the previous Czech Republic-Slovakia-Hungary (CZ-SK-HU) Market Coupling arrangements. The project started in August 2013 with the aim of expanding CZ-SK-HU Market Coupling to include Romania and implement the Price Coupling of Regions (PCR) solution. PCR is an initiative of seven European Power Exchanges, to develop a single price-coupling solution to be used to calculate electricity prices across Europe, and allocate cross-border capacity on a day-ahead basis. Market Coupling allows for more efficient trading and allocation of cross-border capacity, which should enhance security of electricity supplies, improve liquidity and reduce price volatility.

RETAIL MARKET AND PRICES

PRICES

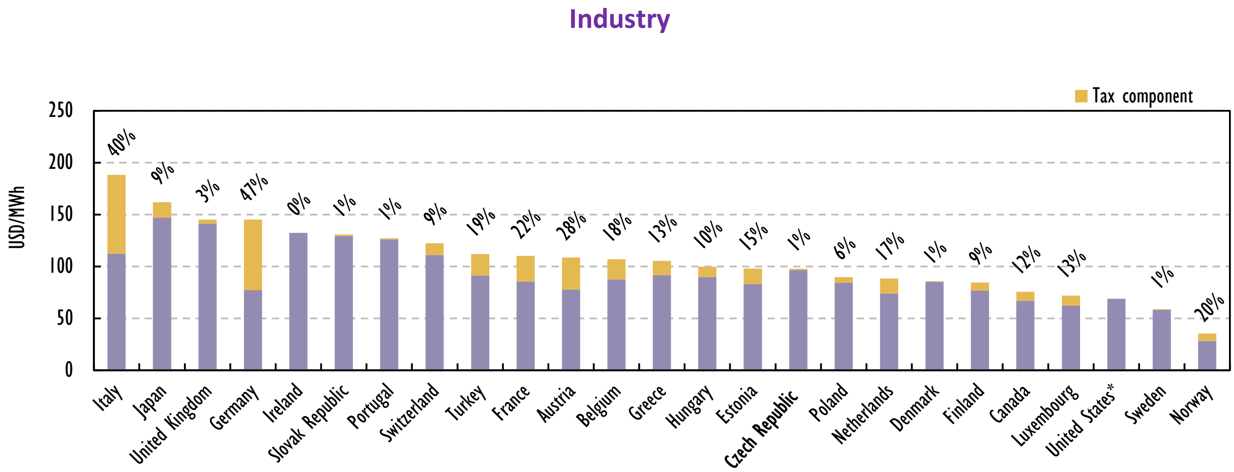
Electricity prices in the Czech Republic are below average among European members of the Organisation for Economic Co-operation and Development (OECD) for both household customers and industry. According to Eurostat, retail prices for electricity for household consumers in the Czech Republic (EUR 0.104 per kilowatt-hour [kWh] excluding taxes and levies or EUR 0.1273/kWh including taxes and levies) are well below the average among the 28 EU member states (EU-28) (EUR 0.1401/kWh excluding taxes and levies, EUR 0.2078/kWh including taxes and levies).[3]

Prices for industrial users (EUR 0.0761/kWh excluding taxes and levies or EUR 0.0934/kWh including taxes and levies) are also less than the EU-28 average (EUR 0.0894/kWh excluding taxes and levies or EUR 0.1496/kWh including taxes and levies).[4]

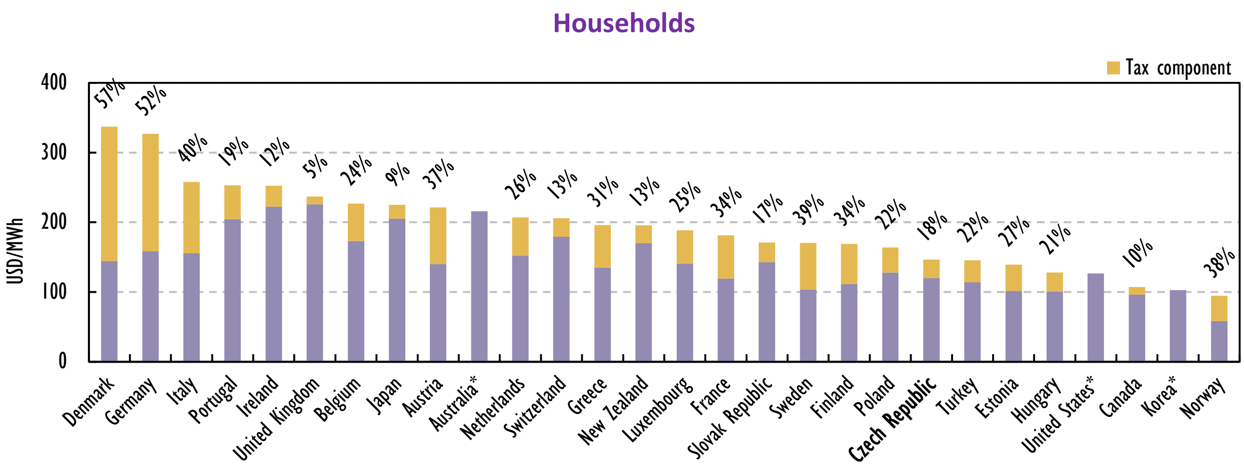
3. Eurostat (2016), electricity prices for domestic consumers – bi-annual data (from 2007 onwards) – Band DC 2 500 kWh < consumption < 5 000 kWh, (First semester 2015), http://ec.europa.eu/eurostat/web/energy/data/main-tables, last accessed 1 October 2016.

4. Eurostat (2016), electricity prices for industrial consumers – bi-annual data (from 2007 onwards) – Band IC 500 MWh < Consumption < 2 000 MWh (First semester 2015), http://ec.europa.eu/eurostat/web/energy/data/main-tables, last accessed 1 October 2016

Figure 6.6 Electricity prices in IEA member countries, 2015



Note: USD = United States dollar. Data not available for Australia, Korea, New Zealand and Spain



Note: Data not available for Spain.

* Tax information not available.

Source: IEA (2016c), *Energy Prices and Taxes 2015*, Q1, www.iea.org/statistics/.

RETAIL MARKET

Retail prices are unregulated and determined by the market. There are three incumbent suppliers, part of vertically integrated undertakings, and more than 300 alternative suppliers.

There were 5.91 million meter points connected to the low-voltage network at the end of 2014. Based on data provided by the market operator OTE in July 2015, suppliers other than the incumbents supplied 1.43 million customers. The three largest active suppliers in the retail market were Bohemia Energy (318 700 customers), RWE Energie (297 333 customers) and Centropol Energy (280 398 customers). The three regional suppliers in their respective grids (ČEZ Prodej, E.ON Energie and Pražská Energetika,) supplied approximately 4.48 million customers among them. Information on customer switching rates across all sectors and customer switching procedures are published by OTE on its website. The following table shows the number of meter points where changes of supplier occurred in the specific year and month.

Table 6.5 Number of executed changes of electricity supplier

Year	2003-10	2011	2012	2013	2014
Total	466 706	448 860	473 128	374 440	333 542
Aggregate total	2 096 676				

Source: MIT, IDR country submission.

A total of 333 542 changes of electricity supplier were registered in 2014, less than in 2013 and down significantly on previous years. While the reasons for the decline are unclear it is possible that a large number of customers that moved suppliers in previous years signed a contract for a period of more than one year. In its 2015 Market Monitoring Report, the Agency for the Co-operation of Energy Regulators (ACER) highlighted unethical supplier sales practices in some countries including the Czech Republic, where customers' switching under pressure has been reported. This has created bad publicity for some alternative suppliers and undermined trust in the market, and thus discouraged consumers from switching. The Czech Republic has introduced some measures to combat these claims such as banning door-to-door sales of electricity (ACER/CEER, 2015).

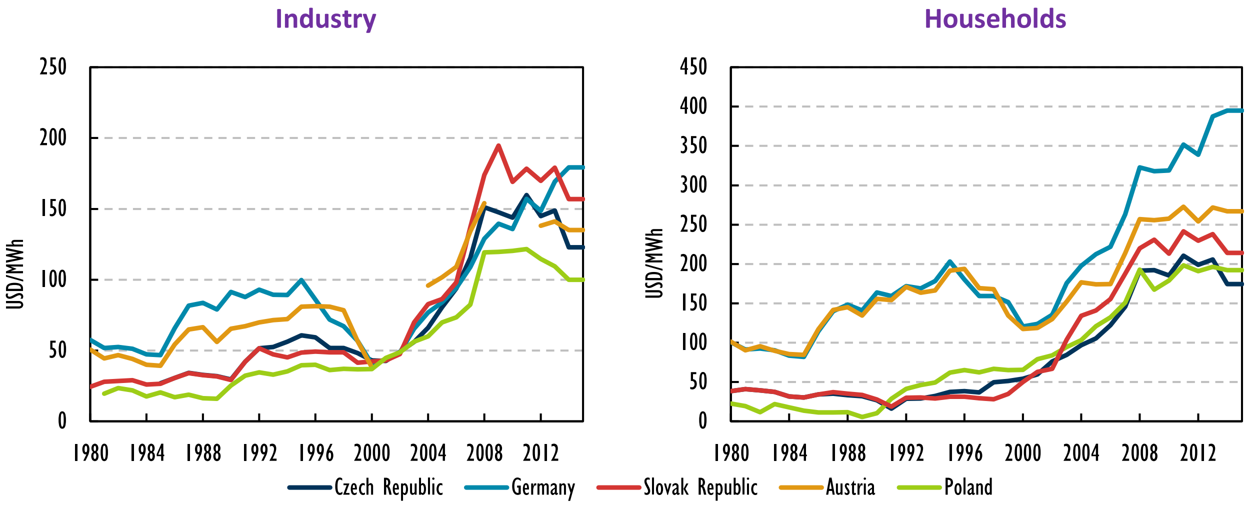
The time it takes to switch suppliers in the Czech Republic also seems long. The requirement set in the EU directive is that the switching period should not last more than three weeks, i.e. 15 working days. In the Czech Republic, the switching process itself takes 10 days, but when taken in combination with a 90-day (three month) notice period, switching appears to take 90 days in practice (ACER/CEER, 2015).

In September 2015, ACER published a study of competitiveness of retail electricity and gas markets in EU member states and Norway. The outcome of the study ranked the Czech Republic the ninth most competitive electricity retail market among the 29 countries studied (IPA, 2015).

Supplier of last resort

Should any supplier or trader be declared insolvent, a supplier of last resort is designated by the ERO to ensure the continuity of electricity supply. Suppliers of last resort may supply electricity for up to six months to customers. In 2014, the option of supplier of last resort was not used.

Figure 6.7 Electricity prices in the Czech Republic and in other selected IEA member countries, 1980-2015



Note: Data for the Czech Republic for industrial prices are not available for 1980-84; data for Austria for industrial prices are not available for 2001-03 and 2009-11; data for Poland for industrial prices are not available for 1980.

Source: IEA (2016c), *Energy Prices and Taxes 2016*, Q1, www.iea.org/statistics/.

ASSESSMENT

In 2015, electricity generation output was 83 TWh, which was slightly less than the previous year owing to a relatively mild winter. In 2015, coal power was the main source of generation, with a share of 54.0%. Nuclear provided 32.5% and renewables 10.7% (biofuels and waste 6.3%, solar 2.7%, hydro 1.0% and wind 0.7%). The Czech share of coal in electricity generation is fourth-highest among IEA member countries behind Estonia (oil shale), Poland and Australia. As a result of this high share, a long-term security consideration is depleting lignite reserves, which are forecast to be exhausted by 2050. The SEP sets out the key goals for the electricity system over coming years. The targets regarding the electricity sector refer to – among other things – the mix of primary energy sources in electricity generation, a high degree of self-sufficiency and affordable electricity prices.

In the SEP, the government has projected that nuclear energy will contribute from 46% to 58% of total gross electricity production in 2040 compared with 35% today. Electricity generation from coal – especially lignite – is projected to decrease from approximately 48% today to a corridor of somewhere between 11% and 21%. Furthermore, the SEP suggests that coal only be utilised in high-efficient or co-generation power plants.[5] The share of renewables and of secondary sources in electricity generation is projected to increase to somewhere form 18% to 25% (from 10.6% today) whereas natural gas will increase to 15% (from 7% today).

The Czech Republic plans to continue to have surplus generating capacity and remain a net exporter of electricity based on a diversified mix of primary energies, while making best use of domestic resources. The goal of the Czech Republic is to remain self-

5. Co-generation refers to the combined production of heat and power.

sufficient in electricity consumption and to have sufficient generation adequacy; it is no longer a goal to have surpluses and to be a large electricity exporter. The TSO ČEPS will remain state-owned, and the government is seeking to maintain its majority share in the Czech Republic's largest electricity utility, ČEZ.

The government aims to keep electricity costs at affordable levels for households as well as industry in order to preserve the competiveness of the economy and in order to ensure social sustainability. The government has thus set the goal to keep electricity prices below the average of the EU-28. Furthermore, the aim is to keep the ratio of household energy expenses to total expenses below 10%.

The SEP aims at an integrated European energy market with minimal market distortions. In this regard, the Czech Republic has made an important step forward with the introduction of the 4M MC including the Slovak, Hungarian and Romanian electricity markets. This has improved price stability in the region. Market coupling with the rest of the European regions, notably with the North West Europe region, remains a priority.

The Czech Republic has a very high share of relatively inflexible generation capacity such as nuclear and lignite. Furthermore, the country has developed large volumes of solar PV but a very limited amount of gas-fired capacity. Countries that have experienced rapid renewables deployment, such as the Czech Republic, can benefit from the flexibility potential elsewhere, provided that enough interconnector capacity is available. Nonetheless, this approach cannot work if all countries adopt the same approach. There is a need, therefore, to integrate the intraday and balancing markets, as well as some system services within the region. Within the Czech Republic, there is a need to review the balancing arrangements and the role of demand-response.

Major power flows in Central Europe, including loop flows, originating in Germany, in the north-south direction through the Czech Republic and Poland, are among the drivers of the need for enhanced operational co-ordination, financial settlement and infrastructure investment in Central Europe. In the case of the Czech Republic, which has the highest level of interconnection capacity within the Central European region, its transmission capacity is reduced at times because of loop flows originating mostly from Germany and flowing via Poland to the Czech Republic. Furthermore, the expansion of wind capacity in northern Germany is likely to place further constraints on its transmission grid. In order to address these problems, Germany is undertaking a substantial programme of investment in its transmission system. Simultaneously, the Czech TSO is taking necessary steps to improve the situation including the construction of phase-shifting transformers that control electricity flows while Germany has proposed to increase the financial compensation included in the inter-TSO compensation mechanism.

With regard to market distortions it is to be welcomed that the Czech Republic will revise the network tariff systems to reflect the costs of the network. The government should use the opportunity also to review other energy taxes and charges for possible distortions to price signals that would hinder electricity markets to work efficiently.

The investment climate for investment in new capacity can to some extent be influenced by an appropriate regulatory framework. Low electricity prices in the Czech Republic and elsewhere may not send sufficient price signals to potential investors in electricity generation capacity, most notably gas-fired generation. The establishment of a special Construction Office at the MIT sends a important signal to prospective investors and also improves the investment conditions in those areas the government can effectively control.

Despite the liberalisation progress over the past decade, the market concentration in generation capacity remains high. State-owned ČEZ holds around 60% of generating capacity, although market concentration has declined since the last in-depth review. There is no evidence of abuse of the dominant position as access to interconnector capacity and imports from other national markets sustain a high level of competition. While this may hold true in the day-ahead market, this may not be the case in other product markets, e.g. for long-term contracts and in the balancing markets. Although it is worth noting that the concentration of ČEZ in the market for AS (frequency control) is lower than its share of installed capacity. Nonetheless, the regulators should remain vigilant.

In the retail market, the consumer can choose from a large number of suppliers. Consumer switching rates have been high, reaching more than 2 million between 2003 and 2014. Nevertheless, around 80% of the electricity customers in the Czech Republic are served by the three biggest retailers. The duration of end-user supply contracts and other cumbersome contractual arrangements alongside lengthy switching processes should be examined in greater detail. For example, the EU directive states that the customer switching period should not last more than three weeks, i.e. 15 working days. In the Czech Republic, the switching process itself takes 10 days but only after a 90-day (three months) notice period, which has the effect of extending the switching period to up to 100 days. This notice period should be shortened as soon as possible.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Improve flexibility of the electricity market, in both supply and demand, by strengthening the role of price signals, for example, in the balancing system to enable more efficient, automatic responses to potential market imbalances and minimise the need for TSO intervention.*
- ☐ *Regularly review the appropriateness of the targeted primary energy mix in the electricity supply and the country's position as a net exporter of electricity, taking into consideration economic impacts, consequences for security of supply, potential transmission constraints and the need for more flexible generation capacities with increasing shares of renewable energies in the Czech Republic and abroad.*
- ☐ *Remove any possible negative signals to potential investors arising from the Czech government's dominant position in the generation market.*

References

ACER/CEER (Agency for the Co-operation of Energy Regulators and the Council of European Energy Regulators) (2015), *Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2014*, ACER/CEER, Ljubljana/Brussels.

EC (European Commission) (2014), *EU Energy Markets in 2014*, EC, Brussels.

ERO (Energy Regulatory Office) (2015), *National Report of the Energy Regulatory Office on the Electricity and Gas Industries in the Czech Republic for 2014*, ERO, Prague.

IEA (International Energy Agency) (2016a), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2016b), *Electricity Information 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2016c), *Energy Prices and Taxes 2016,* Q1, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2011), *Technology Roadmap: Smart Grids*, OECD/IEA, Paris.

IPA (2015), *Final Report: Ranking the Competitiveness of Retail Electricity and Gas Markets at the National Level in Member States of the European Union and in Norway*, IPA Advisory Limited for ACER, London.

OTE (2016), *Year Report on the Electricity and Gas Markets in the Czech Republic for 2015*, OTE, Prague.

7. NUCLEAR ENERGY

Key data (2015 estimated)

Number of reactors: six nuclear units at two sites

Installed capacity: 3 924 MW

Electricity generation: 26.8 TWh, +8.5% since 2005

Share of nuclear: 17.2% of TPES and 32.5% of electricity generation

OVERVIEW

Nuclear energy plays an important role in the Czech electricity mix, and the government’s commitment to the future of nuclear energy is strong. The 2015 State Energy Policy (SEP) is explicitly part of the country's commitment to a European Union (EU) target for cutting carbon emissions. The main purpose of the SEP is to ensure reliable, secure and environment-friendly energy supplies at acceptable prices.

In association with the SEP, a National Action Plan for the Development of Nuclear Energy in the Czech Republic (NAP NE) was approved on 3 June 2015. Its objective is to ensure the option of future development of nuclear energy by preserving competencies and technologies. This involves preparations for the siting and construction of one unit at each nuclear power plant (NPP) site, with the possibility of the construction of two units at each site in anticipation of the closure of currently operating units in Dukovany within two decades.

In January 2016, the government also initiated a new committee led by the Minister of Industry and Trade to co-ordinate the development of nuclear power in the country. The committee will be responsible for the co-ordination of new construction, the supply chain, wastes and legislation to move the nuclear sector forward.

Nuclear is expected to become the main source of electricity production with its share rising from present level, 32.5% in 2014, to between 46% and 58% in 2040.

SUPPLY

Nuclear energy supply in the Czech Republic was 7.0 million tonnes of oil-equivalent in 2015, accounting for 17.2% of total primary energy supply. Nuclear energy is used in electricity generation, producing 26.8 terawatt-hours of electricity in 2015 (32.5% of the total). Since 2005, electricity generation from nuclear has increased by 8.5% while total electricity generation has increased only 0.8% over the same period. Consequently, the share of nuclear increased from 30.2% in 2005, offsetting decreasing use of coal in power generation. Of the 16 International Energy Agency (IEA) member countries with nuclear energy in the electricity generation mix, the Czech Republic ranks seventh in terms of the share of nuclear in the energy mix.

CAPACITY

There are two NPPs with six operating pressurised water reactors (Table 7.1). Four reactors are located at the Dukovany plant and two are located at the Temelín plant. All of the NPPs are operated by the ČEZ Group (referred to here as ČEZ), a multinational group operating utilities throughout Eastern Europe and Turkey. At the end of 2014, the Czech Republic by means of the Ministry of Finance owned nearly 70% of the group's capital.

Nuclear power capacity in 2014 was 3 924 megawatts electrical (MW_e): Dukovany 1 878 MW_e and Temelín 2 046 MW_e. All Dukovany and Temelín units have undergone uprates in the past ten years, and further uprates are under consideration.

Table 7.1 Nuclear units in operation in the Czech Republic, 2014

Unit	Net capacity[1] (MW_e)	Design net capacity[2] (MW_e)	Gross electrical capacity[3] (MW_e)	Thermal capacity[4] (megawatts [MW])	Commercial operation	Years of operation	Licence to
Dukovany 1	468	420	500	1 444	1985	30	2025*
Dukovany 2	471	420	500	1 444	1986	29	2016**
Dukovany 3	468	420	500	1 444	1986	29	2017**
Dukovany 4	471	420	500	1 444	1987	29	2017**
Temelín 1	1 023	912	1 080	3 120	2002	13	2020
Temelín 2	1 023	912	1 080	3 120	2003	12	2022
Total	3 924	3 504	4 160	12 016	-	-	-

Source: International Atomic Energy Agency (IAEA) (2015), *Power Reactor Information System*, IAEA, Vienna.

* Dukovany 1 has a conditional licence for non-specified period.

** Dukovany 2 entered the licence renewable process in 2016 and Dukovany 3 and 4 are expected to be renewed in 2017.

[1] The maximum (electrical) power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions. It is measured at the unit outlet terminals, i.e. after deducting the power taken by unit auxiliaries and the losses in the transformers that are considered integral parts of the unit.

[2] The unit electrical output after deducting the self-consumption power assumed by the original unit design, no matter if it has ever been routinely achieved during operation. This value does not reflect possible power changes during subsequent operation.

[3] The maximum (electrical) power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions. The gross electrical power is measured at the output terminals of the turbine generator.

[4] The reactor thermal power is the net heat transferred from the fuel to the coolant.

The original capacity at Dukovany was 1 760 MW_e (four by 440 MW_e). All four Dukovany units were uprated from 440 MW_e to 456 MW_e between 2005 and 2008 by replacing low-pressure turbines. Further uprates of units 3 and 4 were implemented from improved fuel, replacing the high-pressure turbine, refurbishing the generator, and instrumentation and control changes. Similar uprates of units 1 and 2 followed, all completed by the end of 2012, reaching 1 878 MW_e of capacity in total. An upgrade of the Temelín units began in 2013, which resulted in an increase in the capacity of each block from 1 000 MW_e to 1 023 MW_e in 2015.

The lifetime of the four Dukovany units was extended by ten years, with the first closure due in 2025. ČEZ is reviewing plans to extend the lifetimes by an additional 20 years.

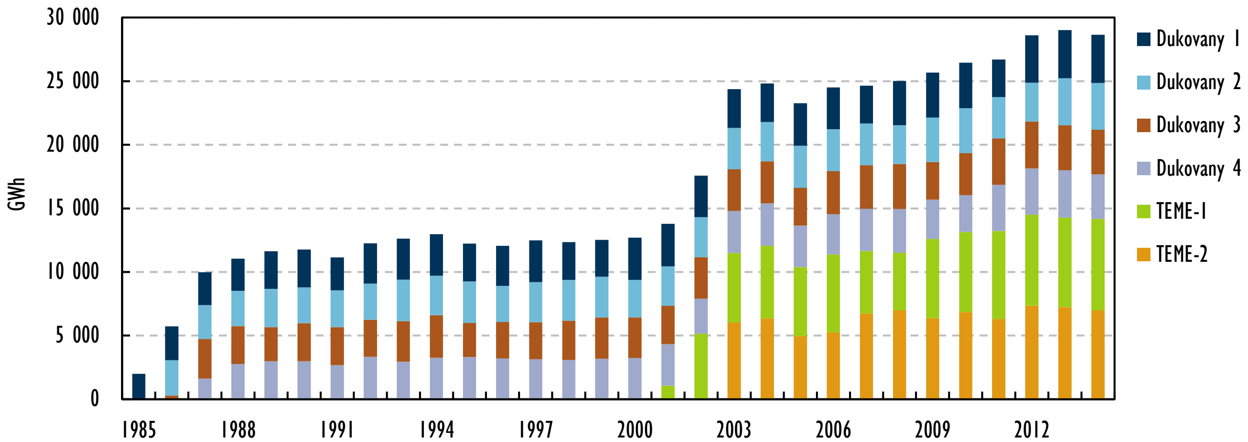
The Czech government publicly declared the country's intention to build two nuclear units – one in Temelín and one in Dukovany. New nuclear capacity of 2 500 MW_e is to be added by 2035, and more thereafter. The government sees that Dukovany 5 has priority over Temelín 3.

Table 7.2 Planned and proposed reactors, 2015

Unit	Estimated capacity (MW_e)	Construction start	First power generation
Dukovany 5	1 200	late 2020s	by 2035
Temelín 3	1 200	-	by 2035
Planned (2)	**2 400**	**-**	**-**
Temelín 4	1 200	-	-
Dukovany 6	1 200	-	-

Source: World Nuclear Association (2016) *Nuclear Power in Czech Republic*, World Nuclear Assocation, London www.world-nuclear.org/information-library/country-profiles/countries-a-f/czech-republic.aspx, last accessed 1 October 2016

Figure 7.1 Electricity supply from six operating NPPs, 1985-2014



Note: GWh = gigawatt hours.

Source: IAEA (2015), *Power Reactor Information System*, IAEA, Vienna.

RECENT AND ANTICIPATED POLICY DEVELOPMENTS

There was much discussion about building new NPPs in the Czech Republic between 2010 and 2015. In March 2010, ČEZ announced that negotiations had begun with three candidate NPP providers:

- a consortium led by Westinghouse/Toshiba with the AP1000 plant design of 1 140 MW_e (net)
- a consortium led by Škoda/Atomstroyexport/Gidropress with the water-water energetic reactor VVER-1200 of 1 078 MW_e (net) with Russian financing
- Areva with the European Pressurised Reactor (EPR) of 1 650 MW_e (net).

Bids were formally invited by ČEZ in October 2011 for the supply of two nuclear power units on a "turnkey basis, including nuclear fuel supply for nine years of operation." Bids were submitted in July 2012, and the contract was to be signed in late 2013, but was then deferred to mid-2015 following completion of the SEP and the NAP NE, in which implementation steps and roles of the Czech government are described as follows:

- regulation in the field of nuclear safety through the State Office for Nuclear Safety (SONS)[1]
- ensuring a long-term sustainable infrastructure necessary for construction
- the decommissioning of nuclear installations and the disposal of nuclear waste of all categories, both from nuclear power and from nuclear research, medicine and industry through the Radioactive Waste Repository Authority
- research in the field of nuclear power or learning and education primarily through the Nuclear Research Institute at Řež.

The previous government was planning to create a contract-for-difference programme for electricity from Temelín Units 3 and 4. This would cover the difference between market electricity prices and the cost of construction and operation. The Ministry of Industry and Trade (MIT) wanted this included in the SEP, but it was opposed by the Ministry of Finance, and the prime minister of the coalition government opposed any price guarantees. In April 2014, following government confirmation that it would not provide any price guarantees, ČEZ informed bidders that it had cancelled the procurement process in accordance with the public procurement law.

The SEP anticipates one new unit (between 1 200 MW_e and 1 700 MW_e gross) at Dukovany, and possibly three more at the two sites. It recommends that ČEZ create a subsidiary company to prepare construction plans and explore options for financing the new build, even though the first might not be approved until 2025. There are three construction organisation options: 1) plants would be built by ČEZ or a wholly owned subsidiary of ČEZ; 2) plants would be built by international consortiums, with or without ČEZ participation; or 3) the Czech ministries would form a state-owned enterprise to build the plants, then lease or sell them to ČEZ. To ensure local content, the government would prefer ČEZ as a favoured investor. Whoever builds the units, they must secure financing of approximately CZK 125-150 billion (EUR 4.5 billion to EUR 5.4 billion), with allowance for a second unit at each site. The feasibility study for a new reactor at Dukovany is in progress, and ČEZ is preparing for an environmental assessment at the site. The NAP NE envisages that construction permits would be gained/approved before 2025.

REGULATORY AND LEGAL FRAMEWORK

The general act governing all forms of nuclear energy activities is the Act on Peaceful Utilisation of Nuclear Energy and Ionising Radiation. The act, usually referred to as the Atomic Act, was adopted and entered into force in 1997. It has undergone numerous amendments.

1. SONS is a governmental body as stipulated by Act. No. 2/1969 Coll. SONS is headed by a chairperson who is appointed by the government of the Czech Republic.

According to the Atomic Act, primary responsibility for nuclear safety and radiation protection of nuclear facilities resides with the operator, while supervisory functions and competencies fall under the jurisdiction of SONS. Thus, ČEZ is accountable for the safe construction, operation and decommissioning of nuclear plants, as well as for radioactive waste management under SONS regulation.

The national regulatory body, SONS, has issued 19 decrees related to the Atomic Act that are constantly updated to achieve harmonisation with international requirements and recommendations. Further, SONS co-operates with the International Atomic Energy Agency (IAEA) and the European Commission in the field of safeguards. Inspectors from the IAEA and the European Commission, accompanied by those from SONS, are authorised to inspect nuclear material and accounting and control systems, to ensure the fulfilment of the Euratom Treaty and related treaties and conventions listed below. SONS has legal competency to negotiate international treaties both between governments (in co-operation with the Ministry of Foreign Affairs) and between regulatory bodies. It has the power to propose to the cabinet accession to international conventions. The most important international conventions signed and ratified by the Czech Republic in the nuclear field include the following:

- the Convention on Nuclear Safety
- the Joint Convention on the Safety of Spent Fuel Management and Waste Management
- the Convention on Early Notification of a Nuclear Accident
- the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency
- the Treaty on the Non-Proliferation of Nuclear Weapons
- the Convention on the Physical Protection of Nuclear Material
- the Comprehensive Nuclear Test Ban Treaty
- the Convention on Civil Liability for Nuclear Damage.

According to the Atomic Act, SONS is the legally competent body for granting licences to nuclear operators. SONS inspectors appointed by its chair verify whether licensees are adhering to the licence conditions and the act's provisions. In case of non-compliance, SONS can enforce remedial actions, amend or even revoke a licence. Inspectors are permanently present at the Dukovany and Temelín plants. Also supervised by SONS are facilities such as the three research reactors, the spent nuclear fuel (SNF) interim storage facility and the low-level radioactive waste repository.

MIT develops national legislation and intergovernmental treaties in the nuclear field, proposing government strategies and policies. The Ministry of the Environment regulates nuclear activities to ensure compliance with environmental laws, including the application of the environmental impact assessment procedures, as a prerequisite for a nuclear licence. The Ministry of the Interior is responsible for establishing details of regional crisis plans and emergency plans.

The Atomic Act incorporates third-party liability provisions in accordance with the Vienna Convention under which the nuclear operator must bear responsibility for damages caused to any third party. In 2009, this liability was increased to CZK 8 billion (EUR 300 million) per nuclear installation and CZK 2billion (EUR 80 million) for other facilities, including transport. The nuclear operators must be insured for liability. To cover these liability claims, a nuclear insurance pool was established in 1995. The government is obliged to compensate for amounts exceeding insurance coverage.

More importantly, in 2009, the Nuclear Safety Directive provided the first European Council framework for the safety of nuclear installations, making the major international nuclear safety principles legally binding in all member states. (Council Directive 2009/71/EURATOM of 25 June 2009 established an EU framework for the safety of nuclear installations.) It requires member states to establish and maintain a national legislative, regulatory and organisational framework governing the safety of nuclear installations and recognises the prime responsibility of licence holders for nuclear safety, under the supervision of the competent authorities. The implementation of this directive is supported by the European Nuclear Safety Regulators' Group (ENSREG).

Following the accident at Fukushima Daiichi Units 1-4 in March 2011, the European Council of 24-25 March 2011 requested a review of safety at all EU nuclear plants on the basis of comprehensive risk and safety assessments, "stress tests", defined as transparent and targeted assessments of NPP safety margins developed by ENSREG under the direction of the European Commission. The ENSREG, in co-operation with the Western European Nuclear Regulators' Association, was tasked with implementing the stress tests of both operating NPPs and SNF storage facilities. The stress tests focused on applying lessons learned from the Fukushima Daiichi accident to three areas:

- natural initiating events, including earthquakes, floods and extreme weather events
- the loss of safety systems or electrical power (including a station blackout)
- severe accident management, including methods to avoid and to manage 1) the loss of reactor core and SNF storage pool cooling; and 2) containment integrity.

The stress tests were conducted in a three-step process:

- All NPP operators were required to review the response of their plants to extreme situations and to make proposals for safety improvements.
- The national nuclear regulators conducted independent reviews of the operators' assessments, and issued requirements and summary national reports.
- The final national reports were reviewed by peer review teams, set up by ENSREG.

The final ENSREG report concluded that four main areas should be improved at the EU level. These were; increase consistency in the assessment of natural hazards, increase regular assessments of the implementation of safety measures, increase preventive measures, including the protection of mobile equipment and emergency response centres against extreme natural hazards and contamination and increase the availability of rescue teams and equipment to support operators and local first responders.

On 31 October 2011, ČEZ (in consultation with the Nuclear Research Institute at Řež and the Czech Technical University in Prague) submitted its final reports on stress tests conducted at Dukovany and Temelín, which confirmed the NPPs are resistant to natural hazards (e.g. earthquake, floods and temperature extremes) and did not reveal any safety problems that would require immediate action. After their NPP reviews, SONS submitted a national report to the European Commission.

Although shown to be safe, Dukovany and Temelín units will be equipped with more backup power supply sources, including additional mobile diesel generators, as well as more hydrogen recombiners to prevent hydrogen from accumulating to explosive levels. These measures became a part of the Long-Term Operation Plan for Dukovany.

The results of the stress tests were announced on 4 October 2012. All EU countries with NPPs, as well as Switzerland and Ukraine, conducted stress tests and participated in peer reviews. The peer reviews concluded that all countries had taken important steps to improve the safety of their plants. Recommendations were also made to strengthen safety at many operating reactors, including: installing (or improving) on-site seismic instrumentation and filtered containment venting systems; storing equipment for accidents in secure, easily accessible locations; and installing a backup emergency control room.

NUCLEAR FUEL CYCLE INCLUDING URANIUM PRODUCTION

The European Commission presented in May 2014 the European Energy Security Strategy (EC, 2014a) together with an evaluation of security of supply in the European Union and raised concerns about the foreign supply of nuclear fuel (EC, 2014b). At the same time, it concluded that nuclear fuel cycle facilities in member states (conversion, enrichment and fuel fabrication) provide sufficient capacity for the production of nuclear fuel to assure nuclear fuel supplies for all but the Russian-designed reactors.

With the last operating uranium mine in the European Union in the Czech Republic, domestic resources played a substantial role until the 1990s in meeting domestic uranium demand. Annual natural uranium requirements in the Czech Republic are approximately 680 tonnes, requiring 410 000 kilogrammes separative work units (kg-SWU), a measure of the amount of separation work, measured in kilogrammes, to increase, i.e. “enrich”, the percentage of radioactive uranium, U-235, from about 0.7% in natural uranium, primarily made up of U-238, to about 3.6% for VVER-440s and 4.4% for VVER-1000.

Up to 2010, cumulative production was about 111 000 tonnes of uranium (tU), peaking at about 3 000 tU/year in 1960 (NEA, 2006). However, production declined steadily to about 500 tU in 2000 to 250 tU/year since 2008 from the Dolní Rožínka mine. Although production activities were expected to cease in 2002, the closure has been repeatedly postponed and now Dolní Rožínka is scheduled to close in 2017. (There is no discussion of relying on domestic uranium in the SEP or in the NAP NE.) The cost estimate for mining remediation is approximately EUR 200 billion.

Different approaches have been applied with respect to procurement of uranium, conversion from uranium oxide to uranium hexafluoride (UF_6), the enrichment of UF_6, reconversion to uranous oxide, and nuclear fuel fabrication for the two plants. Most Czech fuel has been manufactured in the Russian Federation (hereinafter “Russia”). A contract for the supply of fuel for Dukovany was signed with the Russian company JSC TVEL before the Czech Republic became a member of the European Union. This was “grandfathered” by the Euratom Supply Agency. Fuel was initially purchased as a “partial bundle”, including conversion and enrichment services, while ČEZ supplied uranium concentrates purchased from the domestic production. Until 2002, uranium needs for the reactors at the Dukovany site were fully covered by domestic sources. Today, because production has decreased, a growing portion of fuel is being purchased from TVEL as a “complete bundle” (including uranium).

Fabrication of fuel for the reactors at the Temelín plant was provided by Westinghouse, while uranium and related processing services were procured based on long-term contracts with a diversified portfolio of suppliers. However, TVEL was selected to replace Westinghouse in 2010 in fabricating fuel for the Temelín plant. On the other hand, ČEZ has signed enrichment contracts for fuel with Areva of France to ensure some diversification of the fuel supply.

NUCLEAR WASTE AND DECOMMISSIONING

Regarding the management of nuclear waste from the nuclear fuel cycle and decommissioning in 2011, the EU nuclear waste management policy was strengthened with the adoption of Directive 2011/70/Euratom, establishing an EU framework for the safe management of SNF and radioactive waste, based on advice from the ENSREG and expert groups of the Euratom Scientific Technical Committee. (The term "decommissioning" is defined by national regulations, and hence differs from country to country; here "decommissioning" refers to "decontamination and demolition," D&D, hence the terms "decommissioning" and D&D will be used interchangeably.) The directive is based on the "polluter pays principle," which ensures that future generations will not be burdened by current waste streams, placing the responsibility on member states to manage and dispose of these wastes. All EU member states were to bring their laws and regulations into compliance with the directive by August 2013. Member states' reports on the implementation of the directive are to be submitted to the European Commission by August 2015 (Czech Republic, 2015). Further, the directive affirms:

- That the primary responsibility of managing waste lies with the producer of the waste under licence from a national regulatory authority.
- That the safety of managing this waste is under the appropriate national regulatory authority.
- Public participation in decision making.

Member states are in various stages of implementing their national programmes. EU member states have low- and medium-level radioactive waste disposal facilities; however, there is not yet a single final repository for high-level radioactive waste produced in the European Union. Some member states plan geologic repositories to be opened by 2030. However, owing to economies of scale, regional waste disposal sites could be less costly than national waste disposal sites, in particular for countries with small nuclear programmes, as informally discussed in the European Nuclear Energy Forum (ENEF). However, this will have to overcome the legal hurdle of import/export of radioactive waste. ČEZ as a nuclear plant operator is required to put aside funds for waste disposal (equal to CZK 1.5 billion), which is accumulated with the Czech National Bank at a rate of CZK 50 per megawatt-hour (MWh) (EUR 1.80/MWh).

The Atomic Act and its implementing decrees form the legislation framework for all SNF and radioactive waste management activities, including the provision of a radioactive waste categorisation (Decree No. 307/2002 Coll.). The policy adopted by the Czech government in 2002 also referred to as the Radioactive Waste Management Concept (Resolution No. 487/2002) identifies objectives, priorities and roles of various organisations and interest groups in relation to the generation and management of radioactive waste and SNF.

The Czech government is responsible for guaranteeing the safe disposal of all radioactive waste, including monitoring and supervision of repositories after their closure. For this purpose, MIT established the Radioactive Waste Repository Authority (RAWRA) in 1997, funded through fees imposed on generators of radioactive waste. In compliance with international principles, these waste generators are required by Governmental Order No. 416/2002 to bear all the costs of radioactive waste management from production to disposal, including the cost of monitoring repositories after their closure and the cost of the associated research and development (R&D). Funds are accrued in the Nuclear Account, lodged with the Czech National Bank and managed by the Ministry of Finance. As part of the governmental assets and liabilities, the fund may be used only for tasks specified in the Atomic Act through the intervention of RAWRA.

Short-lived low- and intermediate-level waste (LILW-SL) constitutes the largest volume of radioactive waste, with activity decaying to low levels after 200 to 300 years. Hence, this type of waste can be deposited in near-surface repositories, by adopting processing and disposal techniques that are well developed. A LILW-SL disposal facility is located on the Dukovany site for the disposal of operational waste produced by both the Dukovany and the Temelín nuclear power stations. Two facilities have been designated for the disposal of institutional waste, generated by industry, research and medical activities: the Richard disposal facility, located near the town of Litoměřice; and the Bratrství disposal facility, located in a former uranium mine near the town of Jáchymov.

High-level waste (HLW) and SNF represent the most hazardous category of radioactive waste, although the volume of this category of waste is low, amounting to less than a tenth of the volume of all radioactive waste generated in the Czech Republic. The levels of long-lived radionuclide activity and concentrations are high, requiring long-term disposal in a deep geologic repository. In the interim, following temporary storage at reactor pools, ČEZ has adopted a concept of dry storage in dual-purpose transport/storage containers, to be kept on the premises of the plants and continuously monitored. Since March 1997, a 600-tonne interim dry storage facility has been operating on the Dukovany site. This has been recently extended with the addition of a new dry storage facility of 1 340 tonne capacity. At Temelín, the initial storage capacity was sufficient for nine years of operation and is currently being expanded with the construction of a new dry storage facility. This additional capacity was approved by the Minister of the Environment in November 2005 and has been completed. SNF from research reactors is stored at the Nuclear Research Institute at Řež.

Fuel is stored by the NPP owner/operator in dry interim storage for approximately 80 years. However, in the longer term, the final storage of SNF and radioactive waste management will be in a national deep geologic repository (DGR). Since 1993, activities to implement a DGR have continued to be developed step by step, as follows:

- selection of candidate sites and the structure of the engineered barrier system
- proposal of the final site and corresponding design of the engineered structures
- confirmation of the safety of the DGR by safety analysis
- construction, operation and closure of the DGR.

It is expected that a DGR will be constructed in granitic rock formations. Based on geologic data, 30 potential locations were initially identified in the Czech Republic. With RAWRA having completed the regional mapping phase, seven candidate sites were selected for further study. The availability of a geologic repository is expected after

2065. According to the Radioactive Waste Management Concept, a final location should be chosen by 2025 (delayed from 2010's target of 2015) with commissioning activities of the repository starting in approximately 2065.

Containers are currently being designed for the direct disposal of SNF or processed high-level waste. Insulation materials are being analysed and will be ultimately selected based on geologic and hydrogeologic conditions at the identified site.

The Czech government recognises that public involvement in the DGR site selection process is very important. According to its Programme Proclamation, the government's search for a geologic repository for SNF will be carried out in a transparent manner (Government Decree No. 44 of 17 January 2007). The agreement of the respective communities will be required. In an attempt to raise public acceptance, RAWRA members provide technical information to each affected community, as well as financial incentives.

Although the Czech Republic is in the process of selecting a geologic SNF repository site, as the possibility of shared disposal facilities is increasingly discussed in international forums, the Czech government does not rule out the option of high-level waste and SNF disposal in an international regional repository. If such a project became feasible in the future, the knowledge acquired in the development of a deep geologic repository in the Czech Republic would be valuable for its realisation.

Under the provisions of the Czech Atomic Act, licensees are obliged to make financial provision for the decommissioning of nuclear facilities. Funds must be available at the required time for decommissioning preparation and activities in an amount commensurate with the methods proposed by the licensee and approved by SONS. The estimated cost of decommissioning is verified by RAWRA and licensees are obliged to update their evaluation every five years.

In 2013, ČEZ estimated that the cost of decommissioning the four Dukovany units would be CZK 22.4 billion and the cost for the two Temelín units, CZK 18.4 billion. These funds are accumulated in an earmarked fund within the ČEZ internal accounts. As of 31 December 2014, these funds were CZK 22.7 billion. These can be compared with the decommissioning of a set of VVERs in the Slovak Republic: the EU International Decommissioning Support Fund for the decommissioning of the Bohunice V1 plant (two VVER-440s/V-230s). In 2012, the Slovak Republic started decommissioning the Bohunice V1 reactors. It has been estimated that the decommissioning will be completed by 2025 at a total cost of approximately EUR 1.1 billion.

R&D AND HUMAN RESOURCES

With respect to the continuous advancement of nuclear technologies, the Czech Republic's engagement in international programmes is recognised as important. Czech organisations, and notably the Nuclear Research Institute at Řež, have been involved in the R&D of advanced and new-generation reactor systems, including, among others, research activities on advanced high-temperature reactors, fast reactors (with sodium, helium and lead-bismuth coolants) and the molten salt reactor. Recently, a new large R&D facility has been built at Řež to simulate nuclear reactor loops. The project is funded by the European Union under the umbrella of the Sustainable Energy programme, promoting regional R&D centres. The strategic tasks outlined in SEP are to focus on smart grids, electricity storage and nuclear technology in the context of Government Resolution No. 552 of the national priorities on research, experimental development and innovation.

Research institutions and universities have been engaged in activities covered by various Euratom programmes. The Czech Republic is also a member of the IAEA International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). The SEP encourages expanding this already established involvement of the Czech Republic in such international frameworks.

The Czech Republic shares with other countries a growing scarcity in human resources stemming from the ageing of the current workforce and emerging gaps resulting from the stagnation in nuclear research. The safe design, operation and regulation of nuclear systems can be achieved only with sufficient and competent staff. ČEZ has been engaged in several initiatives and education programmes with schools to raise the awareness and level of information of young people on scientific and technological matters in general, and on topics related to energy sources and power generation, nuclear power, in particular. Further encouragement of educational programmes and enhancement of co-operation among research centres, academia and industry by the government should help to encourage young professionals into nuclear careers and increase technical awareness and competencies.

ASSESSMENT

The European Commission presented in May 2014 the European Energy Security Strategy (EC, 2014a), together with an evaluation of security of supply in the European Union, and raised concerns about the foreign supply of fuel (EC, 2014b). At the same time, it concluded that nuclear-fuel cycle facilities in member states (conversion, enrichment and fuel fabrication) provide sufficient capacity for the production of nuclear fuel to assure nuclear fuel supplies for all but the Russian-designed reactors. It proposed actions in five primary areas, including increasing EU electricity capacity, while diversifying energy supply with nuclear capacity in those member states, where safe nuclear power is an electricity generating option. To increase electricity reliability in the European Union 1) in the short and medium term (before 2030), NPP lifetimes could be extended with upgrades and uprates; and 2) in the medium and long term (after 2020), new NPPs could be constructed.

Nuclear energy plays an important role in the Czech energy mix. Future expansion of nuclear capacity has been presented as one of the major pillars of the SEP that strongly supports independence and security of supply through maximum use of domestic primary resources.

The average availability factor at the Dukovany plant has consistently been around 90% in recent years, reflecting an unplanned loss factor below the world average. Efficiency has also been enhanced through programmes of modernisation and upgrading carried out at the Dukovany and Temelín plants in recent years. These have improved operational and safety indicators and will create the conditions necessary for the potential life extension of the Dukovany units. The technical and safety performance of the nuclear units in operation at Dukovany is satisfactory, according to the IAEA and other international bodies.

To ensure security of supply and reduce emissions of greenhouse gases and solid pollutants, the Czech government envisages the construction of additional reactors in the SEP. The key operator ČEZ decided to build new nuclear facilities at Temelín and launched, in August 2009, a public tender to select a contractor for the construction of two nuclear units of advanced pressurised-water designs.

The development of additional nuclear facilities will, in the first place, be aimed at replacing thermal power plants at the end of their lifetime. The role of the regulator and the Office for the Protection of Competition will continue to be central in monitoring market developments, as ČEZ already has a dominant position in the Czech electricity market.

While some of the Czech Republic's neighbours have nuclear facilities or are considering their development, other countries in the European Union either do not have nuclear plants or are considering shutting them down. In this environment, the Czech Republic should consider supporting co-operation among governments and system operators at the regional level to avoid excess capacity over the longer term. Regional co-operation could also be encouraged with regard to radioactive waste storage/repository facilities.

The government has important responsibilities in ensuring the safe and secure deployment of nuclear systems throughout their life cycle, including 1) obligations with respect to nuclear safety; 2) R&D and necessary educational and legal frameworks; and 3) decommissioning and radioactive waste management. At the political level, a consistent approach to developing a safe nuclear programme is needed to maintain public acceptance, especially for those living near a nuclear facility. Efforts to hold public meetings and debates with all the interested stakeholders at the national and local levels should be continued.

According to a recent public opinion survey, 77% of the population is in favour of using nuclear energy. This is an impressive share at the country level, but it is also reported that there is a high public resistance among people living near candidate sites for future radioactive waste repository facilities. The continuous and transparent involvement of the population, in particular in local communities, is a prerequisite for a fair, effective and successful process of siting a DGR. RAWRA has made efforts to communicate with the public and promote the dissemination of information. These efforts, however, have not been sufficient, and public resistance in communities near proposed sites remains high. The government should continue to enhance the involvement of local communities, and consideration should be given to providing incentives.

Czech law requires yearly transfers are to be made to the Nuclear Account by ČEZ and other radioactive waste generators to finance the future development of a permanent high-level radioactive waste repository. However, because cost estimates for the facility have changed over time, it is important that the government regularly monitor these provisions to ensure the adequacy of the Nuclear Account in covering the projected costs of waste management and final disposal of low-, intermediate- and high-level radioactive waste (HLW) and SNF, as well as the cost of decommissioning existing nuclear power plants. The government should continue to guarantee that the money dedicated to these long-term costs is not used for other purposes, even in case of financial difficulties. To be sustainable, i.e., where nuclear development meets the needs of the present generation without compromising the ability of future generations to meet their needs, radioactive generators should minimise the burdens of HLW and SNF on future generations.

Dolní Rožínka is the only uranium mine still operating in the Czech territory. Recent government legislation has decreed that DIAMO, the state-owned company responsible for mining activities, including the management of remediation programmes, should continue mining and processing uranium ore in the mine as long as it is economically feasible. Through DIAMO, the Czech government has continued the clean-up of closed uranium mines. Remediation programmes for the decontamination of polluted groundwater covers 19 closed mining sites and will require considerable effort over several decades (up to 2040). These activities need adequate funding, which should be planned and allocated over the long term and in a systematic manner. Prolonged, unproductive or costly programmes in the restoration of closed mines could have a negative impact on public opinion. The government should intensify its efforts to remediate closed uranium mines.

It is commendable that numerous high-level R&D projects are being sustained in nuclear fission technology, including generation III and IV reactors, notably in the Nuclear Research Institute, building on national strengths and capacities and engaging in prominent international programmes.

The safe design, operation and regulation of nuclear systems can be achieved only with sufficient and competent staff. The Czech Republic shares with other countries the growing problem of scarce human resources as the current workforce ages and emerging gaps result from the stagnation in nuclear research.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Work with ČEZ to ensure that all operating licences are renewed well before their expiration (based on, for example, five-year safety reviews) so that electricity system planning can proceed.*
- ☐ *Determine mechanisms of government support for the construction and operation of new nuclear power plants including the maximum levels.*
- ☐ *Choose a specific technology by 2020 so that permits can be approved by 2025, and construction can be completed before 2035. This process should involve a detailed analysis of the roles of the government and nuclear plant operators.*
- ☐ *Minimise the burdens of SNF and HLW on future generations, in all ways possible, given that a repository might not be available by 2065.*
- ☐ *Determine, with ČEZ, how each type of decommissioning waste will be managed, as well as update their D&D cost estimates based on these inventories and waste management strategies.*

References

IAEA (International Atomic Energy Agency) (2015), *Power Reactor Information System*, IAEA, Vienna.

Czech Republic (2015), *National Report under the Article 14.1 of Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste*, Czech Republic, Prague.

EC (European Commission) (2014a), *Communication from the Commission: European Energy Security Strategy, COM(2014) 330 Final*, EC, Brussels.

EC (2014b), *In-Depth Study of European Energy Security, Commission Staff Working Document, SWD (2014) 330*, EC, Brussels.

NEA (Nuclear Energy Agency) (2006) *Forty Years of Uranium Resources, Production and Demand in Perspective*, OECD Publishing, Paris.

World Nuclear Association (2016), *Nuclear Power in Czech Republic*, World Nuclear Assocation, London, www.world-nuclear.org/information-library/country-profiles/countries-a-f/czech-republic.aspx, last accessed 1 October 2016.

8. COAL

Key data (2015 estimated)

Production: 8.3 Mt of hard coal and 38.1 Mt of brown coal*

Net exports: 0.6 Mt of hard coal, -88.3% since 2005

Share of coal: 39.2% of TPES and 54% of electricity generation

Inland consumption (2014): 15.9 Mtoe (power generation 76.7%, industry 10.4%, other transformations 9.4%, residential 3.3%, commercial and public services and agriculture 0.2%)

* In International Energy Agency (IEA) coal statistics, brown coal comprises sub-bituminous coal and lignite, while hard coal comprises anthracite and bituminous coal.

OVERVIEW

Coal is the only significant indigenous energy resource in the Czech Republic. Alongside nuclear power, coal has been a sufficient and affordable source of electricity for decades and helped the country maintain a lower level of dependence on imported natural gas than many other Central European countries.

Since 2005, coal supply has fallen by 21.1%, contracting as a share of total primary energy supply (TPES) from 45% to 39.2% and of electricity generation from 63.8% to 54%. This steep decline of the coal share is partly a result of the government's decarbonisation policy adopted in 1991, which largely limited brown-coal mining activity in northern Bohemia on environmental grounds by establishing limits on mining activity in particular regions, thereby limiting the overall production. The government also developed incentives for users to replace coal with other fuels. Part of the decline was also caused by resource depletion in some locations. The State Energy Policy (SEP) projects a relatively large decrease in coal supply; it is expected that most of the energy from coal will be replaced with nuclear energy in the power sector.

SUPPLY AND DEMAND

SUPPLY

Coal supply of the Czech Republic was 16 million tonnes of oil-equivalent (Mtoe), in 2015. Coal represents 39.2% of TPES and 54% of electricity generation (44.6 terawatt hours [TWh]). Coal use in the Czech Republic peaked in 1984, supplying 34.9 Mtoe or 71.3% of TPES; it has gradually decreased up to now. Compared with other IEA member countries, the Czech Republic had the third-highest share of coal in TPES after Estonia and Poland in 2015.[1]

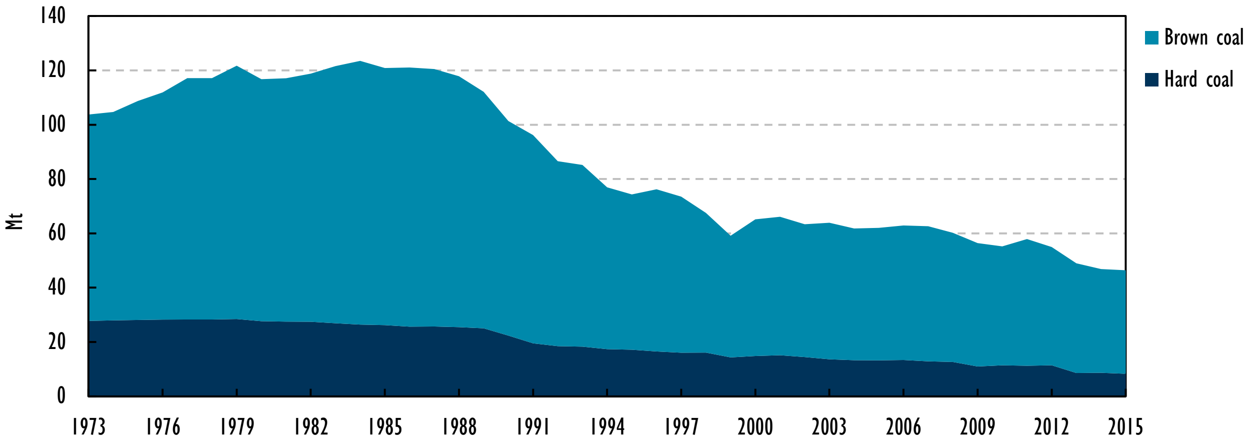
1. Estonia's oil share is counted as coal in IEA statistics.

Coal supply consists of domestic and imported coal. The country holds an estimated 57 Mt of hard coal reserves and 771 Mt of extractable brown coal reserves with an additional 900 Mt of extractable brown coal reserves that is non-accessible, the result of a binding territorial limit imposed by the government in 1991. Domestic mining production in current brown-coal mines will continue under the State Raw Materials Policy.

In 2015, coal made up 59.5% of the country's indigenous energy supplies at 46.4 Mt of coal (Figure 8.1). Coal production was 25.1% lower compared with 2005 and 54.5% lower compared with 1990, a year before the limits on coal mining were imposed. The continuing decline has been mainly driven by the government's long-term strategy for decreasing the significance of coal in total primary energy demand, natural depletion of mining resources, and recent oversupply and weak demand of coal shown both worldwide and within Europe. The influx of cheaper hard coal largely from the United States in recent years alongside an oversupplied seaborne market has further weakened the coal industry in the Czech Republic, as the initiation of support on shale-gas exploitation and use in the United States has reduced domestic coal consumers there.

Brown coal (lignite) production was 38.1 Mt in 2015, accounting for 82% of all coal produced, while the remainder was hard coal (8.3 Mt). Brown coal production was 21.9% lower in 2015 compared with ten years prior and correlates to domestic demand, mainly to the transformation sector, which consumes 90% of lignite supply. Hard coal production was 37.6% lower in 2015.

Figure 8.1 Brown coal and hard coal production, 1973-2015



Note: Data are estimated.

Source: IEA (2016a), *Coal Information 2016*, www.iea.org/statistics/.

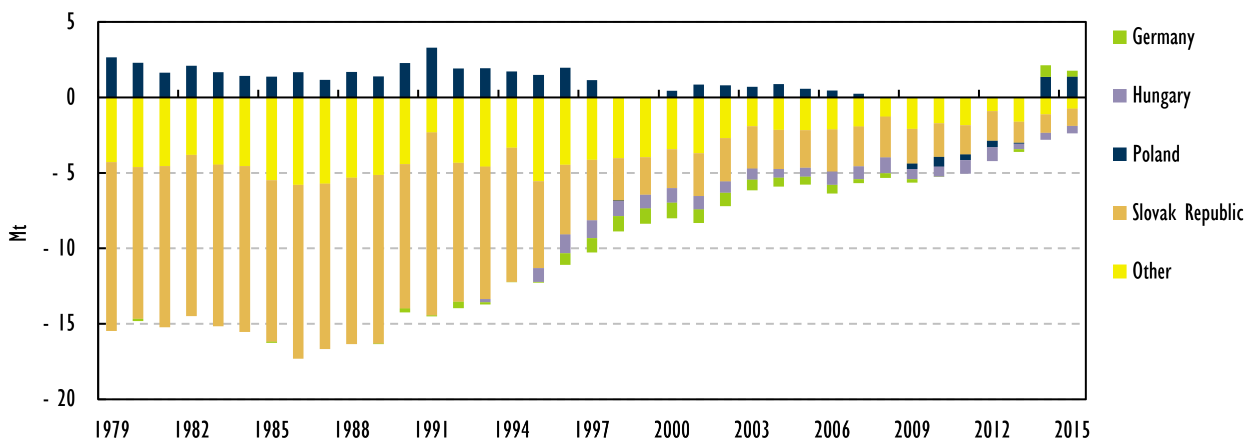
IMPORTS AND EXPORTS

The Czech Republic has been historically a net exporter of both hard coal and brown coal. In 2015, net exports amounted to 0.6 Mt (circa 1.5% of total coal supply), with 5.2 Mt of exports and 4.6 Mt of imports. The trend over the past ten years shows that imports have increased by 262% while exports declined by 20% over the same period (Figure 8.2).

Hard coal exports were 4.2 Mt in 2015, largely destined to nearby markets in Poland (41.1%), Austria (20.2%), the Slovak Republic (19.9%) and Germany (12.5%) with smaller volumes going elsewhere. Imports were 3.6 Mt in 2015, mainly from Poland (93.3%) and the United States (3.4%). In the recent past, hard coal exports to countries such as Poland, Slovak Republic and Austria have been declining. Unfavourable pricing conditions for coking coal in the Czech Republic have contributed to this trend. Prices for coking coal have collapsed and in 2015 were at their lowest level since the financial crises of 2008-09.

In 2015, brown coal imports were 1.0 Mt and exports were 0.9 Mt. Brown coal was imported from Germany (91%) and Poland (8.9%) while it was exported to the Slovak Republic (31.7%), Poland (30.8%) and Hungary (26%). The Czech Republic started importing brown coal from Germany following its acquisition of German lignite mining sites in 2009 to facilitate trans-border lignite deliveries. The Czech Republic was for the first time in the last decade a net importer of brown coal as a result of a surge in imports from Germany in 2013-14; Germany accounted for 84.4% of total brown coal imports.

Figure 8.2 Coal trade, 1973-2014



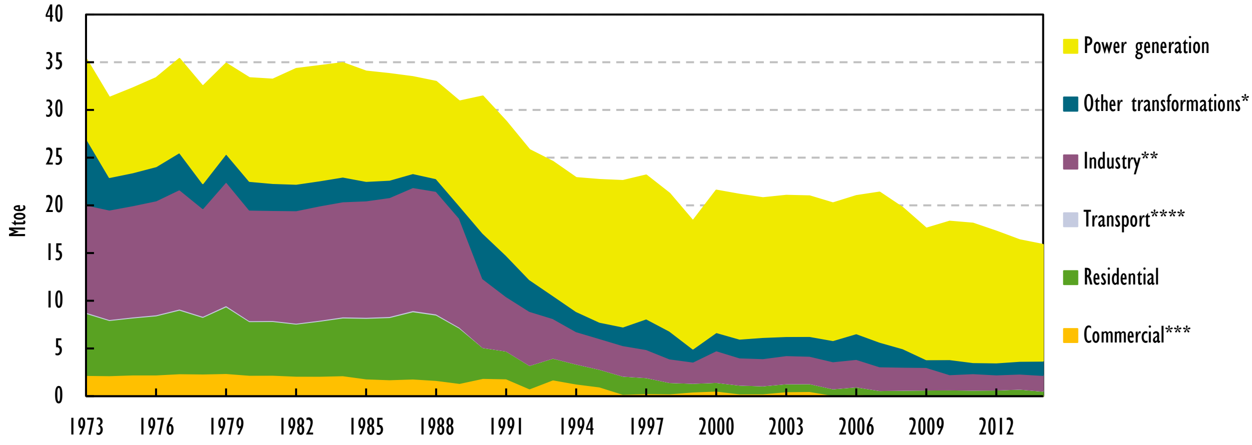
Source: IEA (2016a), *Coal Information 2016*, www.iea.org/statistics/.

DEMAND

Inland consumption of coal was 15.9 Mtoe in 2014. This is the lowest figure recorded since 1973. Around 76.7% of energy from coal is used in power generation directly, while another 9.4% is further refined into coal products, which are also mainly used in power generation. In 2014, coal provided 43.7 TWh of electricity, or 51.5% of total generation. For comparison, in 2004, coal accounted for 63% of total generation, providing 52.8 TWh. The industry sector accounted for 10.4% and households for 3.3%, while commercial uses are negligible (Figure 8.3).

Coal consumption consists of 83.9% brown coal and 16.1% hard coal. The power and heat generation sector is the largest consumer of steam coal, accounting for 91.8% of consumption or 3.2 Mt in 2014. Most of the remaining steam coal was consumed in the industry sector to produce non-metallic minerals, iron and steel, and chemical products. Coking coal is used in coke ovens, and the coke produced is used in the nearby blast furnaces to produce iron and steel, accounting for 3.9 Mt, with no use in the metallurgy industry. Brown coal is also largely used in power and heat generation (87.8% of supply), and the rest is used in industry (chemicals, paper, pulp and printing products) and households.

Figure 8.3 Coal supply by sector, 1973-2014



* *Other transformations* includes other transformations such as coke ovens and refining, and energy own use.

** *Industry* includes non-energy use.

*** *Commercial* includes commercial and public services, agriculture/forestry and fishing (negligible).

**** Negligible.

Note: TPES by consuming sector.

Source: IEA (2016b), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

COAL RESERVES

At the end of 2014, there were 56.5 Mt of extractable hard coal reserves in active mines available within the Czech Republic and approximately 771.3 Mt of extractable brown coal reserves (Table 8.1).

Table 8.1 Coal reserves in the Czech Republic

Mine	Extractable reserves (Mt)	Production (Mt)	Mining	Number of mines	Calorific value (MJ/t)
Hard coal					
OKD, a.s.	56.5	8.3	Underground	Four	19-36
Brown coal					
Severočeské Doly (SD)	346.4	21.7	Opencast	Two	11-13
Severní Energetická (SEAS)	27.7	3.8	Opencast	One	10-18
Vršanská Uhelná (VUAS)	265.9	6.5	Opencast	One	10-18
Sokolovská Uhelná (SUAS)	131.3	6.4	Opencast	Two	12-13
Důl Kohinoor a.s.	0.5	0.5	Underground	One	15

Note: MJ/t = megajoules per tonne.

Source: MIT, IDR country submission.

Hard coal reserves are located in the Czech part of the Upper Silesian Basin in North Moravia near the Polish border. With an area of 6 500 square kilometres (km²), it ranks as one of the largest hard coal basins in Europe. A major part of this basin is located in Poland, while about one-sixth lies in the Czech Republic, in the Ostrava-Karviná area. Brown coal reserves are extracted in the coal basins located in the valley along the Krušné Hory Mountains, which follow the north-west border of the Czech Republic with Germany in north-western Bohemia.

Significant hard coal reserves located in the Beskydy Mountains of Northern Moravia, in the southern part of Upper Silesian Basin, are off-limits to mining. Construction of the Frenštát coal mine started there in the 1980 but remains incomplete as a result of objections from the local population.

In the North Bohemian Basin, there are large reserves of extractable brown coal reserves, most of which are non-accessible as a result of binding territorial limits imposed by the Czech government and relate to the ČSA and Bílina coal mines. These limits have been put in place with regard to the environment and the local population. In October 2015, however, the government decided to partly revoke the ban (Box 8.1).

Box 8.1 Mining limits in the Czech Republic

Limits on brown-coal mining in northern Bohemia were established in 1991 as a guarantee for towns and villages situated on coal deposits that they would not be demolished and relocated to make way for further mining activity and in order to improve the environment in these regions.

In October 2015, following a process of negotiation with government, mining companies, labour unions, employers and the local population, the government published a decision revoking the mining limits and opening the way for mining to continue in the area until 2055. The government amended the limits only at the Bílina opencast mine, owned by Severočeské Doly, where approximately 100 Mt of lignite reserves are available and where the ongoing mining will not necessitate the relocation of the population.

Although extending the mining limits will not require the demolition of nearby villages, locals voiced their concerns that increased mining activity could have a negative impact on their living conditions and may set a precedent for future decisions. The mining company will be required to guarantee that excavation work will not come closer than 500 metres from nearby villages as a measure to protect the inhabitants from excessive noise and dust pollution. In this regard, it is necessary to emphasise that this decision lifted the ban, but does not automatically mean permission for further mining. This decision needs to be validated within other standard procedures, which also includes environmental impact assessment.

INDUSTRY STRUCTURE

OKD is the only producer of hard coal in the Czech Republic. The company employs approximately 14 000 employees making it one of the largest employers in the Czech Republic. OKD produces, processes and sells coking and steam coal that is mined in its four deep mines located in the Moravian-Silesian Region south of the Polish border:

- The Karviná mining operation is the largest deep mine complex in the Czech Republic. The total licensed mining area is 32.2 km².
- The Darkov mine is the second-largest deep mine complex in the Czech Republic. Its licensed mining area covers 25.9 km².

- The ČSM mining operation is located in the eastern part of the Karviná coal basin. Coal is mined at two interconnected sites, North and South. The total licensed mining area covers 22.1 km².
- The Paskov mining operation produces high-quality metallurgical coal mined at the Staříč and Chlebovice sites. The total licensed mining area covers 42.5 km².

In 2014, the company's output was 8 315 Mt of coal, which was 1 395 Mt (or 14%) less than 2013. This was made up of 4 225 Mt of coking coal, 3 547 Mt of steam coal and 1 034 Mt of pulverised coal injection, which is injected into the blast furnace to reduce coke consumption. In 2015, the company planned to sell 4.0 Mt of coking coal, 3.4 Mt of thermal coal and 0.6 Mt of PCI [pulverised coal injection] coal.

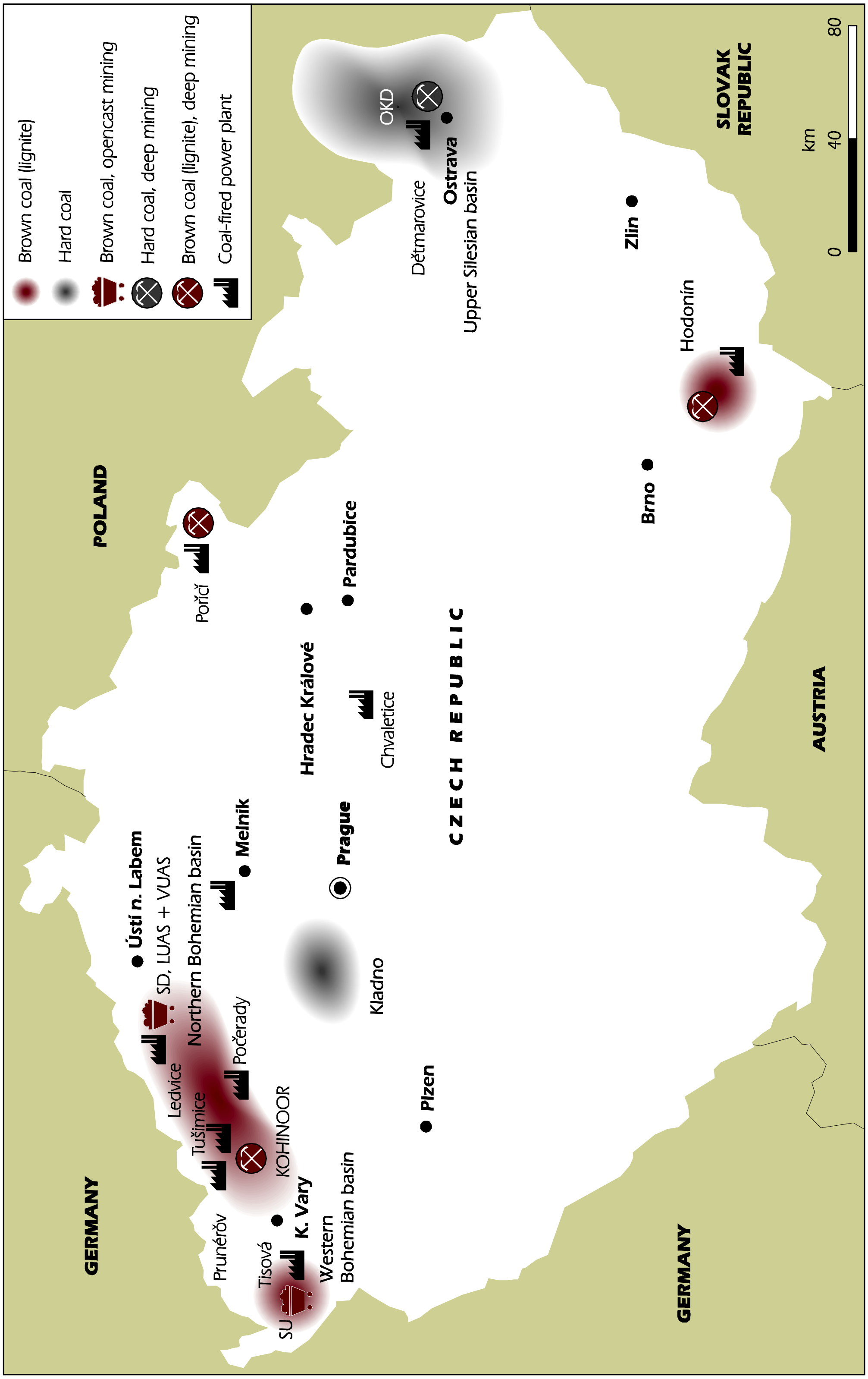
Steam coal and brown coal are mainly consumed by power and heat generation. Brown-coal-fuelled power plants are generally located near the coal mines and connected by conveyor. There are a number of companies operating in the brown coal sector.

Brown coal is extracted in the Northern Bohemian coal basin by mining company Severočeské Doly, part of the ČEZ group of companies, at the Doly Nástup Tušimice and Bílina opencast mines. The company produces around 23 Mt of coal annually and is the largest producer of brown coal in the Czech Republic.

Severní Energetická mines the surface of the North Bohemian brown coal basin near Most and sells a large portion of its output directly to the 800 megawatt (MW) Chvaletice coal-fired power station. Vršanská Uhelná mines in Vršany in the central part of the North Bohemian brown coal basin. Důl Kohinoor is an underground mining company, situated in North Bohemia, which extracts a limited amount of brown coal. Sokolovská Uhelná operates the Družba and Jiří opencast mines near the town of Sokolov in Western Bohemia.

There are no subsidies for coal production or consumption, but state aid has been provided for the closure of the uncompetitive Paskov mine. The European Commission assessed the compatibility of the aid and decided not to raise objections when notified of the measure.

Figure 8.4 Map of coal mines and coal-fired power plants in the Czech Republic, 2015



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

CLEAN COAL TECHNOLOGIES

OVERVIEW

There are no direct programmes or promotion policies for clean coal technologies in place other than those related to research and development. Clean coal technologies are currently driven by environmental requirements and emissions limits. Nonetheless, there is an ongoing refurbishment programme for existing power plants under way in order to comply with environmental requirements. Examples of construction of a super-critical plant and comprehensive refurbishments of two major coal power plants and short descriptions of them are provided below.

The Czech Republic has one operational integrated gasification combined cycle (IGCC) power station, Vresova IGCC, which is operated by Sokolovská Uhelná. The 400 megawatt electrical (MW_e) IGCC power station consists of 26 Lurgi type fixed-bed gasifiers, using brown coal from local mines and a recent installed liquid gasifier from Siemens, which provides additional syngas from tars produced by the fixed-bed gasifiers. The possibility to replace the fixed-bed gasifiers with more modern technology has been investigated; one of the options that have been considered is the High Temperature Winkler process, which is based on the fluidised bed. There is no plan to commission any additional unit operating on an IGCC basis. The coal supply serving the Vresova IGCC power plant will be available until approximately 2040. The potential usage of other fuels for this power plant after 2040 is being discussed.

SUPERCRITICAL PLANT

The Ledvice power plant (660 MW_e) project consists of the construction of a new supercritical unit combusting pulverised lignite from the adjacent mine at Bílina. The lifetime of the heat- and power-producing unit is expected to be 40 years. The unit was commissioned in 2015 and will be the largest and most modern lignite-fired unit in the Czech Republic (Table 8.2). It is possible, however, that the Ledvice supercritical unit could be the last major coal unit that is built in the Czech Republic as a result of decreasing coal extraction. Available reserves are to a large extent committed to existing power plants, and new power plants would need to replace existing capacity.

Table 8.2 Basic parameters of the supercritical Ledvice power plant

Power output	**660 MWe**
Boiler efficiency	91.20%
Net electrical efficiency of the unit (lower heating value [LHV])	42.50%
Emission limits (parts per million [ppm])	
Dust	20
Sulphur dioxide (SO_2)	150
Nitrogen oxides (NO_x)	200
Carbon monoxide (CO)	200

Source: MIT, IDR country submission.

REFURBISHMENT PROGRAMMES

Refurbishment of Tušimice II power plant

Complete refurbishment of the Tušimice II (four by 200 MW_e) power plant consisted of two phases (Table 8.3). Two of the four pulverised-lignite firing units were renewed in each phase in 2009 and 2011 respectively. The power plant lifetime has been extended by an additional 25 years in compliance with the assumed exploitation of adjacent mine.

Table 8.3 Basic parameters of the Tušimice II power plant, before and after refurbishment

Tusimice II	Before	After
Power output	4x200 MW_e	4x200 MW_e
Boiler efficiency	86.50%	90.50%
Net electrical efficiency of the unit (LHV)	32.70%	37.80%
Emission limits (ppm)		
Dust	100	20
SO_2	500	200
NO_x	650	200
CO	250	250

Source: MIT, IDR country submission.

Refurbishment of Prunéřov II power plant

Refurbishment started in September 2012, and the refurbished units will be put into operation during 2015 and 2016. Three out of five units are being retrofitted and their assumed lifetime is being extended by an additional 25 years (Table 8.4). The increased efficiency and availability of the refurbished units will allow increased energy production from the lignite reserves. The remaining two units will be shut down in 2016.

Table 8.4 Basic parameters the Prunéřov II power plant, before and after refurbishment

Prunéřov II	Before	After
Power output	5x210 MW_e	3x250 MW_e (+ 2x210 MW_e)
Boiler efficiency	88.80%	90.60%
Net electrical efficiency of the unit (LHV)	32.80%	39.06%
Emission limits (ppm)		
Dust	100	10
SO_2	500	150
NO_x	650	200
CO	250	200

Source: MIT, IDR country submission.

CARBON CAPTURE AND STORAGE

POLICY OVERVIEW

The IEA considers carbon capture and storage (CCS) a crucial part of worldwide efforts to limit global warming by reducing greenhouse gas (GHG) emissions. Government policy does not assume the large-scale deployment of CCS technology outside the research area, and there are no plans for a CCS pilot project in the Czech Republic. Nonetheless, the Czech Republic is active in CCS research of carbon dioxide (CO_2) and storage and is actively assessing the storage potential. The most promising storage sites are understood to be aquifers in northern Bohemia and depleted oil fields in southern Moravia. Furthermore, several options of carbon capture and use are being evaluated.

In June 2009, Directive 2009/31/EC (CCS directive) entered into force and the Czech Republic was obliged to implement this directive in the national legal framework.[2] At that time there was no legal act in the Czech Republic that focused solely on CO_2 storage. The directive was implemented through the act on storage of CO_2 in natural rock structures (Collection of Laws No. 85/2012), which was finalised in February 2012 and which entered into force in April 2012. This act lays down provisions concerning the environmentally safe storage of CO_2. The law explicitly states that storing CO_2 in natural rock structures is not permitted until 1 January 2020. Therefore CCS activities are limited to projects below 100 kilotonnes for the purpose of research, development or testing of new products and processes.

CCS activities

The initial phase of preparations for a small-scale research CO_2 storage pilot in a depleted oilfield is in progress within the REPP-CO_2 project, which is co-funded by Norway. A second project, also funded by Norway, HITECARLO, aims to develop a pilot-scale CO_2 capture facility, using high-temperature CO_2 sorption from flue gas using a carbonate loop. No large-scale project is planned as a result of CO_2 storage restrictions, which will be in force until 2020.

Storage potential

The CO_2 storage potential of the Czech Republic has been studied and assessed as part of the European Union research projects CASTOR, EU GeoCapacity and CO2StoP. There is a preliminary conservative estimation of the countrywide storage potential as approximately 850 million tonnes of CO_2, mostly in deep saline aquifers. This assessment is being gradually refined within various (mostly) research-oriented activities. For example, a new study on the storage potential of the Carpathian (Eastern) part of the country is now ongoing within the REPP-CO_2 project. A more detailed assessment of the storage potential of the Central Bohemian Basin was undertaken within the Towards the Geological Storage of CO_2 in the Czech Republic (TOGEOS) project and the results were published in the *International Journal of Greenhouse Gas Control*.[3] It is also worth noting

2. Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No. 1013/2006.

3. www.sciencedirect.com/science/article/pii/S1750583611001411, last accessed on 1 February 2016.

that suitable sites for CO_2 storage are also suitable for natural gas storage and could therefore "compete" with natural gas storage.

ASSESSMENT

Coal, alongside nuclear power, remains the backbone of the Czech energy system. It is a secure and inexpensive energy source, and the country has substantial coal reserves that could provide energy for decades to come at current rates of use. Conversely, coal combustion is the largest source of GHG emissions in the Czech Republic and also poses a substantial threat to local air quality in the country. Coal-fired power accounted for 50% of installed generating capacity, 52% of electricity production in 2014 and 65% of GHG emissions. The SEP foresees a long-term transition from coal-fired power towards nuclear energy and other low-carbon technologies. In the medium term, retrofitting existing coal-fired power plants with cost-effective flue-gas treatments or replacing ageing plants with high-efficiency plants is likely to happen. These investments are expected to allow coal-fired power plants to continue to make a contribution to the energy supply while reducing harmful environmental impacts. A number of substantial investments in new technology have been made since the previous in-depth review (IDR) in 2010. The Tušimice II and Prunéřov II power plants have benefited from substantial investment and can operate for the next 25 years at much higher efficiency rates and lower emissions levels. In addition, a new 600 MW supercritical combusting pulverised lignite plant has been built at Ledvice, close to the brown-coal mine at Bílina, which will operate for 40 years. Investments in new technologies alongside the projected closure of old inefficient capacity are helping secure the long-term future of the sector.

In October 2015, the government made a decision to revoke a government resolution that limited coal mining in some regions. A number of options were considered before the government decided to lift only some of the mining limits at the brown-coal mine near Bílina, which is owned by Severočeské Doly and supplies a significant share of coal to the ČEZ-owned coal-fired plant at Ledvice in addition to other users and households. While the decision was made to strengthen the country's energy security, local employment and social concerns were also a factor. The decision to lift limits on Bílina was approved by the government in October 2015, and further mining has to fulfil the legislative requirements, mainly an environmental impact assessment and obtaining a mining permit, which is the responsibility of the Ministry of the Environment and the Czech Mining Authority. The limits of the nearby ČSA mine, which is owned by Severní Energetická, a privately owned company, were not extended. This decision was taken on the basis that the ČSA mine is located too near the local villages, and will, therefore, result in closure of this mine within eight years. It may be helpful and in the interest of transparency to make available clear explanation of the reasons underlying the decision to amend the mining limits.

A notable feature of coal use in the Czech Republic is the large proportion of coal consumed by households, which accounts for almost 20% of final coal consumption. Coal provides an inexpensive heating option for Czech families, and a large number of households use coal boilers for space heating purposes, and in some cases they also burn (toxic) waste along with their coal. Unlike coal use in the power sector, there are no direct environmental regulations governing household coal use, which makes a substantial contribution to poor local air quality and public health issues in some parts of the country. The government has acknowledged this problem and offered financial incentives for the replacement of old boilers with more efficient boilers alongside financial support for householders to install domestic insulation. These incentives should be revised to ensure that less well-off householders get the support necessary to switch away from coal use to cleaner solutions, such as connecting to the extensive natural gas network or local district heating systems.

CCS can play a unique role in the global transition to a sustainable low-carbon economy, in both power generation and industry. The previous Czech IDR highlighted the need for the government to increase funding for research and development of CCS. Given the country's reliance on fossil fuels, greater emphasis on CCS policy remains necessary. While the SEP assumes no medium-term deployment of CCS outside the research sector, the Czech Republic remains active in CCS research and is actively assessing the storage potential of the region. In this regard, the country should continue to support CCS-related research activities and actively seek opportunities to co-operate with its regional neighbours with regard to storage solutions.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Ensure that all new coal-fired generating capacity uses high-efficiency, low-emissions technologies.*
- ☐ *Prepare and publish a clear explanation of the decision to extend the mining limits at Bílina.*
- ☐ *Continue to support CCS-related research activities and actively seek opportunities to co-operate with its regional neighbours with regard to storage solutions.*

References

IEA (International Energy Agency) (2016a), *Coal Information 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2016b), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

9. NATURAL GAS

Key data (2015 estimated)

Natural gas production: 0.3 bcm, +22.9% since 2005

Net imports: 7.5 bcm, -20.1% since 2005

Share of natural gas: 15.9% of TPES and 2.7% of electricity generation

Consumption by sector (2014): 7.5 bcm (industry 34.4%, residential 26.6%, commercial and public services and agriculture 17.8%, power generation 16.8%, other energy 3.4%, transport 1%)

SUPPLY AND DEMAND

SUPPLY

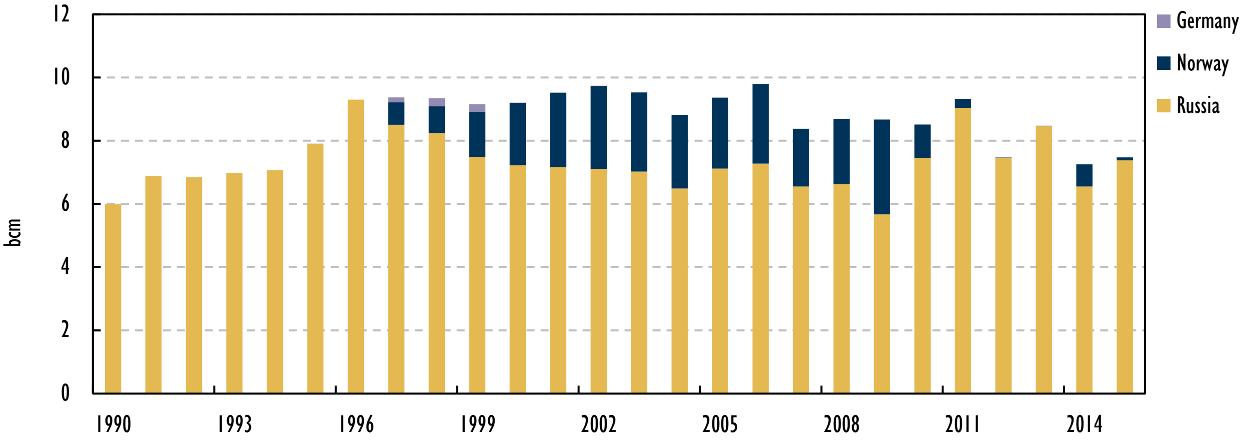
Natural gas supply of the Czech Republic was 6.5 million tonnes of oil-equivalent or approximately 7.9 billion cubic metres (bcm) in 2015. The share of gas in total primary energy supply (TPES) was 15.9% while its share in electricity generation was 2.7%. Over the ten years since 2005, supply of gas fell 15.8%, which is greater than the 9.4% decline in TPES over the same period. Compared with other member countries of the International Energy Agency (IEA), the Czech Republic ranks the eighth-lowest with regard to a share of natural gas in TPES, and the fifth-lowest in terms of its share in electricity generation. Local production is negligible and accounts for 3% of demand. In 2015, indigenous gas production was 247 million cubic metres (mcm). Domestic natural gas production is concentrated in Southern Moravia, and to a lesser extent, Northern Moravia.

IMPORTS AND EXPORTS

The Czech Republic relies on imports for almost all of its natural gas needs. Imports were 7.5 bcm in 2015, which is 3.1% higher than the previous year and 23.7% lower than a peak of 9.8 bcm in 2006 (Figure 9.1).[1] Exports of natural gas are negligible; however, the Czech Republic transits 30.5 bcm a year of Russian natural gas into Western European markets. In 2015, contractual imports were sourced from the Russian Federation (hereinafter "Russia") (98.7% of the total) and Norway (1.3%). The Czech Republic began importing gas from Norway in 1997.

1. Imports represent the net of all import flows and all re-export flows.

Figure 9.1 The Czech Republic's natural gas imports by country, 1990-2015

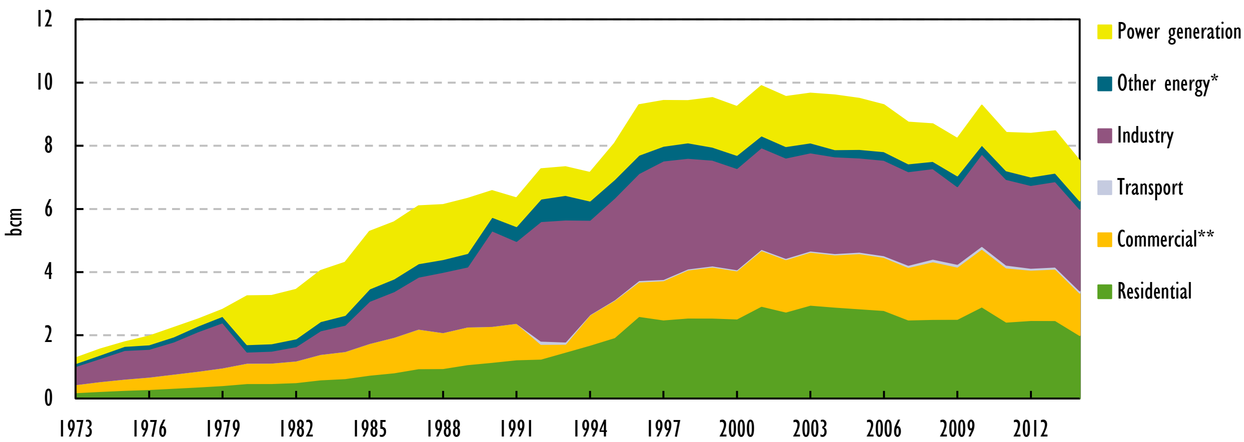


Source: IEA (2016a), *Natural Gas Information 2016*, www.iea.org/statistics/.

DEMAND

Gas consumption was 7.5 bcm in 2014, a decline of 0.9 bcm compared with 2013, representing a downward trend in gas demand across all sectors except for the transport sector and other transformations sector (Figure 9.2). Since 2004, gas consumption has declined by 30% in households, by 25.6% in power generation, by 18% in the commercial sector and by 14.4% in the industry, while increasing by 15.2% in petroleum refining. The overall decline in gas demand has been influenced by milder winters, the economic downturn, volatile gas prices for end consumers and greater emphasis on energy-saving measures (Figure 9.3).

Figure 9.2 Natural gas demand by sector, 1973-2014



* *Other energy* includes transformations into products as well as energy own use.

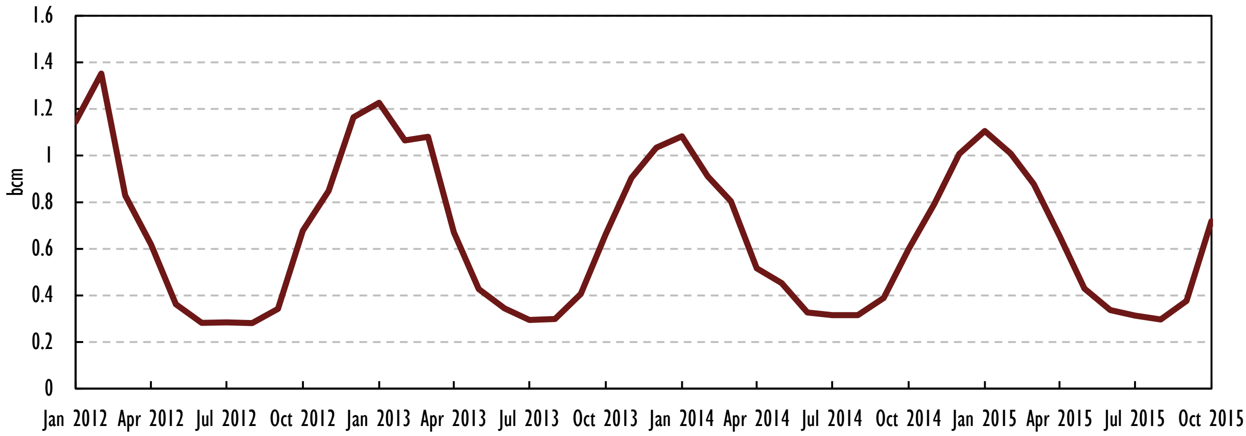
** *Commercial* includes commercial and public services, agriculture/fishing and forestry.

Note: TPES by consuming sector.

Source: IEA (2016a), *Natural Gas Information 2016*, www.iea.org/statistics/.

Industry is the largest gas-consuming sector, with a share of 34.4% of total demand in 2014, while households consumed 26.6% and power generation consumed 16.8%. The commercial and public services sector (including agriculture, fishing and forestry) consumed 17.8%, petroleum refining use represented 3.4% and transport took the remaining 1%. The most influential factor in demand variation is seasonal and strategic fuel switches in the industry and household sectors (Figure 9.3). The industrial sector heavily relies on natural gas as a primary fuel owing to its competitive advantage, reliable supply and low maintenance costs.

Figure 9.3 Seasonality of natural gas consumption in the Czech Republic, 2012-15



Source: IEA (2016a), *Natural Gas Information 2016*, www.iea.org/statistics/.

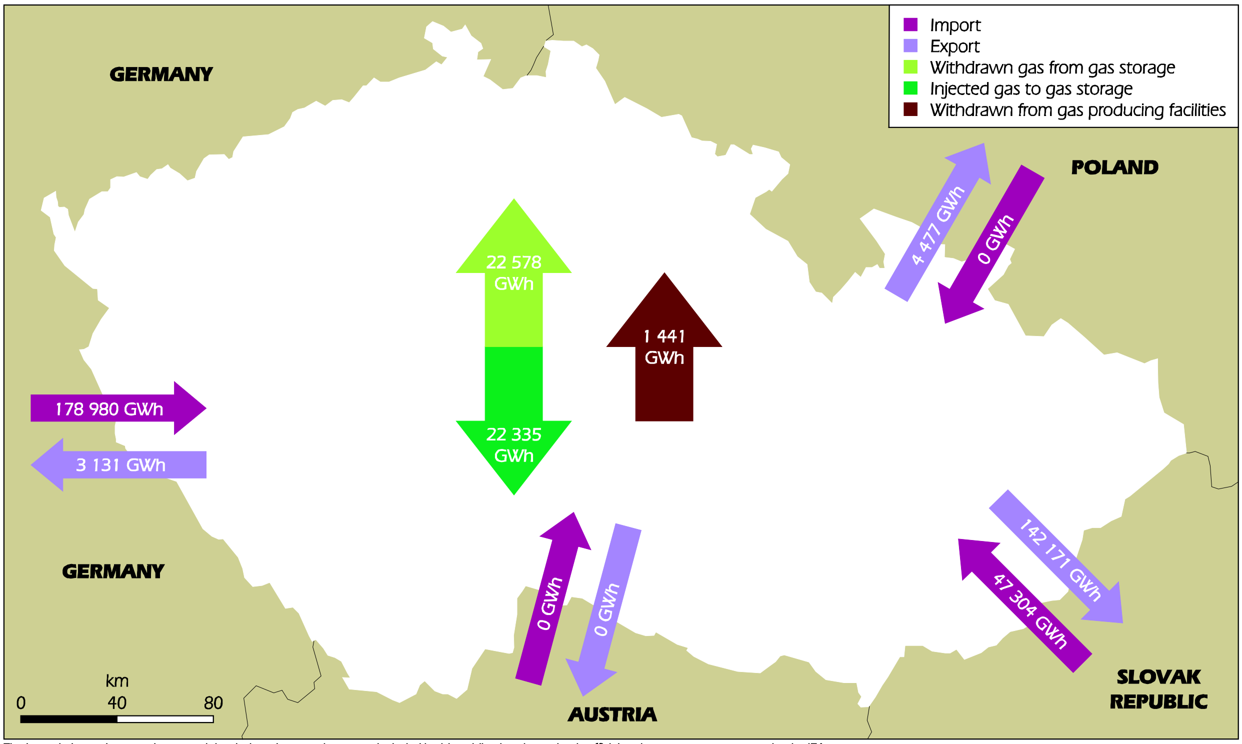
IMPORTS AND TRANSIT

All natural gas enters the Czech Republic via the pipeline system (Figure 9.4). RWE Supply and Trading is the dominant wholesale gas supplier, and it holds two long-term contracts, one with Gazprom Export and another with suppliers in Norway. Historically, all gas imports came from Russia. In the late 1990s, following efforts to diversify supply, the Czech Republic began importing from Norway. Total imports from Norway reached a quarter of gas consumption in the early 2000s, but have since declined, to 1.3% in 2015. Gas is imported under long-term contracts with Russia's Gazprom Export and Norwegian suppliers Statoil, Norsk Hydro and Saga Petroleum. Russian gas contracts represent approximately 70% of RWE Supply and Trading's long-term purchase portfolio and run until 2035, while Norwegian contracts remain in place until 2017.[2]

Most of the gas imported by RWE Supply and Trading is transported to the Czech Republic via Ukraine, first to the Veľké Kapušany cross-border point in the Slovak Republic and then via the Eustream transit system to the Czech border at Lanžhot. Conversely, gas volumes from Norway as well as those from other European Union (EU) countries are transported to the Czech Republic via German transmission networks to Hora Svaté Kateřiny. Alternative routes for gas supply from Russia are the Nord Stream and OPAL pipelines, for which the entry point to the Czech gas transmission network is Brandov. Approximately 60 suppliers import gas into the Czech Republic, some of which is re-exported to other markets. In 2014, the largest quantities of gas were imported by RWE Supply and Trading, WINGAS and Vattenfall Energy Trading.

2. Approximately 30% of natural gas that enters the Czech Republic was purchased on European spot markets and may therefore originate in sources other than Russia and Norway.

Figure 9.4 Volumes of gas imported/exported from the Czech natural gas system in 2014



The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

Note: GWh = gigawatt hours.

Source: OTE (2015a), *Yearly Report on the Electricity and Gas Markets in the Czech Republic for 2014*.

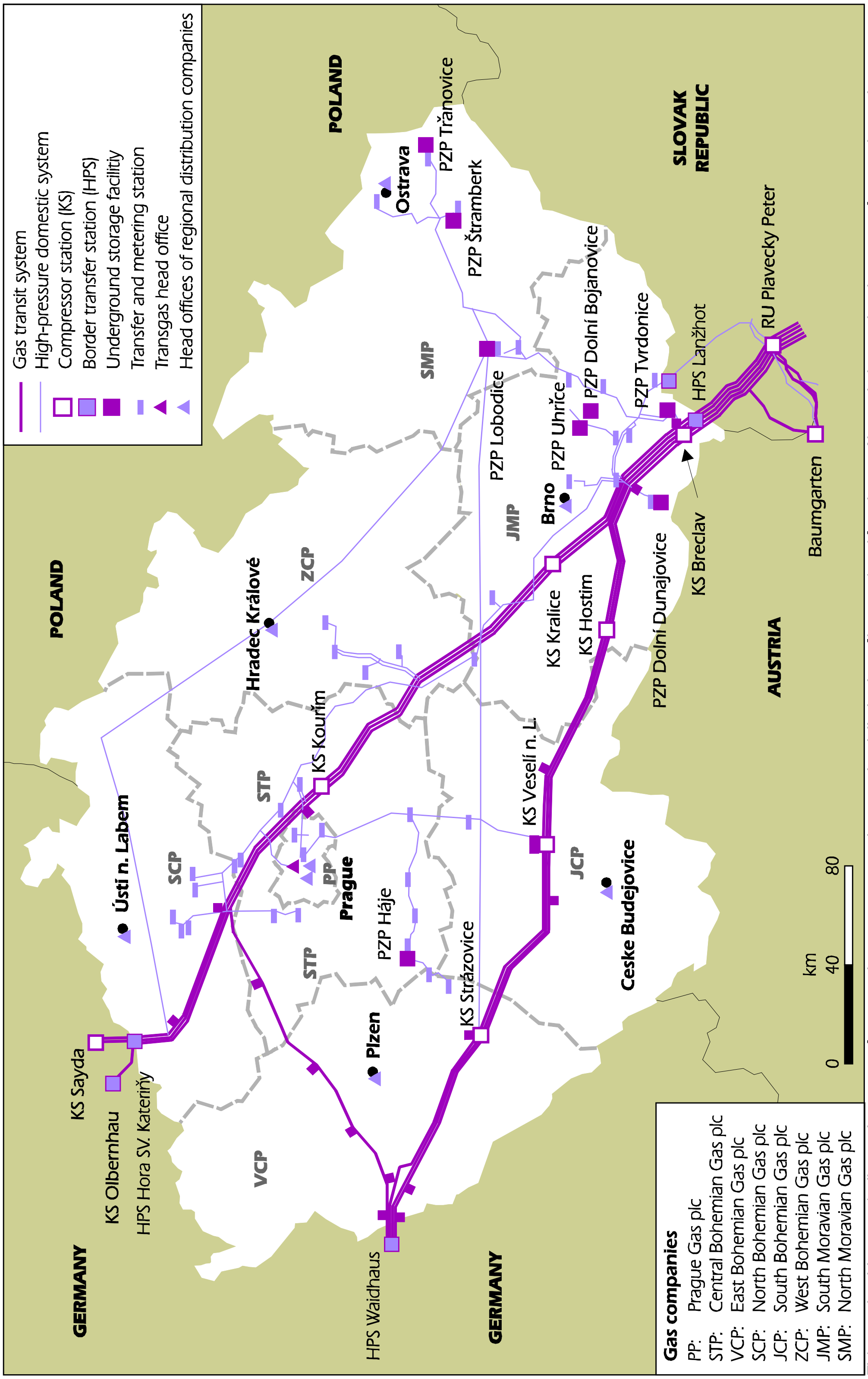
INDUSTRY STRUCTURE

TRANSMISSION

There is one transmission system operator in the Czech Republic, NET4GAS, which operates 2 630 kilometres (km) of transit pipelines and 1 189 km of domestic pipelines, including four compressor stations with a total installed capacity of 243 megawatts. Access to transmission capacity is regulated and existing capacity (including minor upgrades) is booked via an "open subscription window" procedure. Available border-to-border transit capacity is offered as point-to-point capacity products, while domestic transport capacity is offered as an entry and exit product.

In 2006, NET4GAS was legally unbundled from RWE Transgas. It remained, however, part of a vertically integrated undertaking, and the option of an independent transmission operator emerged from the evaluation of feasible options for an effective unbundling. The Energy Regulatory Office (ERO) granted NET4GAS an independence certificate on 28 January 2013.

Figure 9.5 Map of the Czech Republic's natural gas infrastructure, 2015



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

In August 2013, the ownership of the company was transferred from RWE to HYX Czech, which was subsequently renamed NET4GAS Holdings. Ownership interests in NET4GAS Holdings are held by two parties, Allianz Infrastructure Czech HoldCo II and Borealis Novus Parent B.V. The owners of NET4GAS Holdings are therefore companies in the Allianz and Borealis portfolios.

TEN-YEAR NETWORK DEVELOPMENT PLANS

Within the European Network of Transmission System Operators for Gas (ENTSO-G), transmission system operators (TSOs) co-operate on the development of EU-wide grid planning, by means of EU-wide ten-year network development plans (TYNDP), regional investment plans and national ten-year network development plans.[3] In March 2015, ENTSO-G published the fourth edition of the EU-wide TYNDP (TYNDP 2015) covering the 2015-35 period.

Furthermore, TYNDP 2015 plays a central role in the process of selecting Projects of Common Interest (PCIs). These have been defined as projects that help create an integrated EU energy market. The European Commission has drawn up a list of 248 PCIs. These projects may benefit from accelerated licensing procedures, improved regulatory conditions and access to financial support totalling EUR 5.85 billion from the Connecting Europe Facility (CEF) between 2014 and 2020. Among the Czech projects selected as PCIs are:

- Poland-Czech Republic interconnector (currently known as "Stork II") between Libhošť and Hať in the Czech Republic and Kędzierzyn in Poland.
- Bidirectional Austrian-Czech interconnection (between Baumgarten and Reinthal in Austria and Břeclav in the Czech Republic.

In 2014, NET4GAS submitted for ERO approval its Ten-Year Plan for the Development of the Gas Transmission System in the Czech Republic for 2015 to 2024. ERO placed this document in a public consultation process, during which it received no comments from stakeholders. The NET4GAS ten-year development plan analyses the development of demand and the adequacy of the entry/exit transmission capacity of the domestic zone in the Czech Republic for the period from 2015 to 2024. In preparing the plan, the TSO estimated future gas supply and demand and evaluated each investment plan in the development plan in terms of the security of the operation of the gas system, gas supply reliability, environmental impacts, available technologies and economic effectiveness. ERO assessed compliance of the NET4GAS plan with the European Union's TYNDP. Following this assessment the NET4GAS plan was approved by the regulator.

Procedures for capacity allocation and congestion management

In compliance with EU Regulation No. 715/2009, the gas TSO has implemented, at border transfer stations, measures for capacity allocation in the case of congestion.[4] The report submitted in compliance with the congestion management procedures (CMP) suggests that no situation requiring the application of any of the procedures set out in

3. The role of ENTSO-G is to facilitate and enhance co-operation among national gas TSOs across Europe in order to ensure the development of a pan-European transmission system in line with EU energy goals.

4. Regulation (EC) No. 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No. 1775/2005.

CMP occurred at the border transfer stations between the Czech gas transmission system and the transmission systems in adjacent countries.

STORAGE

There are three storage system operators (SSOs), RWE Gas Storage, MND Gas Storage and SPP Storage, who among them operate eight underground gas storage (UGS) facilities. Current total gas storage capacity is 3.5 bcm, of which RWE Gas Storage operates 2.7 bcm (Table 9.1).

RWE Gas Storage operates six UGS facilities at Dolní Dunajovice, Lobodice, Štramberk, Třanovice, Tvrdonice and Háje. MND Gas Storage operates the Uhřice UGS facility in Southern Moravia, and a project to increase its capacity is under way. Another UGS facility in Southern Moravia, Dolní Bojanovice owned by SPP Storage, is connected to the Slovak gas network and does not serve the Czech Republic. MND's Uhřice facility has a total capacity of 235 mcm, and SPP Dolní Bojanovice has a capacity of 576 mcm. A new UGS facility owned by MND Gas Storage at Dambořice became operational on 1 January 2016.

Table 9.1 Gas storage facilities in the Czech Republic

Location	Owner	Capacity (mcm)	Maximum daily withdrawal capacity (mcm/d)	Maximum daily injection capacity (mcm/d)
Tvrdonice	RWE Gas Storage	535	8	8
Dolní Dunajovice	RWE Gas Storage	900	17	12
Štramberk	RWE Gas Storage	500	7	7
Lobodice	RWE Gas Storage	177	5	2.5
Třanovice	RWE Gas Storage	530	8	6
Háje	RWE Gas Storage	64	6	6
Uhřice	MND Gas Storage	235	6	2.6
Other				
Dolní Bojanovice	SPP Storage	576	9	7
Total		**3 517**		
Under construction				
Dambořice *	MND Gas Storage	580	17	N/A
Uhřice extension *	MND Gas Storage	45	12	5.4

* Under construction.

Source: MIT, IDR country submission.

Access to gas storage facilities is based on negotiated third-party access. All SSOs offer long-term and short-term capacity as well as firm and interruptible storage products. A substantial amount of information regarding capacity use and other technical data going beyond the requirements of the Third Energy Package is published by the SSOs on their websites.

DISTRIBUTION

Three distribution system operators (DSOs) operate 61 281 km of distribution pipelines. In 2013, regional DSOs in the RWE Group merged to form a single entity, RWE GasNet, which is now the largest DSO in the Czech Republic. Its market share has fluctuated in the past three years and represents somewhere in the range of 83% to 84% of gas sold. Pražská Plynárenská Distribuce operates between 11% and 12% and E.ON Distribuce, around 4%.

NETWORK TARIFFS

ERO regulates charges for gas transmission and distribution and charges for the market operator's services under Section 17(11) of the Energy Act. The charges for gas transmission are calculated from the adjusted allowed revenues for the TSO, and are allocated to the entry and exit points in the transmission system based on their expected use. The charge for gas transmission to the "domestic point" is integrated within gas distribution charges, and is therefore billed to customers as part of the distribution charge. Transmission charges have a fixed and a variable component. The fixed component is the payment for reserved firm transmission capacity. The variable component of the charge is determined so as to cover the TSO's costs related to the quantity of gas transported.

For each of the DSOs, adjusted allowed revenues are determined, their level depending on the amount of distribution capacity reserved and the planned quantity of the gas to be distributed. The resulting charges for gas distribution are therefore determined individually for each of the distribution areas served by the respective DSO.

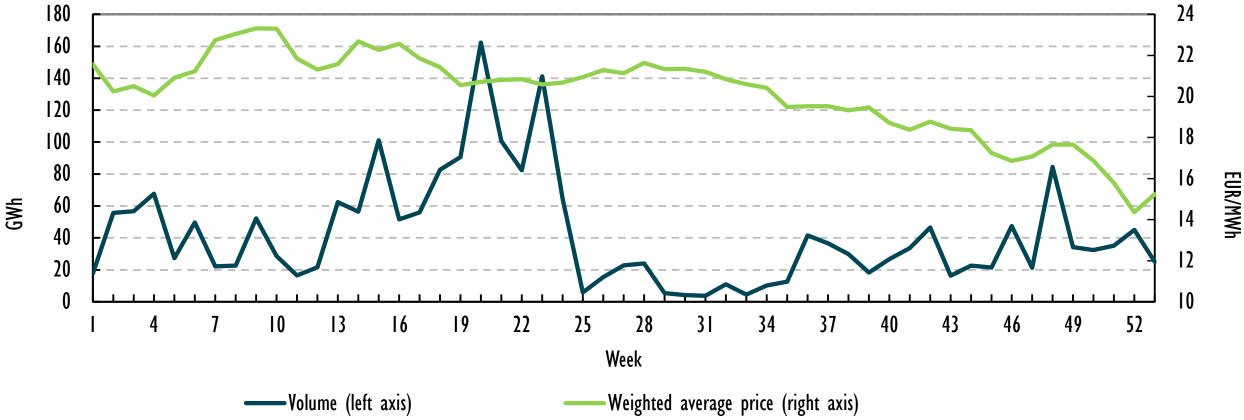
WHOLESALE MARKET

The electricity and gas market operator (OTE) commenced operations on the gas market on 1 January 2010. The short-term gas market comprises a day-ahead gas market and an intra-day gas market. The day-ahead gas market is based on similar principles to the day-ahead electricity market, i.e. supply/demand bid matching.

The intra-day gas market allows market participants access to continuous trading over the course of a gas day. It opens at 10:30 on the morning preceding the gas day, i.e. immediately after the close of the day-ahead gas market. The execution of trades at the intra-day gas market, which runs for seven days a week, i.e. also on non-business days, is also based on supply/demand bid matching. Clearing of executed trades is allowed in euros or koruny. The entire territory of the Czech Republic is one balancing zone, the so-called virtual trading point, at which all gas transactions are registered (excluding old transit contracts).

The number of participants in the market has been steadily increasing since 2014, when there were fewer than 40 active players, to almost 80 in 2014. In 2014, 15 new players entered the market, while 8 players exited the market or ceased to exist following a merger with another company. As of 31 December 2014, 77 counterparties were active in the intra-day gas market. Their number is gradually converging towards the number of those on the electricity market. Alongside continuous growth in the number of participants in the intra-day gas market, the traded gas volumes have also risen significantly. In 2015, a total of 662 GWh was traded on the intra-day gas market, representing an increase of 146% year-on-year. The average price of gas traded on the intra-day market in 2015 was EUR 20.11 per megawatt-hour (MWh), compared with EUR 22.46/MWh in the previous year. Figure 9.6 below illustrates the volumes of gas traded and average prices.

Figure 9.6 Volume of executed transactions and weighted average of prices, in EUR/MWh, at the intra-day gas market in 2015



Source: OTE (2015b), *Gas Imbalances* (database), www.ote-cr.cz/statistics/imbalances-gas.

EMERGENCY RESPONSE POLICY

EMERGENCY POLICIES

The Czech Republic maintains a high degree of natural gas supply security through a combination of several measures, including using long-term supply contracts, having a relatively high capacity of underground commercial gas storage, and requiring safety standards of the supply infrastructure by the transmission and distribution system operators. It seeks to improve security of supply through capacity extensions at a number of storage facilities and increased flexibility in its gas network, including reversibility of gas flows throughout the transmission system and expanding interconnectors to neighbouring countries (UN, 2013).

Natural gas emergency response policies in the Czech Republic are underpinned by Regulation 994/2010/EC, in which the different crisis levels and the variety of actions available to address them are described. The Ministry of Industry and Trade (MIT) updated the legislation regarding specific emergency procedures in 2012, with the adoption of the Preventive Action Plan and the Emergency Plan, as provided for by European regulation.

The Preventive Action Plan, published by MIT in November 2012, describes the measures needed to remove or mitigate identified security risks for the natural gas transmission system. The Emergency Plan, published in December 2012, describes the measures to be taken to resolve or mitigate the impact of a natural gas supply disruption. It describes three crisis levels: Early Warning, Alert and Emergency. During the first two levels, the available natural gas emergency response measures are market based, but if the situation deteriorates to the "Emergency" crisis level, non-market measures are also available.

For emergency response purposes, natural gas customers are divided into eight categories (A, B1, B2, C1, C2, D, E and F) based on their annual gas consumption and their importance for ensuring the provision of essential services. Customers in groups C1, D and F (small business and households) are protected customers.

In normal times the role of the gas National Emergency Strategy Organisation (NESO) is carried out by the central dispatching unit of NET4GAS. In time of crisis, the Central Gas Crisis Task Force can declare a national emergency to activate the country's emergency response measures. The NESO nominally comprises 20 people from 15 organisations including the TSO, all DSOs, all storage operators, MIT, the Fire Brigade, and the oil NESO. The gas NESO conducted an emergency simulation exercise on 31 January 2013 and another on 25 March 2013.

Emergency response measures

There are no government-owned strategic reserves of natural gas in the Czech Republic, and all natural gas storage is on a commercial basis. Natural gas traders that supply protected customers are required by law to store an amount equivalent to 20% of expected forward demand in a UGS facility to ensure they can maintain supply during an emergency.

Other natural gas security policy measures include: greater diversification of natural gas suppliers (European Union, Norway); ensuring the availability of sufficient underground gas storage capacity; full reverse-flow capacity in the gas transmission system; and the delivery of gas from the Gazelle pipeline (a transit pipeline linking the OPAL and Megal gas pipelines, thereby providing the Czech Republic and southern Germany and France with access to Russian gas supplies coming into Europe via the Nord Stream pipeline).

Fuel switching

Fuel switching is not widely applied in the Czech Republic, and it is not mandatory. Coal is the main fuel used for central heating. Natural gas is used for only about 2% of electricity production. Power stations generally produce electricity from gas only during peak consumption periods, and there is no fuel-switching potential.

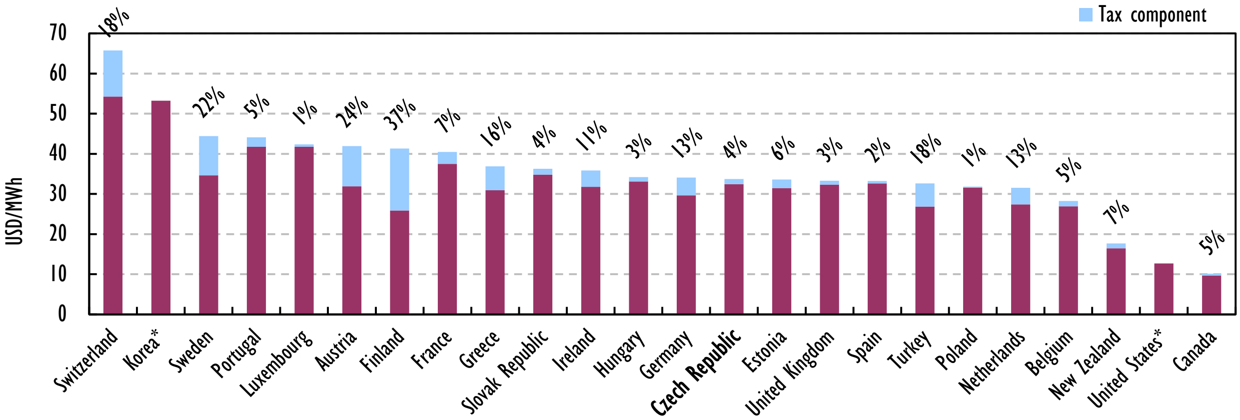
PRICES AND TAXES

Natural gas prices in the Czech Republic are among the lowest among European members of the Organisation for Economic Co-operation and Development (OECD) for both household customers and industry. According to Eurostat, retail prices for gas for household consumers in the Czech Republic (EUR 0.0474 per kilowatt-hour [kWh] excluding taxes and levies or EUR 0.0574/kWh including taxes and levies) are well below the EU average (EUR 0.0514/kWh excluding taxes and levies, EUR 0.0664/kWh including taxes and levies).[5]

5. Eurostat (2016), Gas prices for domestic consumers - bi-annual data (from 2007 onwards) - Band D2: 20 GJ < Consumption < 200 GJ (Second semester 2014), http://ec.europa.eu/eurostat/web/energy/data/main-tables , last accessed 1 October 2016.

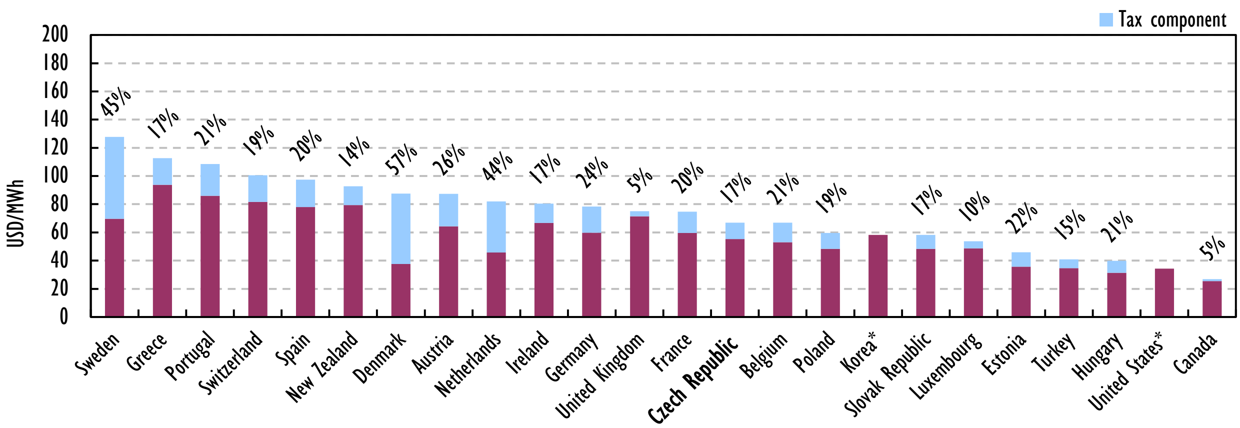
Figure 9.7 Gas prices in IEA member countries, 2015

Industry



Notes: USD = United States dollar. Data not available for Australia, Denmark, Italy, Japan and Norway.

Households



* Tax information not available.

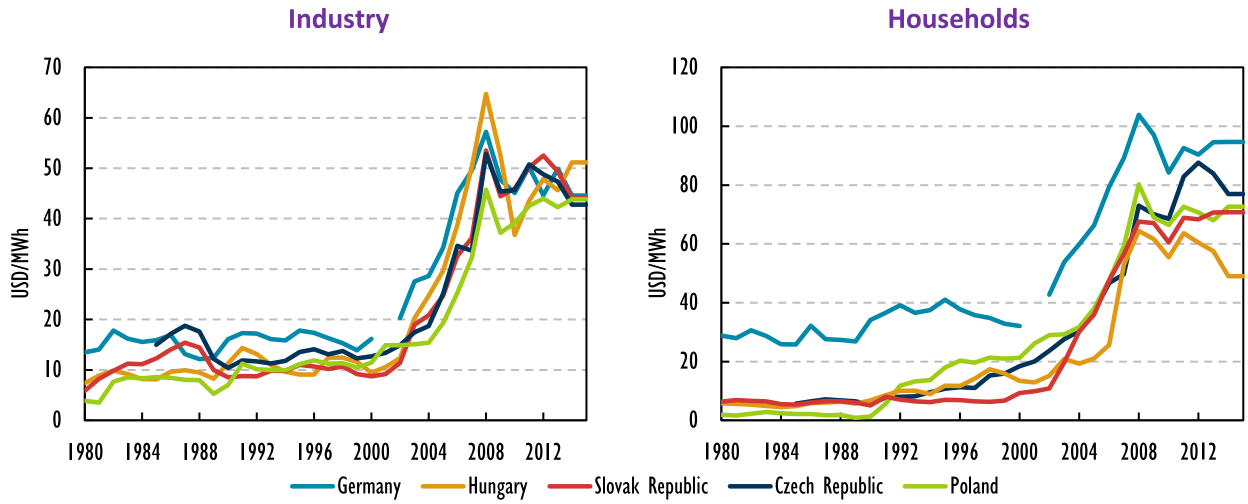
Note: Data not available for Australia, Finland, Italy and Norway.

Source: IEA (2016b), *Energy Prices and Taxes2016, Q1*, www.iea.org/statistics/.

Prices for industrial users (EUR 0.0285/kWh excluding taxes and levies or EUR 0.0359/kWh including taxes and levies) are also less than the EU average (EUR 0.0333/kWh excluding taxes and levies or EUR 0.0443/kWh including taxes and levies).[6]

6. Eurostat (2016), Gas prices for industrial consumers - bi-annual data (from 2007 onwards) - Band I3: 10 000 GJ < Consumption < 100 000 GJ (Second semester 2014), http://ec.europa.eu/eurostat/web/energy/data/main-tables , last accessed 1 October 2016.

Figure 9.8 Gas prices in the Czech Republic and selected IEA member countries, 1980-2015



Notes: Industry data are not available for the Czech Republic from 1980 to 1984. Data are not available for Germany in 2001.

Source: IEA (2016b), *Energy Prices and Taxes2016, Q1*, www.iea.org/statistics/.

Customer switching rates

Since the liberalisation of the gas market in 2007, competition has thrived and 59 gas suppliers are delivering gas to final customers. Subject to the existing commercial terms and conditions, every customer therefore has the right to select their gas supplier. Gas supply security and the quality of services related to gas supply are laid down in implementing regulations.

The household category has the largest number of customers. In 2014, there were 2 642 898 customers in this category (Table 9.2). The low-demand category (i.e. small businesses consuming up to 630 MWh per year) had 197 824 customers. The medium-sized demand category (i.e. businesses consuming between 630 MWh and 4 200 MWh per year) had 6 841 customers, and the high-demand category (i.e. industrial customers consuming more than 4 200 MWh per year) had 1 599 customers.

In 2014, 200 389 customers switched their gas supplier, i.e. approximately 97 000 fewer than in 2013. The largest number of supplier switches, 174 783, took place in the household category, accounting for 87.2% of all changes. In the low-demand category, 23 704 gas supplier switches were made, i.e. 12% of the total number of changes; the medium-sized demand customer category saw 1 572 gas supplier switches; and 330 high-demand customers switched their supplier. OTE publishes supplier switching data, broken down by voltage level and customer category, on a monthly basis.

In all customer categories, the largest number of supplier switches takes place in January. Customers often have gas supply agreements in place for a calendar year or respond to changes in price lists and switch their supplier on 1 January. In 2014, RWE Energie held the largest market share in terms of the gas quantity supplied to customers; it supplied customers with 35.6% of the gas consumed in the Czech Republic. The second largest supplier in terms of gas quantity was Pražská Plynárenská with a market share of 16.2%, followed by trader E.ON Energie, with a market share of 9.4%.

Table 9.2 Supplier switching rates in the natural gas market in Czech Republic, 2014

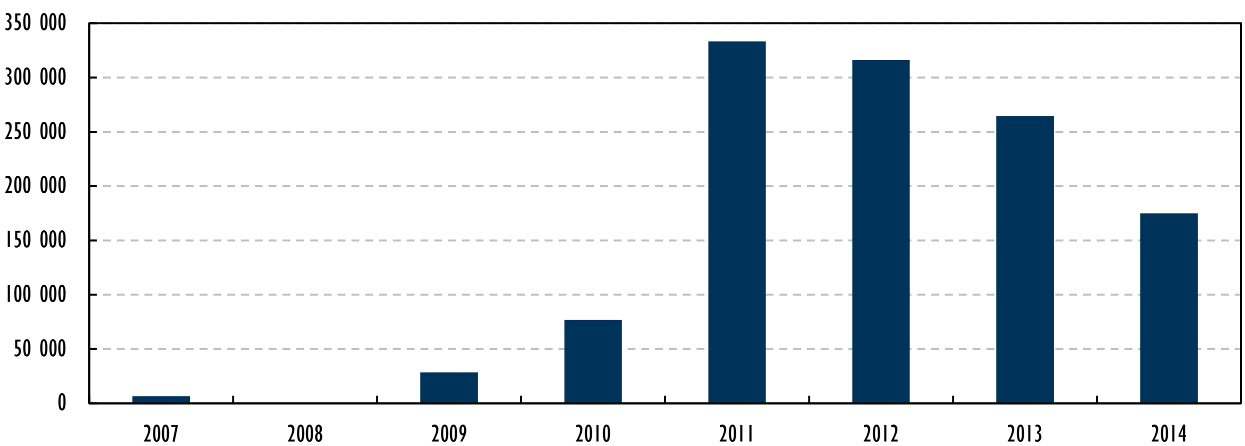
Customer category	Customer switches in 2013	Customer switches in 2014	Total no. of supply points in 2014	2014 switching rate (%)*
High demand	449	330	1 599	20.7%
Medium-sized demand	3 061	1 572	6 841	23%
Low demand	29 091	23 704	197 824	12%
Households	264 680	174 783	2 642 898	6.6%
Total	297 281	200 389	2 849 162	7%

* Switching rate equals the number of gas customer switches per year divided by the total number of supply points.

Source: ERO (2015), *National Report of the Energy Regulatory Office on the Electricity and Gas Industries in the Czech Republic for 2014*.

In May 2015, the Agency for the Co-operation of Energy Regulators (ACER) commissioned a study regarding competitiveness of retail electricity and gas markets in EU member states and Norway. The outcome of the study, which was published in September 2015, ranked the Czech Republic among the five most competitive natural gas retail markets in the group of countries studied alongside Great Britain, Italy, Netherlands and Spain (IPA, 2015).

Figure 9.9 Number of customer switches in the household sector per year 2007 to 2014



Source: ERO (2015), *National Report of the Energy Regulatory Office on the Electricity and Gas Industries in the Czech Republic for 2014*.

Supplier of last resort

Should any supplier or trader be declared insolvent, a supplier of last resort is designated by the ERO to ensure the continuity of gas. Suppliers of last resort may supply gas for up to six months to customers who took up to 60 000 cubic metres over the previous 12 months. In 2014, the option of supplier of last resort was not used.

Implementation of smart electricity and gas metering

Smart metering of electricity and gas and electricity consumption will inform an important part of future smart energy networks in the Czech Republic. The anticipated implementation of this infrastructure will pose a number of challenges for OTE. Discussions are under way about the strategy of developing smart systems and the schedule of preparation and implementation of the proposed steps in conjunction with the Smart Grids National Action Plan project and the State Energy Concept. Owing to the outcome of a cost-benefit study, this smart metering is on hold at the moment.

ASSESSMENT

In 2014, natural gas consumption in the Czech Republic was 7.5 bcm, representing 15% of TPES. The industry sector represented 34.4% of total gas consumption; residential accounted for 26.6%, commercial for 17.8%, power generation for 16.8% and other sectors for 3.4%. Consumption of natural gas in the Czech Republic exhibits a typical seasonal pattern, with low demand in summer and high demand in winter.

In 2014, the bulk of the natural gas consumed in the Czech Republic was imported from Russia (90.4%), with some from Norway (9.6%), although approximately 20% of this gas is purchased from unattributed sources on the spot market; only 0.3 bcm is produced domestically. Of all transited gas through this system, only some 20% is consumed in the country itself. About two-thirds of the total entered the country at the east side through the Gazelle pipeline, and the rest through other interconnections. The contractual gas prices are mostly linked to oil products and hard coal, although this is changing. Gas market prices are generally determined by long-term contracts, but a growing number of suppliers offer prices reflecting spot market prices.

The Czech Republic maintains a high degree of natural gas supply security through a combination of several measures such as long-term supply contracts, a relatively high amount of underground commercial gas storage capacity, and requiring the transmission and distribution system operators to maintain robust systems. The country seeks to improve security of supply through capacity extensions at a number of storage facilities and increased flexibility in its gas network, including reversible gas flows throughout the transmission system and expanding interconnectors to neighbouring countries.

NET4GAS, the Czech gas TSO, operates all transmission pipelines and four compressor stations. NET4GAS was legally unbundled from RWE Transgas, the main gas importer and supplier, and is now jointly owned by two foreign investors. Three DSOs (RWE GasNet, E.ON Distribuce and Pražská Plynárenská Distribuce) operate 61 281 km of distribution pipelines between them. Three (commercial) SSOs (RWE Gas Storage, MND Gas Storage and SPP Storage) operate eight underground storage facilities, one of which connects directly to the Slovak system. The storage system offers a total capacity of 3.5 bcm and a maximum withdrawal rate of 50 mcm/day. Suppliers have to reserve 20% of their security of supply obligation in underground storage in the European Union. From 1 October 2016, this reserve will be increased to 30%. For security of supply reasons, the Czech Republic aims to increase storage capacity from 37% of annual demand to almost 50%. Extensions of existing facilities are planned, and on 1 January 2016, Moravia Gas Storage commissioned its new Dambořice facility.

In terms of new physical capacity, the commissioning of the Nord Stream pipeline and associated downstream infrastructure such as the NEL, OPAL and Gazelle pipeline has allowed large volumes of Russian gas to reach Germany, bypassing Ukraine. As a result of the new route, the flows from Germany to the Czech Republic (and elsewhere) have undergone a major upgrade. Nord Stream has been by far the most important addition to new, physical pipeline capacity occurring in Europe in recent years. Over the next five years, several projects are planned for bidirectional interconnections including between the Czech Republic and Poland. This project has been granted financial support under CEF funding of PCIs.

To improve security of supply, a number of new interconnectors were developed, and all interconnectors were equipped with reverse-flow capacity. In 2012, the Gazelle high-pressure gas pipeline was completed to connect to the OPAL gas pipeline, thus creating a connection on Czech territory between Nord Stream and southern Germany. In September 2011, the interconnector between the Czech and Polish gas transmission systems (the Stork project) was completed; however, this will not play an important role in the integration and liberalisation of the gas market in the region because of its low capacity (0.5 bcm/year). A second and more robust pipeline between the Czech Republic and Poland is at design stage, as are two other projects to connect with Austria. Security of supply is relatively robust and has benefited from reverse flow and new interconnector capabilities on existing pipelines being put in place.

All new pipelines and interconnectors are subject to a cost-benefit analysis. If this analysis demonstrates a net benefit to the Czech consumer, costs will be recovered from the domestic market via network tariffs. If the infrastructure, or parts of it, serves transit purposes, their costs must be covered by contracts with shippers or cross-border cost allocation.

As gas is abundantly available in the country, it could be utilised more, most notably in the power sector, as coal is in decline and nuclear remains uncertain. With the increase in variable renewables, notably solar photovoltaic (PV), the country will need flexible power generation, which gas-fired power can provide. In addition to offering greater flexibility and enhancing energy security, as a transitional fuel gas can provide certain environmental benefits by reducing carbon emissions and air pollution relative to other fossil fuels. Natural gas use in the power sector can lower carbon dioxide emissions by displacing coal in the power sector. Furthermore, flexible combined-cycle gas turbine technology can be used to complement variable renewable technologies, such as solar PV, which is prominent in the Czech Republic.

Czech householders are a major consumer of natural gas, but there is potential for greater use in the sector. Coal use makes a substantial contribution to poor local air quality and public health issues in some parts of the country. The government has offered financial incentives to encourage the replacement of old boilers with more efficient boilers. These incentives could be revised to ensure householders have a greater incentive to switch to cleaner solutions such as connecting to the extensive natural gas network (or local district heating systems).

The Czech Republic has implemented an efficient wholesale market, where a variety of natural gas products can be traded. By the end of 2015, approximately 80 parties were registered at the intra-day gas market, operated by the state-owned market operator OTE. Their number is gradually converging to the number of those on the electricity market, and traded gas volumes have risen significantly. In 2015, a total of 662 GWh was traded on the intra-day gas market, representing an increase of 146% year-on-year. The average price of gas traded on the intra-day market in 2015 was EUR 20.11/MWh, compared with EUR 22.46/MWh in the previous year.

In 2014, there were 59 active gas traders who supplied gas to customers. Despite the dominance of RWE Energie, which in 2014 held the largest market share (35.6% of gas consumed), the market is relatively competitive and there is a lot of customer switching. The retail market has been independently assessed against its EU peers, and the outcome of the study, which was published in September 2015, ranked the Czech Republic among the five most competitive natural gas retail markets in the study.

RECOMMENDATIONS

The government of the Czech Republic should:

- *Work with neighbouring countries and their natural gas TSOs to further diversify natural gas supply source and routes.*
- *Assess, together with industry, the role of gas in district and residential heating, as the share of coal will decrease over time, and the combustion of coal, waste and biomass in households is a major contributor to local air pollution problems.*
- *Assess, together with industry, the role of gas in power generation. The share of coal is decreasing, the share of nuclear is uncertain, and the share of renewables is to increase, thereby requiring more flexible generation capacity, which could be delivered by gas-fired power stations.*

References

ERO (Energy Regulatory Office) (2015), *National Report of the Energy Regulatory Office on the Electricity and Gas Industries in the Czech Republic for 2014*, ERO, Prague.

IEA (International Energy Agency) (2016a), *Natural Gas Information 2016*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2016b), *Energy Prices and Taxes 2016*, Q1, www.iea.org/statistics/, OECD/IEA, Paris.

IPA (2015), *Final Report: Ranking the Competitiveness of Retail Electricity and Gas Markets at the National Level in Member States of the European Union and in Norway*, IPA Advisory Limited for the Agency for the Co-operation of Energy Regulators, London.

OTE (2015a), *Yearly Report on the Electricity and Gas Markets in the Czech Republic for 2014*, OTE, Prague.

OTE (2015b), *Gas Imbalances* (database), www.ote-cr.cz/statistics/imbalances-gas, OTE, Prague, (accessed 1 September 2016).

UN (United Nations) (2013), *Study on Underground Gas Storage in Europe and Central Asia*, UN Economic Commission for Europe, Geneva.

10. OIL

Key data (2015 estimated)

Crude oil and NGLs production: 0.2 Mt, -64.5% since 2005

Crude oil and NGLs imports: 7.2 Mt, -8.5% since 2005

Oil products net imports: 1.4 Mt, -28.5% since 2005 (imports 3.8 Mt, exports 2.5 Mt)

Share of oil: 20.8% of TPES (negligible in electricity generation, 0.1% of total)

Supply by sector (2014): 8.7 Mtoe (transport 61.5%, industry 31.4%, commercial and public services 4.2%, other energy 2.7%, power generation 0.2%, residential 0.05%)

SUPPLY AND DEMAND

SUPPLY

Oil is the second-largest source of energy after coal in the Czech Republic, representing 20.8% of total primary energy supply (TPES) in 2015, or 8.5 million tonnes of oil-equivalent (Mtoe). Oil supply has remained relatively flat for two decades, at 8.5 Mtoe on average.

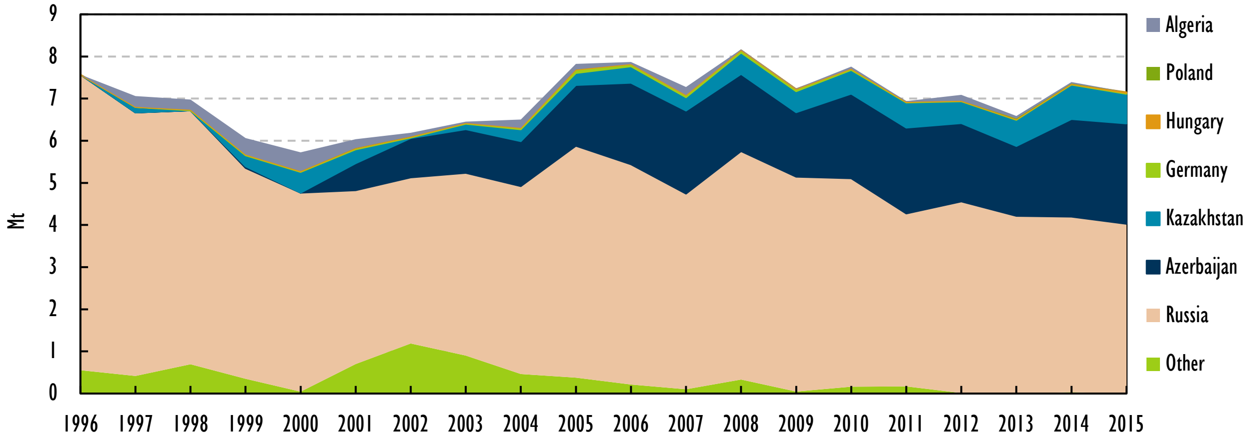
Crude oil and natural gas liquids

There are no significant oil resources in the Czech Republic. Domestic production accounts for 2% to 4% of the volume of oil supplied to the Czech Republic over the long term. In 2015, production of oil and natural gas liquids (NGLs) was 0.2 million tonnes (Mt), 64.5% down from 0.6 Mt in 2005. The Czech Republic imported 7.2 Mt of oil in 2015, 99.7% of which was crude oil with the remainder NGLs. Crude oil was mainly sourced from the Russian Federation (hereinafter "Russia") (56.2%), Azerbaijan (33.3%) and Kazakhstan (9.8%), with the remainder from Germany and Hungary (Figure 10.1).

The main crude oil supply channel is the Druzhba pipeline, originating in Russia and transiting Belarus, Ukraine and the Slovak Republic before terminating in the Czech Republic at the central crude storage terminal at Nelahozeves, from where it can deliver Russian and domestic crude oil to the Litvonov refinery. The Ingolstadt-Kralupy-Litvinov pipeline (IKL) brings crude oil via Germany connecting to the international Trans-Alpine Pipeline (TAL), originating from Triste, Italy, which links to diverse import sources from the Caspian Sea.

Crude oil imports are volatile year-on-year, ranging from a a high of 8.1 Mt in 2008 to a low of 6.5 Mt in 2004. Since 2004, the largest shift in crude oil imports to the Czech Republic has been a modest decrease of 9.7% in imports from Russia, while imports from Azerbaijan have increased by 123.3% and those from Kazakhstan have increased by 148.9%. There are negligible crude oil or NGLs exports from the Czech Republic.

Figure 10.1 Crude oil imports by source, 1996-2015



Source: IEA (2016a), *Oil Information 2016*, www.iea.org/statistics/.

Oil products

Imported crude oil is refined domestically in two refineries (Litvinov and Kralupy), then exported or domestically consumed.[1] The Czech Republic's domestic refinery capacity is not sufficient for meeting oil products demand in the country. With the exception of jet fuel, domestic refinery production is able to meet around 80% or more of demand for each individual product.

In 2015, the Czech Republic was a net importer of oil products with net imports of 1.4 Mt (imports of 3.8 Mt and exports of 2.5 Mt). As oil demand has declined in the Czech Republic over the past decade, imports have contracted by 23.5% since 2005 while exports have boomed by 105.3%.

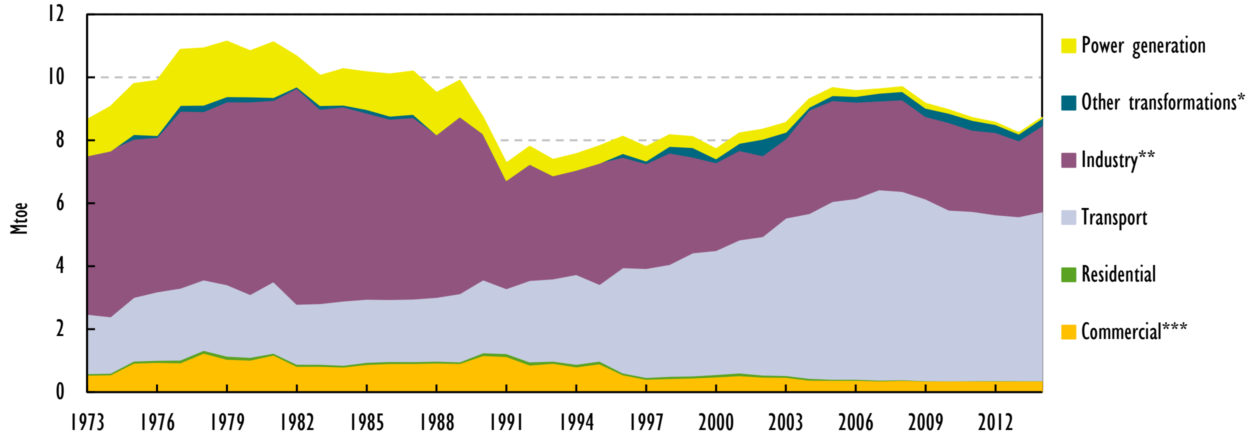
Gas and diesel oil (57.8% of imports and 44.2% of exports) and motor gasoline (13.6% of imports and 24% of exports) dominate trade as a result of high demand in the transport sector, with the remainder liquefied petroleum gases (LPGs) trade. The country imports naphtha and kerosene-type jet fuel. Trade in refined products has been almost entirely conducted with neighbouring International Energy Agency (IEA) countries. Imports of oil products in 2015 were mainly from Germany (36.4%), the Slovak Republic (29.5%), Poland (20.8%) and Austria (7.4%). Similarly, exports were destined for Germany (38.6%), the Slovak Republic (20.7%), Austria (14.5%), Hungary (14.5%) and Poland (5.4%).

DEMAND

Oil is processed in the Czech Republic primarily for use in the transport and industry sectors. Total oil consumption was 8.7 Mt (including imported oil products) in 2014, with 61.5% consumed in the transport sector and 31.4% by industry. The remainder was consumed by commercial and public services and agriculture (4.2%), refineries and energy own use (2.7%), power generation (0.2%), and households (0.05%) (Figure 10.2).

1. While the Kralupy refinery processes sweet crudes; low-sulphur crude oil originating from Azerbaijan, Kazakhstan, Turkmenistan and North Africa; and domestic oil, the Litvinov refinery processes Russian Export Blend Crude Oil (REBCO), which is the heavier oil imported via the Druzhba pipeline. Paramo no longer processes crude oil.

Figure 10.2 Oil supply by sector, 1973-2014



* *Other transformations* includes refineries and energy own use.

** *Industry* includes non-energy use.

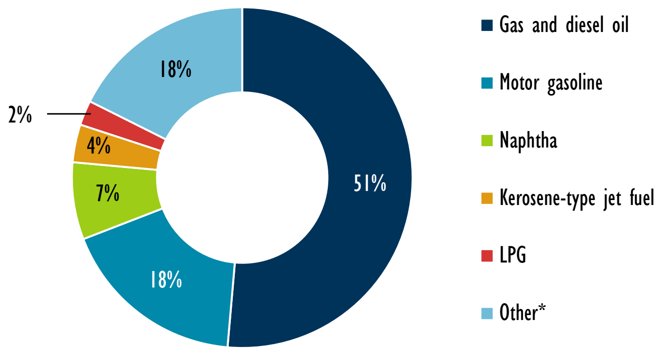
*** *Commercial* includes commercial and public services, agriculture/fishing and forestry.

Notes: TPES by consuming sector.

Source: IEA (2016b), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics/.

Oil demand was 8.9% lower in 2015 compared with 2005. It remained flat for four years from 2005, a year when demand peaked following a period of steady economic growth. Until then, the main driving factor for increased oil demand during 2000-08 was demand for diesel. While total oil demand has slightly decreased since its 2008 peak (4.2 Mt), demand for diesel has continued to grow, increasing its share in consumption from 39.5% in 2005 to 51.4% in 2015. Automotive diesel enjoys a price advantage compared with motor gasoline, which decreased its share from 21.1% in 2005 to 17.7% in 2015, owing to a lower excise tax rate.

Figure 10.3 Oil consumption by product, 2015



Note: Gross inland deliveries per oil product. Also includes oil used in the energy transformation sector (small share compared to final consumption).

* *Other* includes fuel oil, white spirit, refinery gas, paraffin waxes, petroleum coke, aviation gasoline, kerosene other than kerosene-type jet fuel, ethane and gasoline-type jet fuel, and other non-specified oil products.

Source: IEA (2016a), *Oil Information 2016*, www.iea.org/statistics/ .

Transport is the largest consuming although its total share is decreasing. The surge in heavy goods vehicles transiting the country following Poland's accession to the European Union (EU) in 2004 partly contributed the consumption of oil in the transport sector.

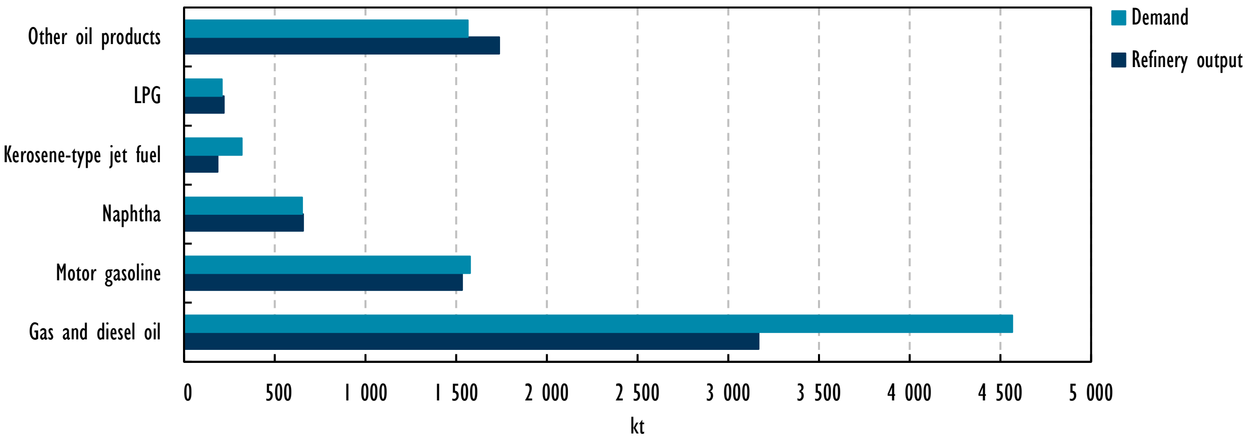
Diesel is the single largest component in the mix of oil products, representing 51.4% of total oil demand in 2015.[2] Motor gasoline represents 17.7%, and a further 7.3% is accounted for by naphtha as a feedstock in industry). Since 2005, diesel oil consumption increased by 18.6% while demand for motor gasoline decreased by 23.3%.

INFRASTRUCTURE

REFINING

The Czech Republic has two operating refineries, the Kralupy refinery and the Litvinov refinery, both owned by Česká Rafinérská (the Czech Refining Company). These refineries produce a significant proportion of all products consumed in the country, with imports making up the shortfall. Diesel accounted for around 42.2% of refining output in 2015, followed by gasoline at 20.4% and naphtha at 8.8%. Refinery output in 2015 was 7.5 Mt, a small decrease from 2014 (7.8 Mt).

Figure 10.4 Czech Republic refinery output and demand, 2015



Notes: kt = kilotonnes. 2015 data are estimated.

Source: IEA (2016a), *Oil Information 2016*, www.iea.org/statistics/.

The Litvínov refinery, which processes REBCO, is a modern refinery with high hydro-skim-refining capacity. It operates two petroleum distillation units, four conversion units and a range of technological equipment for increasing the quality of primary distillation products. The overall annual processing capacity is 5.4 Mt of crude oil. Sulphurised crude oil is supplied to the refinery via the Druzhba or IKL pipeline. The main production process, which creates automobile gasoline, diesel fuel and liquefied natural gas (LNG), includes the use of raw materials for the petrochemical products of Unipetrol, which is present at the same production site. The refinery also produces heating oil, asphalt, oil hydrogenates for the production of lubrication oils and elementary sulphur.

The Kralupy refinery, which processes sweet crudes (including Azeri, CPC blend, Turkmeni and North African crudes, in addition to the crude oil produced domestically), is a comprehensive conversion refinery with a modern fluid catalytic cracking unit, which was used to develop the original hydro-skimming refinery with an annual processing capacity of 3.3 Mt of oil. A methyl tertiary-butyl ether (MTBE) unit ensures its ability to

2. Estimated data for 2015 including oil products used in energy transformation.

produce high-octane unleaded gasoline. The refinery also produces Jet A-1 aviation fuel, which is used at Prague's international airport.

The Kralupy refinery processes low-sulphur crude oil transported via the IKL and TAL pipelines from Terst through Vohburg to the Nelahozeves central storage terminal and Moravian oil transported via the Druzhba pipeline. Automobile gasoline and diesel fuel produced in the Kralupy refinery is primarily transported by tanker trucks as well as by rail tankers and, to a lesser extent, product pipelines. The two refineries have a combined atmospheric distillation capacity of 8.8 Mt per year (/y) (or 995 000 barrels per day [kb/d]).

A third refinery, the Pardubice refinery owned by Paramo (part of Unipetrol), ceased refining operations in 2012 and now specialises in processing petroleum into refinery and asphalt products and in the production of lubricating and process oils.

PIPELINES

The Czech Republic has two major crude oil pipelines. These are the 180 kb/d capacity Druzhba pipeline and the 260 kb/d capacity IKL pipeline. As a landlocked country, the Czech Republic has no oil ports; however, the IKL pipeline, which is connected to the TAL pipeline, receives oil via the oil port in Trieste, Italy. The Czech portion of the Družba pipeline is 506 kilometres (km) in length and can transport 9.0 Mt of crude oil per year. The 347 km IKL pipeline is linked to the 960 kb/d capacity TAL pipeline, which runs from the port of Trieste through the Italian region of Friuli Venezia Giulia, from where it crosses the Alps and continues through Austria to Ingolstadt in Germany, where it splits. The western part of the pipeline terminates in Karlsruhe, and the eastern part near Neustadt. The total length of the pipeline is 753 km.

The IKL and TAL pipeline provides an important alternative supply route for the country's oil imports, reducing overall reliance on the Druzhba. The Czech state-owned company MERO obtained a 5% share of the TAL in December 2012, which gives the company the right to utilise any spare pipeline capacity.

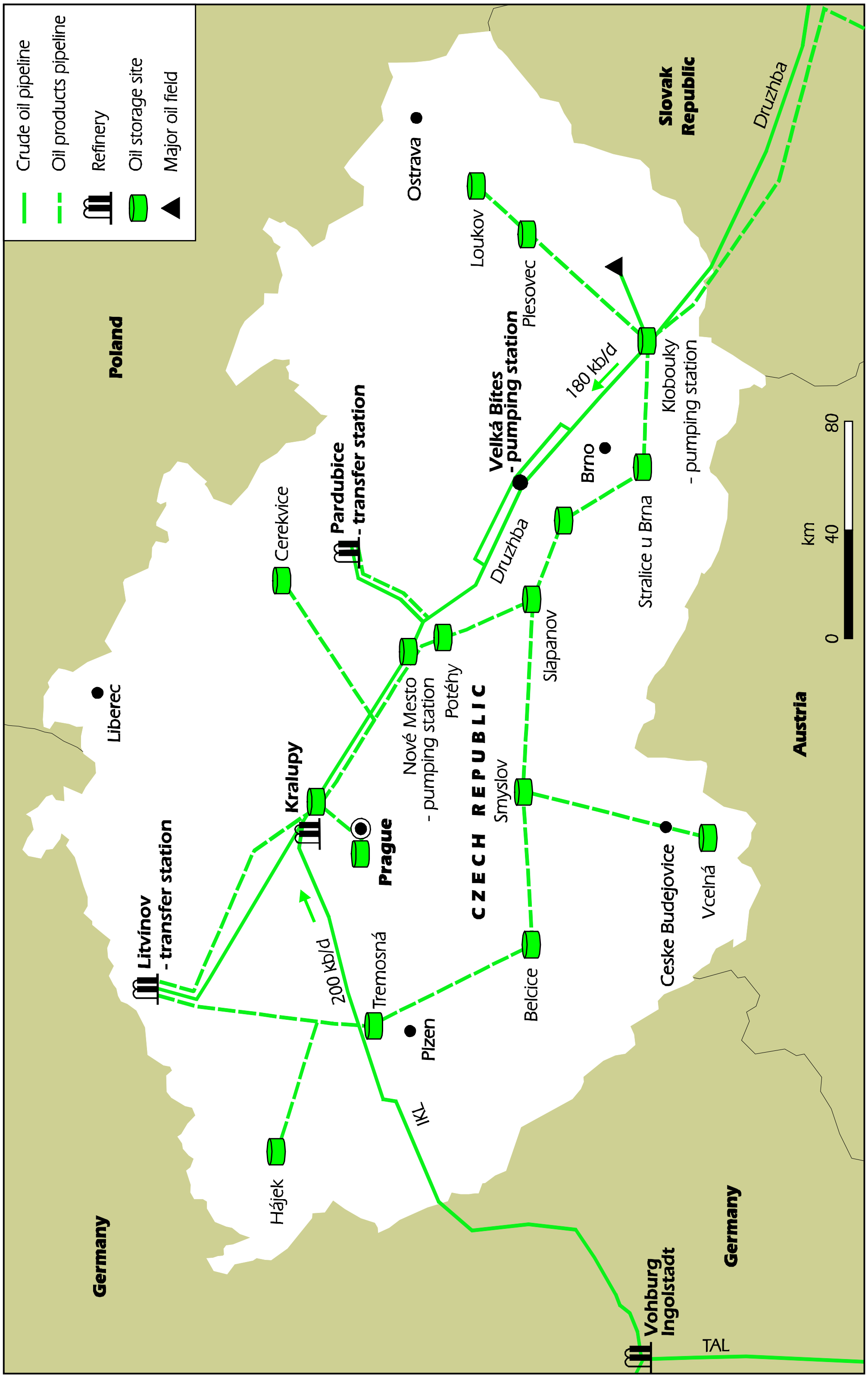
With regard to product pipelines, a domestic product pipeline network (operated by the state-owned company CEPRO) connects the main consumer regions to the domestic refineries as well as 17 product storage facilities with a combined capacity of 1.75 million cubic metres (mcm). The 1 100 km network is also connected to the Slovnaft refinery in the Slovak Republic – enabling both the import and export of oil products. The network is fully reversible.

STORAGE

With regard to oil storage, there are seven main oil storage facilities with a total storage capacity of just over 4 mcm (or 25 million barrels [mb]). With regard to crude versus products, around half of the country's storage capacity is for crude oil and the other half for products. The bulk of the storage is held by two state-owned companies – MERO (crude stocks) and CEPRO (product stocks), which provide storage facilities for the public stocks of the Administration of State Material Reserves (ASMR).

MERO operates 16 above-ground crude storage tanks with a combined capacity of 1.55 mcm. CEPRO has 17 product storage sites (including 14 underground storage tanks) along the domestic product pipeline network (which the company also owns and operates), with a combined storage capacity of 1.75 mcm.

Figure 10.5 Map of the Czech Republic's oil infrastructure, 2014



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

MARKET STRUCTURE

EXPLORATION AND PRODUCTION

Upstream activities in the Czech Republic are limited: there is only one company active in the sector, Moravske Naftove Doly (MND), which operates in the south-east of the country. Production output meets approximately 2% to 3% of crude demand. Part of the production is exported by rail, mostly to Austria and the remainder; about 200 kt/y to 300 kt/y is transported along the Druzhba pipeline to Czech refineries.

ROAD TRANSPORT

The Czech Republic passenger fleet is among the oldest in the European Union, with 54% of automobiles older than 10 years compared with an average of 9.65 years in the 28 EU member states.[3] Imports of second-hand cars from neighbouring countries (notably Germany) outnumber domestic purchases of new models. In 2013 and 2014, government support for alternative fuels resulted in some growth in the compressed natural gas (CNG) fleet.

The heavy goods vehicle (HGV) fleet is a mixture of new and old models: Euro VI and Euro V engines benefit from road tax relief to support modification of the fleet. The passenger transport fleet is mainly composed of diesel-powered units although CNG-fired buses run in some towns in an effort to reduce emissions.

There are 1.6 million diesel-fuelled passenger cars and 3.2 million petrol-fuelled passenger cars in the Czech Republic. In the freight-transport sector there are 0.5 million diesel-fuelled freight transport vehicles and 92 000 petrol-fuelled freight transport vehicles.

From a fuel efficiency point of view, diesel vehicles are more efficient than petrol-fuelled cars and can be seen from the carbon dioxide (CO_2) emissions perspective as a better alternative. Conversely, they have a negative impact on local pollution and human health as a result of particulate pollutants (PM2.5, PM10). On this basis, therefore, there are no policies to increase the share of diesel in the Czech Republic vehicle fleet. According to the Czech Transport Policy 2014-20, consumption of both gasoline and diesel in transport should be reduced and partially replaced with alternative fuels over time.

EMERGENCY PREPAREDNESS

EMERGENCY RESPONSE POLICY

The Czech Republic's primary response measure in an oil supply disruption is the use of public oil stocks. The office that oversees the state's emergency reserves, the ASMR, is mandated to meet the entire Czech oil stockholding obligation to the IEA (and also the European Union). The chairperson of the ASMR has the ability to draw down public stocks held in excess of this minimum level, without needing to seek government approval. This allows the Czech Republic to respond quickly to an IEA action or provide loans to relieve shortages in domestic supplies.

3. www.acea.be/statistics/tag/category/average-vehicle-age, last accessed on 1 February 2016.

The director of the State Material Reserves Section of the ASMR serves as the head of the oil National Emergency Strategy Organisation (NESO) in the Czech Republic. The ASMR has a broad remit, with responsibility for stockpiling and security of supply of all key resources considered essential for the protection of the public interest during crises (not just energy crises). ASMR reserves include agricultural goods, metals and industrial materials as well as oil and oil products.

In 2002, the country's National Security Council approved 23 "Standard" situations that have the potential to lead to a crisis situation. The ASMR is responsible for developing and keeping up to date a Standard Plan to address the "Standard" situation in relation to a "Disruption of oil and oil products supply". Under Act No. 189/1999 Coll. Article 9(1), the ASMR is responsible for developing an action plan outlining measures for use during an oil supply emergency. The aim of the plan is to determine which activities, measures and procedures will be implemented by ASMR if required. The plan also specifies co-operation among the ASMR and other government bodies, local government units and other entities.

The principal Czech oil companies and storage facilities are listed by the ASMR as critical infrastructure operators. Accordingly, these companies are required to perform risk analyses, which take into consideration relevant threat scenarios in order to assess the vulnerability and the potential impact of a disruption or destruction of critical infrastructure, and to prepare plans for different types of emergencies.

NATIONAL EMERGENCY STRATEGY ORGANISATION (NESO)

Within the ASMR, the Oil Security Division has the leading role in co-ordinating the NESO and maintaining contact with the oil industry and the IEA during an emergency. Other relevant ministries also play a role in the NESO, notably the Ministry of Industry and Trade (MIT) and the Czech Statistical Office.

The structure of the NESO remains the same during business-as-usual and in times of crisis, but it can be expanded to include additional personnel or organisations during a crisis. In normal times, the NESO meets once a year but may be convened for additional meetings at the request of any member. In 2014 and 2015, in conjunction with its regular meetings, the NESO Secretariat conducted a co-ordination exercise during a hypothetical oil supply disruption. No follow-up exercises have been held since then.

Legislation

The legal basis for the maintenance of compulsory stocks of crude oil and product is Decree 165/2013 Coll., of 10 June 2013. The decree clearly defines:

- types of crude oil and petroleum products for storage in emergency oil stocks that the ASMR is to hold for emergency purposes
- the methodology for calculating the minimum levels required to meet both the IEA and EU stockholding commitments
- the reporting of emergency stocks
- conditions for storage facilities.

Act No. 189/1999 Coll. on oil stocks, in compliance with European Commission law (Council Directive 2009/119/EC of September 2009, imposing an obligation on member states to maintain minimum stocks of crude oil and/or petroleum products), deals with creating, maintaining and releasing emergency strategic stockpiles of crude oil and petroleum products. The act was amended in 2013 by transposition of Council Directive 2009/119/EC.

STOCKHOLDING REGIME

The Czech Republic's emergency oil stocks are administered by ASMR. Czech law requires that ASMR stocks be maintained at a level of at least 90 days of net imports of oil and petroleum products. There is no compulsory stockholding obligation on industry in the Czech Republic. Decree 165/2013 Coll. also specifies that emergency stocks may consist only of the petroleum products listed in the relevant EU regulation on energy statistics (Annex C of Regulation No. 1099/2008 (EC) of 22 October 2008, on energy statistics, in part 3.1, first paragraph, as amended) and types of crude oil that can be processed in the refineries within the territory of the Czech Republic.

ASMR's crude oil stocks consist of a single type of crude oil (REBCO). As only the Litvínov refinery can readily process this type of crude, the government has considered proposals to partially replace existing stocks of REBCO with stocks of light sweet crude blends. This is to ensure that the country's emergency oil stocks are aligned with domestic refining needs, but no decision to do so has yet been taken.

The ASMR contracts the necessary storage infrastructure from oil storage companies. MERO holds 98% of ASMR's crude oil stocks, with Česká Rafinérská (the Czech Refining Company) holding the remaining 2%. CEPRO also holds 88% of ASMR's oil product stocks, with ASMR holding another 5% of product stocks directly, and various small stockholders responsible for the remaining 7%. Although the stock release process for oil and product stocks held by MERO, CEPRO and ASMR appears relatively straightforward, it is not clear how a release of the 7% of product stocks held by small private stockholders would be organised.

Approximately 95% of the product stocks held on behalf of ASMR are stored separately, and they are not commingled with working stocks. Furthermore, 100% of ASMR's crude oil stocks are also stored separately. In the event that ASMR emergency stocks were to be commingled with other stocks, provisions for the separate monitoring of emergency stocks and prioritising the release of those stocks would be required.

As ASMR has full responsibility for meeting the country's oil stockholding obligation, there is no compulsory stockholding obligation on the Czech oil industry. Industry stocks are therefore minimal, held solely for operational and/or commercial purposes (equivalent to 35 days of net imports in January 2014). There is no formal estimate, however, as to what level of commercial crude oil and product stocks is required to meet minimum operating requirements.

Bilateral stocks and tickets

The Czech Republic has bilateral stockholding agreements with Germany and the Slovak Republic. According to IEA figures, between three and four days of Czech stocks (147 kb of middle distillates) were being held abroad as of the end of November 2015. Stockholding ticket agreements are not used within the Czech Republic.

Compliance with IEA 90-day stock-holding obligation

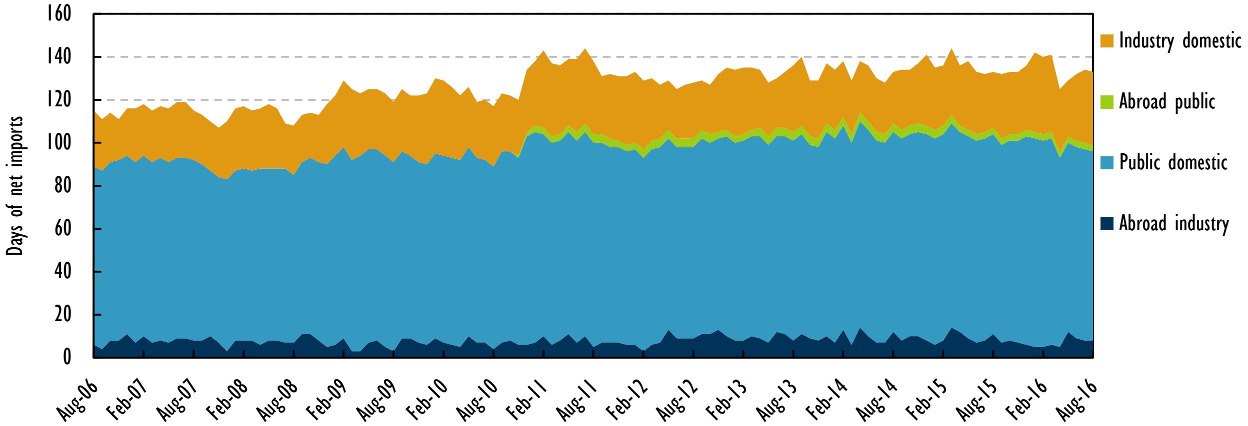
The Czech Republic has a strong record of compliance with its 90-day obligation. As of the end of November 2015, the country held stocks equivalent to 133 days of net imports (98 days of which are public stocks and 35 days are industry stocks). The total volume of stock held was 2.7 Mt of crude oil-equivalent (or 20.5 mb), whereas the quantity required to meet the 90-day obligation was 1.8 Mt (or 13.9 mb) – or around 860 kt (6.6 mb) in excess of the required minimum.

Decision making and responding to a call for collective action

In the case of an IEA declared emergency, the chairperson of ASMR may approve the use of emergency oil stocks in excess of the 90-day obligation without the consent of the government. In the event of any such decision, the ASMR chair is required to immediately inform the NESO, MIT, the Central Crisis Committee, the Security Council of the State and the government. If the drawdown will cause stocks to fall below the 90-day requirement, government approval of the ASMR chair's decision is required. Decision making under the Initial Contingency Response Plan can be completed within 48 hours in situations where government approval is not needed – but it may take longer.

In the case of a domestic oil supply disruption, the NESO must be convened to discuss appropriate measures for mitigating the impact of the disruption. The Central Crisis Committee, Security Council of the State, the government and the media are to be informed of any discussion outcomes and proposed solutions.

Figure 10.6 Czech Republic's compliance with the IEA 90-day obligation



Source: IEA (2016), *Monthly Oil Statistics*, [December], www.iea.org/statistics/.

During a drawdown of ASMR stocks, volumes may be either lent or sold at tender with loans the preferred method of release. The process is designed to run transparently, with offers posted on the ASMR website. There are no restrictions on who can participate in an oil stock loan or tender process, but tenders may initially be addressed only to direct industrial users and petrol station owners, and recipients are not allowed to export any of the volumes lent or purchased. NESO members have agreed that in the event of a stock release during an oil supply disruption, industry stocks will be drawn down ahead of ASMR/government stocks. It is notable that although the policy appears robust, the sale process for ASMR stocks has never been used in practice nor tested during an exercise.

On 4 September 2013, the ASMR signed an agreement on processing petroleum during oil crisis situations. This strategic agreement defines the conditions under which emergency oil stocks held by the ASMR would be processed in Unipetrol-owned refineries. The ASMR would then distribute the processed petroleum products to the crisis management authorities and the public.

Financing and monitoring

The ASMR is an independent government body overseen directly by the government rather than by a specific ministry or other agency. The Minister of Finance and Minister of Industry and Trade are jointly authorised to recommend nominees for the position of director of the ASMR to the government. These ministers have no authority over, or responsibility for, the ASMR.

ASMR oil stocks are government property, and all acquisition, maintenance and storage costs are met from the central government budget. The government is entitled to use any income generated by the sale of ASMR stocks to offset these costs. The ASMR is responsible for monitoring quantities and the quality of stock held by storage operators in its behalf. It must also report total stock levels and composition to the Czech government and the European Commission.

OIL DEMAND RESTRAINT AND OTHER OIL EMERGENCY RESPONSE MEASURES

Oil demand restraint policy and measures

During a declared emergency, appropriate demand restraint measures are proposed by the ASMR chairperson for approval by the government. These range from voluntary measures, which would be used in the first instance, to compulsory measures that may be adopted if required.

Compliance with demand restraint measures is monitored and enforced by a range of authorities depending on which measure is used. These include the police, the Rail Authority, the Civil Aviation Authority, the Czech Trade Inspection Authority and the Customs Administration.

The measures available to reduce the consumption of oil and petroleum products are listed in the Petroleum Emergency Response Guidelines, which was prepared in accordance with the provisions of Act 189/1999 Sb., on strategic petroleum reserve, petroleum emergency response and amendment of some related laws (Strategic Petroleum Reserve Act). There are no published criteria to establish when such measures would be activated, however, or how they would be implemented in practice. Also, it is unclear what the expected savings from each measure would be. The demand restraint measures listed in the Petroleum Emergency Response Guidelines are:

- Reduce the speed limits for motor vehicles on public roads.
- Prohibit or limit the use of certain types, categories and classes of motor vehicles on certain days or for certain purposes.
- Prohibit or limit the use of cars with odd or even end numbers on registration plates on certain days.

- Limit the use of diesel-powered railway engines.
- Limit commercial air transport and other related aviation activities.
- Limit the business hours of petrol stations and prohibit the sale of fuel to containers.
- Set up regulatory measures for the use of crude oil and petroleum product supply for essential suppliers.
- Introduce a rationing system.
- Temporarily prohibit or limit the export of crude oil and petroleum products.

Other oil emergency response measures

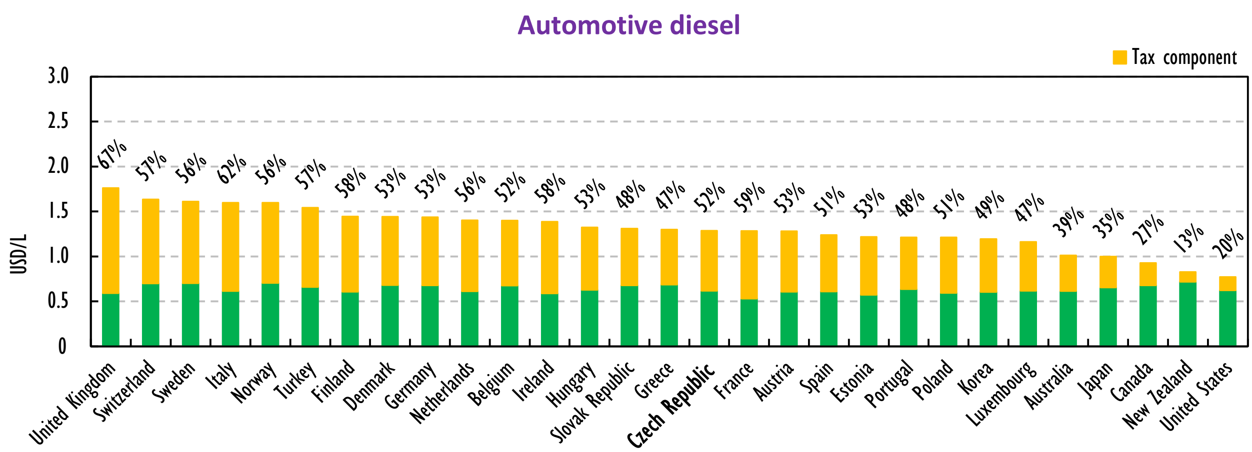
Fuel switching is not an option in the Czech Republic, as the country's capacity in this area is only a fraction of total oil consumption. Likewise, reducing fuel specifications or other environmental regulations to boost potential supply are also not realistic options, as decisions in this area are the prerogative of the European Union and cannot easily be imposed locally.

PRICES AND TAXES

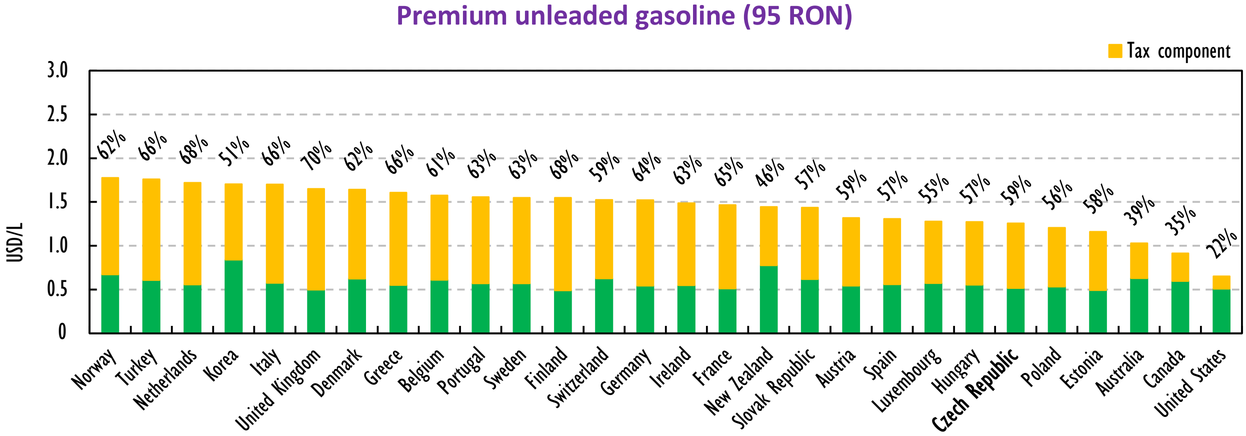
By mid-2015, there were 7 045 retail sites in the Czech Republic (register of MIT). Of these, 3 819 are open to public and operated on a commercial basis. The remaining 3 226 are closed to public and service the needs of their owners.

End-user prices are fully liberalised and their levels are not subject to any regulation. Some small subsidies exist in the sector: excise tax and road tax are used as incentive mechanisms in some cases. A reduced or completely abandoned excise tax applies to different fuels or mixed fuels with a biofuel component. No excise tax is levied on 100% fatty-acid methyl esters (FAME) and E85, and a partly reduced charge is applied to diesel/FAME (30%) blend. Minimum duties and taxes are applied to CNG for use in transport.

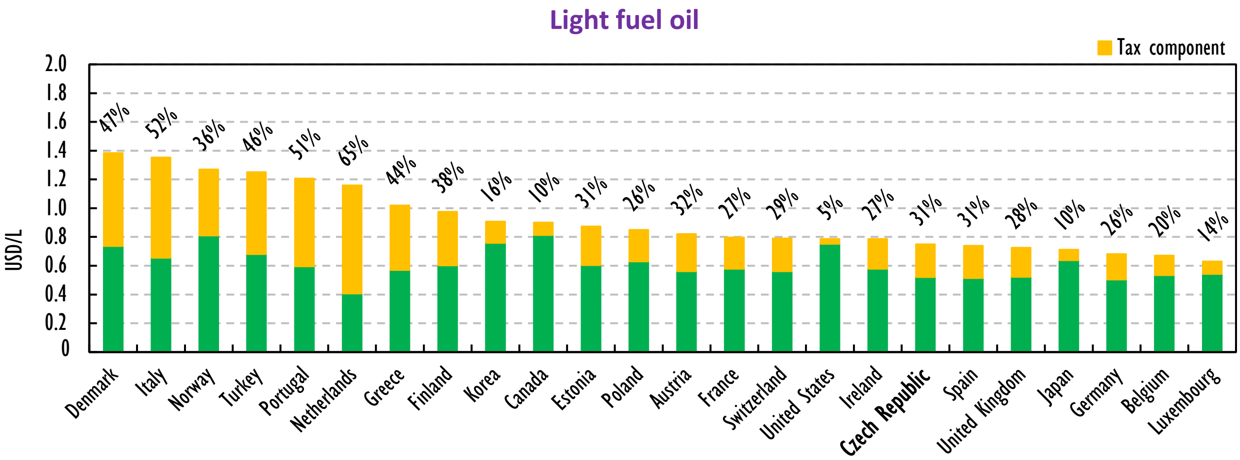
Figure 10.7 Fuel prices in IEA member countries, first quarter 2016



Note: USD/L = United States dollar per litre.



Notes: RON = research octane number. Data are not available for Japan.



Note: Data not available for Australia, Greece, Hungary, New Zealand, the Slovak Republic and Sweden.

Source: IEA (2016c), *Energy Prices and Taxes 2016*, Q1, www.iea.org/statistics/.

ASSESSMENT

Oil represents the second-largest share of TPES after coal, with 20.8% in 2014. It has stood at this level for the last decade. Transport is by far the largest oil-consuming sector, accounting for nearly two-thirds of all oil use. Industry accounts for 31.4% and commercial services for 4.2% of the total. Diesel is the single largest component in the mix of oil products, representing 47.9% of total oil demand. Automotive diesel has a price advantage for consumers compared with gasoline because of a lower tax rate. Accession to the European Union in 2004 was a significant contributing factor to the increase in diesel demand, as this has led to a greater number of HGVs transiting the country.

Over 96% of oil demand is met by imports, largely in the form of crude oil from countries of the Former Soviet Union. Russia is the single largest source of crude oil imports, providing 56.5% of the total in 2014, but its share has been declining gradually for the last decade. Imports from Azerbaijan have steadily grown over the same period and accounted for 31.4% of crude oil imports, while Kazakhstan provided 11.1%. The Czech Republic imports little refinery feedstocks (11 kt) and no NGLs.

Oil demand has been declining since 2008, when it peaked at 215 b/d, following a period of steady economic growth. Demand for diesel was the greatest factor for increased oil demand in the period from 2000 to 2008, when total demand increased at an average annual rate of 2.9%. Oil demand stood at 203 kb/d in 2014 and is expected to slightly decline in the future.

MND is the only oil exploration and production company in the Czech Republic and it produces only 2% of the country's total oil demand. Two oil refineries at Litvínov and Kralupy, owned by the Unipetrol Group, contribute to supply and account for over 90% of refining capacity. Since 2012, the other Unipetrol-owned refinery in Paramo has focused on processing petroleum into refinery and asphalt products and in the production of lubricating and process oils.

The main channel for crude oil is the Druzhba pipeline, originating in Russia and transiting Belarus, Ukraine and the Slovak Republic before terminating in the Czech Republic. MERO is the state-owned pipeline operator and owner of the Czech part of the Druzhba pipeline. The pipeline can deliver Russian and domestic crude oil to the central storage tank farm in Nelahozeves. In 2013, MERO became a shareholder in the TAL-IKL pipeline that brings crude oil from the Mediterranean, as part of the country's diversification of supply. MERO has 1.55 mcm of storage capacity for crude oil.

The oil-product pipeline network, owned and operated by state-owned CEPRO, connects the main consumer regions of the country to domestic refineries. Total product storage capacity in the Czech Republic is approximately 25 mb, mostly owned and operated by CEPRO. The company is also the owner of approximately 190 petrol stations (5% of total) which puts it in third place in the number of petrol stations and a fourth place by the volume of fuel sales.

The NAP CM has high ambitions for electric mobility and for the use of CNG and LNG in the transportation sector, for which market incentives still have to be designed. Policies related to biofuels are overseen by the Ministry for Agriculture. In August 2014, the Czech government approved the multi-annual programme to support sustainable biofuels in the transport sector for the period 2015-20. This programme was abandoned in 2015.

The Czech Republic's primary response measure in an oil supply disruption is the use of public oil stocks, which are composed of roughly 50% products and 50% crude oil. The ASMR has the mandate to meet the entire Czech oil stockholding obligation to the IEA and the European Union. The chairman of the ASMR has the power to draw down public stocks held in excess of this minimum level, without needing to seek government approval. This allows the Czech Republic to respond quickly to a call for an IEA action or to provide loans to relieve shortages in domestic supplies. In case of oil supply disruptions, there are also demand restraint measures available, ranging from soft (educating fuel efficiency to the public) to hard (limiting motor vehicle use, imposing driving restrictions and fuel rationing), but they are not likely to be used early on in a crisis.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *In light of the current imbalance of petrol and diesel use, and the existing old diesel car fleet, which creates local pollution in populated areas, review whether the tax difference between diesel and petrol should be removed.*
- ☐ *To increase energy security, partially replace existing crude stocks of REBCO with stocks of light sweet crude blends to ensure that the emergency oil stocks are better aligned with domestic refining needs.*

References

IEA (International Energy Agency) (2016a), *Oil Information 2016*, www.iea.org/statistics/ , OECD/IEA, Paris.

IEA (2016b), *Energy Balances of OECD Countries 2016*, www.iea.org/statistics, OECD/IEA, Paris.

IEA (2016c), *Energy Prices and Taxes 2016*, Q1, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2016), *Monthly Oil Statistics* [December], www.iea.org/statistics / , OECD/IEA, Paris.

PART III
ENERGY TECHNOLOGY

11. ENERGY TECHNOLOGY RESEARCH, DEVELOPMENT AND INNOVATION

Key data (2014)

Government spending on energy R&D: CZK 410.3 million

Share of GDP: 0.1 units of GDP per USD 1 000

R&D per capita: CZK 43

OVERVIEW

While the State Energy Policy (SEP) prioritises support for research, development and innovation (RDI) in the energy sector, the country rates poorly compared with other member countries of the International Energy Agency (IEA). There is no comprehensive long-term strategy to support energy technology research, development and demonstration (RD&D), but there are a number of highly specialised facilities and research infrastructures such as ÚJV Řež, a. s., which has a long history of research activity in nuclear and other energies, and a number of other research reactors and tokamaks. The SEP highlights the need to increase funding for research and development (R&D) in the energy sectors and notes that any science and research development strategy should have an emphasis on the energy sector.

RD&D STRATEGY

NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION POLICY

In October 2009, the government of the Czech Republic approved the National Research, Development and Innovation Policy of the Czech Republic 2009-2015 (NRDIP). This document replaced previous policies for the period 2004-08 and the National Policy of Innovation for 2005-10. The aim of NRDIP is to create a framework for the implementation of RDI-related measures stimulating the development of a knowledge-based society, which will contribute to the competitiveness of the domestic economy and improve the quality of life in the Czech Republic. The NRDIP focuses on eight areas, one of which is energy, for which it established milestones and a set of related activities that together contribute to achieving its objectives.

The purpose of energy R&D activities is to ensure that the Czech Republic has sustainable, reliable and cost-effective energy sources and infrastructure networks, and therefore the capacity to promote growth and competitiveness across the economy. The NRDIP also acknowledges that it is necessary to ensure that the energy sector develops in a way that is as environment-friendly as possible and in line with the objectives of the European energy policy. Energy priorities include research in fossil fuels, nuclear-fission and fusion-energy facilities; renewable and distributed resources; energy distribution networks; and other energy infrastructure. Energy research is closely linked to other fields of activity such as materials research, engineering, security and defence, and environmental research.

The NRDIP highlights the following activities across a number of energy-related research fields:

- **Fissile nuclear energy**: ensuring the safe, reliable and economic operation of existing nuclear power plants and extending their service life by up to 60 years; the development and innovation of new third-generation and generation III+ nuclear power plants; the R&D of fourth-generation nuclear systems.
- **Thermonuclear fusion**: high-tech materials, plasma stability and the development of high-repetition, diode-pumped high-power lasers.
- **Renewable and alternative energy sources**: focusing on the use of biomass, wind energy and geothermal energy, as well as on the use of solar energy through new photovoltaic (PV) materials and efficient PV cells; the efficient use of secondary energy sources (waste heat), energy storage, and technical equipment and systems related to renewable energy sources; hydrogen management and the use of hydrogen in fuel cells or internal combustion engines for transportation or decentralised energy.
- **Local distributed energy units and integrating them into broader infrastructure**: focusing on the dependence of heating on fossil fuels, taking into account the difficulties in transporting heat from large energy sources, and managing problems with quick-start sources.
- **Energy research**: focusing on reliability of energy distribution networks, including the integration of distributed energy sources and system security. At the same time, research will focus on new elements of network infrastructure for the supply of hydrogen or synthesis gas for the production of second-generation biofuels.

In November 2016, the Research and Development Council approved an updated version of NRDIP for the years 2016-20.

NATIONAL INNOVATION STRATEGY OF THE CZECH REPUBLIC

In September 2011, the government approved the **National Innovation Strategy of the Czech Republic** (NIS), which amended the NRDIP. The aim of the NIS is to create the conditions, and lay the foundations, for the formulation of the Czech Republic's innovation policy. Its purpose is to strengthen the importance of innovation and the use of modern technologies as a source of competitiveness and to increase their contribution to long-term economic growth, high-quality job creation and development of quality of life.

NATIONAL PRIORITIES OF ORIENTED RESEARCH, EXPERIMENTAL DEVELOPMENT AND INNOVATIONS

The priority areas of energy technology RDI are set out in the **National Priorities of Oriented Research, Experimental Development and Innovations** (NPOREDI) document, which was approved by the Czech government in July 2012 (Table 11.1). This document builds on the goals and activities of the NRDIP.

There are six defined priority areas, and each has several sub-areas with defined targets:

- competitive knowledge-based economy
- sustainability of energy and material resources
- environment for quality life
- social and cultural challenges
- healthy population
- safe society.

Both the sustainability of energy and material resources and the environment for quality life priority areas contain a number of sub-areas and targets for the energy sector.

Table 11.1 Energy-related priority areas in the NPOREDI

Priority area	Sub-area and no. of targets	Goal
Sustainable energy and material resources	Sustainable energy (25 targets)	To achieve a long-term sustainable energy mix based on many sources, with priority use of all domestic energy sources; increase energy independence; and ensure energy security.
	Lowering the energy demand of the economy (6 targets)	To sustain the current pace of decreasing energy demand of the economy and improve the quality of the environment.
	Material base (4 targets)	To achieve sustainable and competitive material economy and the efficient use of all resources and technological changes.
Environment for quality life	Natural resources (10 targets)	To ensure the functioning and stability of the key parts of the environment – biodiversity, water, soil, air and mineral deposits.
	Global changes (3 targets)	To prevent activities that alters the balance in biodiversity and creates risks for human health.
	Sustainable development of landscape and settlements (3 targets)	To decrease the fragmentation of the landscape as a result of changes of territorial structure of settlement and production activities of man.
	Environmental technologies and eco-innovations (8 targets)	The implementation of new technologies and processes to reduce the environmental strain of air protection, water, waste management, recycling and removal of old ecologic damage.
	Environment-friendly society (2 targets)	Setting up the development of the economy in a way that prevents the deterioration of the environment, loss of biodiversity and unsustainable use of natural resources.

Source: MIT (2012), *National Priorities of Oriented Research, Experimental Development and Innovations*.

Each sub-area, goal and target was submitted to an Expert Co-ordination Council for review. This group then translated each target into draft R&D priorities and allocated appropriate funding. Each of the defined priority areas was allocated a share of overall allocated funding.

The percentage listed next to individual priority areas in Table 11.2 represents the approximate shares of funding, which will be allocated for the implementation of R&D priorities from the total R&D budget. It doesn't represent the total direct support funding. It is also expected that the share of private funding spent on the co-funding of projects aimed at the fulfilment of R&D priorities will in some cases be higher and in others lower.

Table 11.2 Allocation of funding to priority areas in the NPOREDI

Priority area	Share of funding
Competitive knowledge-based economy	20%
Sustainability of energy and material resources	18%
Environment for quality life	18%
Social and cultural challenges	10%
Healthy population	20%
Safe society	14%

Source: MIT (2012), *National Priorities of Oriented Research, Experimental Development and Innovations.*

INSTITUTIONS

There are a number of ministries and government agencies active in the energy technology RD&D sector. Following the enactment of Act No. 130/2002 Coll. on the support of R&D from public funds in 2002, all authority in relation to supporting R&D, including international co-operation, has been vested in the Ministry of Education, Youth and Sports (MEYS). The Ministry of Industry and Trade (MIT) is responsible for industrial research and is also recognised as a guarantor for innovation, which is supported with resources from operational programmes under its jurisdiction.

A government advisory body, the Research and Development Council (RDC), was also established in accordance with this act. The RDC is responsible for the preparation and implementation of national R&D policy. In 2014, a special section for science, research and innovation was established under the Office of the Government. This office has taken over some tasks and responsibilities of the RDC.

In 2009, the Technology Agency of the Czech Republic (TA CR) was established. The establishment of TA CR was one of the steps that followed implementation of the Reform of the Research, Development and Innovation programme in 2008. TA CR centralises state support in the field of applied R&D, which was previously scattered across a large number of support providers. The main function of TA CR is the preparation and implementation of programmes of applied RDI.

Basic research is carried out primarily by the Czech Academy of Sciences, which was created especially for this purpose, and is supported by the Grant Agency of the Czech Republic. Basic research and applied research is also carried out by the universities and research organisations. Several ministries also support the implementation of RDI within their jurisdiction by means of their own programmes.

TECHNOLOGY PLATFORMS

The Czech Republic has also established entities known as technological platforms, which resemble European technology platforms and mimic them in some sense. Their role is to activate private-sector involvement and international activity. Some of them are focused on energy research technologies, for example, the National Technology Platform for Hydrogen Technologies; the National Technology Platform for Biogas; the Technology Platform on Sustainable Water Resources; the Technology Platform for Sustainable Mobility; the Technology Platform for Energy Security; the Technology Platform for Smart Grids; and the Technology Platform for Sustainable Energy for the Czech Republic. The Technology Platform for Sustainable Energy for the Czech Republic is the broadest cross-cutting platform with regard to energy technology R&D. This platform also prepares strategic research priorities, which provide valuable input for overall priority formulation.

LARGE RESEARCH INFRASTRUCTURES

Research infrastructures are one of the principal components of the Czech national research and innovation ecosystem. The government has defined a large research infrastructure as "a unique research facility, including its acquisition and related investment costs and the costs of ensuring its activities that are essential for comprehensive research and development with heavy financial and technological demands and which is approved by the government of the Czech Republic and established by one research organisation for the use of other research organisations".

The research infrastructure of the Czech Republic tends to focus on nuclear fission and fusion, energy efficiency, biofuels, geothermal energy, and distributed power and energy. Meanwhile, other relevant R&D activities such as renewable energy and energy efficiency and energy conversion are less well covered. While there are R&D centres, which undertake important energy-oriented R&D programmes, these are not operated on the basis of research infrastructure. Furthermore, as nuclear energy will form an important component of the energy mix of the Czech Republic in the long term, the advanced technologies necessary for addressing nuclear R&D challenges make up an important element of the energy research infrastructures landscape.

CATPRO: EFFICIENT USE OF ENERGY RESOURCES USING CATALYTIC PROCESSES

Hosting institution: Research Institute of Inorganic Chemistry

CATPRO is focused on the efficient use of carbon-energy resources using catalytic processes. One of the biggest challenges in R&D of transformation of carbon-energy raw materials including the use of biomass for the production of advanced liquid fuels and chemicals is the gap between the laboratory and industrial scales. CATPRO thus enables researchers to perform almost all activities in the R&D value chain that are essential to overcome that gap and for the development of heterogeneous catalysts and catalyst processes.

COMPASS: TOKAMAK FOR THERMONUCLEAR FUSION RESEARCH

Hosting institution: Institute of Plasma Physics, Academy of Sciences of the Czech Republic

The COMPASS research infrastructure consists of the tokamak and auxiliary systems.[1] It represents one of the key facilities in a joint European effort to master thermonuclear

1. A tokamak is an experimental machine designed to harness the energy of fusion.

fusion within the EUROfusion consortium (European Consortium for Development of Fusion Energy). COMPASS operates in diverter plasma configuration with ITER-like plasma cross-section allowing it to address the key problems in construction and future exploitation of the ITER tokamak (International Thermonuclear Experimental Reactor). COMPASS works largely within the EUROfusion consortium and collaborates with ITER.

CVVOZE POWER LABORATORIES

Hosting institution: Brno University of Technology

CVVOZE Power Laboratories consists of two special laboratories at the Science and Technology Park of Professor List. The research infrastructure expertise covers research fields such as electrical switching technology adapted to direct-current equipment, physics of the electric arc during a switching process, faults in the structure of insulation materials, and methodology of electromagnetic compatibility measurement and testing. CVVOZE Power Laboratories is a member of DERlab (European Distributed Energy Resources Laboratories).

JULES HOROWITZ REACTOR: PARTICIPATION OF THE CZECH REPUBLIC

Hosting institution: Research Centre Řež

JHR (Jules Horowitz Reactor) will represent a material research reactor of 100 megawatts thermal power output, designed for R&D and material and nuclear fuel qualification. The reactor will make possible a material testing under conditions corresponding to power reactors, an acceleration of model degradation and an evaluation of component properties at the end of their lifetime.

NUCLEAR RESEARCH REACTORS LVR-15 AND LR-0

Hosting institution: Research Centre Řež

The LVR-15 and LR-0 nuclear research reactors are a research infrastructure for basic and applied R&D in the field of neutron applications, especially for nuclear power technologies of Generation II, III, IV and fusion. The experimental loops can be used also in conventional power engineering, such as supercritical water or hydrogen technology.

RINGEN: RESEARCH INFRASTRUCTURE FOR GEOTHERMAL ENERGY

Hosting institution: Charles University in Prague and its partner institutions

RINGEN will be constructed in an existing geothermal site with a 2.1 kilometre deep testing well. The aim of RINGEN will be the R&D support and offer of services and expertise in deep geothermal energy exploitation and related areas such as underground construction, or oil and gas exploitation.

SUSEN: SUSTAINABLE ENERGY

Hosting institution: Research Centre Řež partnered with the University of West Bohemia in Pilsen

The SUSEN research infrastructure, currently under construction, will focus on nuclear research. Its future development will be aligned with the research goals set out in the National Nuclear Energy Action Plan of the Czech Republic.

TRAINING REACTOR VR-1

Hosting institution: Czech Technical University in Prague

The VR-1 Training Reactor is a key experimental facility for R&D in the field of safe operation of nuclear installations, theoretical and experimental reactor and neutron physics, and nuclear fuel cycle and fuel management, and as a source of neutrons for dedicated experiments. The reactor collaborates with 18 Czech and 28 foreign research organisations. It is a member of national and international educational and research networks such as the Eastern European Research Reactors Initiative, the Research Reactors Operators Group and the European Nuclear Education Network. The reactor has developed a wide collaboration with the International Atomic Energy Agency (IAEA).

FUNDING

TA CR operates seven funding programmes or schemes:

The **ALFA programme** aims to support applied research and experimental development notably in the field of advanced technologies, materials and systems; energy resources and the protection and creation of the environment; and the sustainable development of transport.

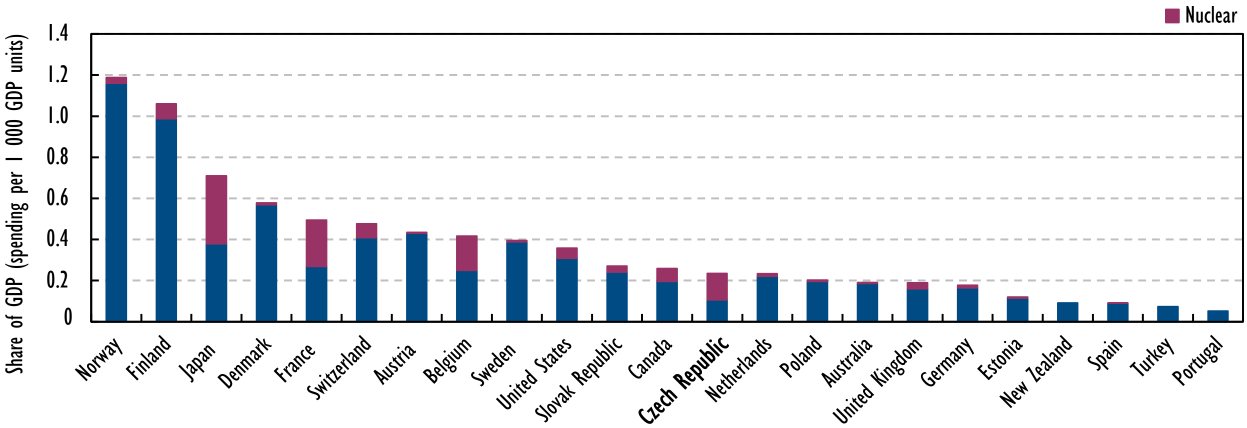
The **BETA programme** is a public procurement programme in research, experimental development and innovation for the government. **The GAMMA programme** aims to support the verification of the results of applied research and experimental development in terms of their practical application and to prepare their subsequent commercial use. The main objective of the programme is to support and significantly streamline the transformation of RDI results achieved in research organisations and/or in collaboration between research organisations and enterprises into practical applications to enable their commercialisation and support their implementation.

The **DELTA programme** is aimed at supporting collaboration in applied research and experimental development projects through joint projects of enterprises and research organisations supported by TA CR and major foreign technological and innovation agencies and other similar agencies with which TA CR has/will have at the time of publication of the public tender in RDI established collaboration.

The EPSILON programme is mainly focused on improving the standing of the Czech Republic, as well as European industry, through the support of applied research and experimental development, whose results have a high potential for rapid application in new products, production processes and services. **The OMEGA programme** supports projects of applied research and experimental development, the results of which have a high potential for application. **The Competence Centres programme** supports the establishment and operation of centres for RDI in advanced fields of science.

MIT is also responsible for funding programmes. None of them is focused solely on the energy sector and energy technologies, but activity in the energy sector might be supported in those funding schemes.

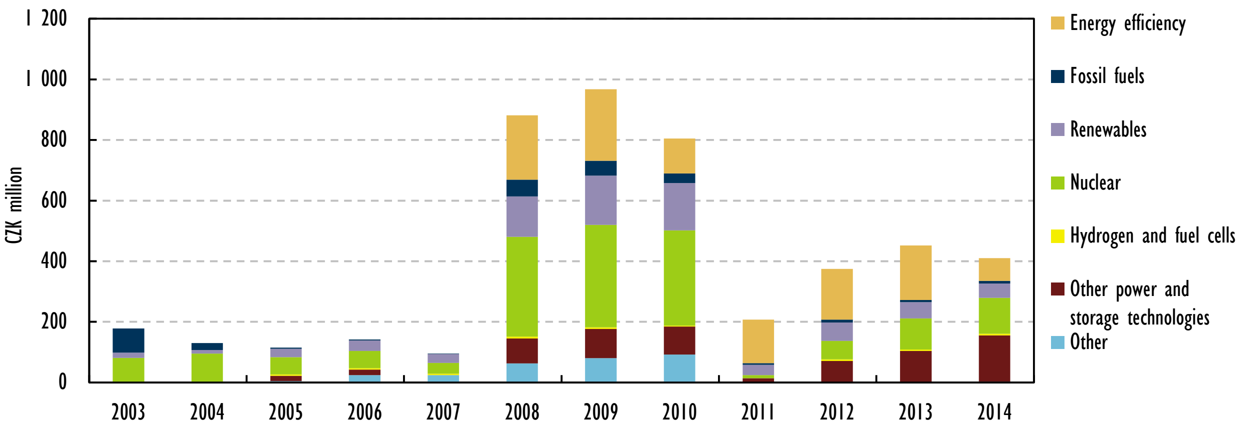
Figure 11.1 Government energy RD&D spending as a ratio of GDP in IEA member countries, 2014



Notes: GDP = gross domestic product. Includes demonstration. Data are not available for Greece, Hungary, Ireland, Italy, Korea, Luxembourg.

Source: IEA (2015), "RD&D budget", Energy Technology RD&D (database), www.iea.org/statistics/.

Figure 11.2 Government energy RD&D spending in the Czech Republic, 2003-14



Note: CZK = Czech koruny. Government energy RD&D spending including demonstration.

Source: IEA (2015), "RD&D budget", Energy Technology RD&D (database), http://www.iea.org/statistics/

MONITORING AND EVALUATION

The overall evaluation of the R&D funding projects is the responsibility of the RDC. For this purpose the council created a methodology for evaluation of the results of research organisations and evaluation of the results of completed programmes, which was valid for the period 2013-15. Generally, the evaluation is based on resources attributed to the programme, on the outputs of the project and on its compliance with the given priorities. Reform of evaluation mechanisms is focused on reformulation of the evaluation process and the introduction of project efficiency measures similar to those in other European Union (EU) countries.

Following on the initial phase (since 2010) of financing of large infrastructures from the state budget, expenditures on R&D and investments made by using the European Regional Development Fund in the period 2007-15, MEYS performed a comprehensive evaluation of research infrastructures in 2014. All research infrastructures, regardless of their previous main funding source, were subject to this assessment, which was carried out by an International Evaluation Committee.

The evaluation itself was carried out in two stages and was based on the principles of informed international peer review combining the methods of panel and peer review evaluation. To pass the first stage of assessment, all proposals were expected to fulfil the definition of a research infrastructure. The second stage of assessment consisted of a detailed evaluation of the quality level of research infrastructure characteristics. The outcomes and recommendations made by the International Evaluation Committee will serve MEYS and the government as the independent expert basis for the informed policy decision making concerning funding the large infrastructures, declaring the political and financial commitment of the Czech Republic to the pan-European research infrastructures and joining the emerging European Research Infrastructure Consortiums to be established within the European Research Area (ERA).[2]

INTERNATIONAL COLLABORATION

The Czech Republic participates in one IEA Technology Collaboration Programme (formally organised under the auspices of an Implementing Agreement), the Energy in Buildings and Communities Programme. The Czech Republic also participates in 17 EU Horizon 2020 projects.[3] Participation of the country compared with others among the 28 EU member states is low in non-nuclear energy research. Participation in the Euratom Programme, however, is very high, and the Czech Republic participates in 243 out of 311 programmes, reflecting the high quality of nuclear energy R&D in the country. Participation of the private sector is limited and mainly executed through co-funding of some funding programmes.

ASSESSMENT

The SEP identifies research, development, innovation and education as fundamental factors in establishing the competitiveness of the energy economy and critical factors for success. The government will focus support on sectors in which Czech RD&D already achieves international standards or where it has a significant competitive advantage.

In order to achieve the objectives set out in the SEP, the possibilities provided by effective RDI policy should be fully exploited. The SEP has the potential of filling the gap of clear energy technology policy guidelines that can catalyse the interest and resources of the scientific and industrial communities.

The country has made some positive progress such as the publication of the NRDIP, the establishment of the TA CR, and the development of national priorities of oriented research, experimental development and innovations. Further reforms of the sector are planned and include simplified administration rules and the establishment of the Ministry for Research and Development, which is under consideration at present, although it is not clear how this ministry will prioritise investment in the energy sector over other competing interests. At present there are a number of agencies and

2. An ERA is a unified research area open to the world based on the EU internal market, in which researchers, scientific knowledge and technology circulate freely.

3. The EU Framework Programme for Research and Innovation.

ministries overseeing the sector and resulting in complex decision-making and funding arrangements.

The SEP also highlights the need to increase the level of funding available for R&D in the energy sector and engineering. The main funding source is the state budget, which lacks a specific part dedicated to energy research. Overall, the level of resources devoted to research and innovation, both private and public, is significantly lower in the Czech Republic compared with other IEA member countries. Furthermore, funding from the private sector is limited, and the level of activity is hard to determine. Nonetheless, the Czech Republic has been successful in obtaining funding from the EU Horizon 2020 Framework Programme for Research and Innovation, notably Euratom. Energy R&D is an important policy instrument to meet national energy policy objectives. Given the stringent budgetary conditions for government energy R&D programmes in many member countries, a coherent energy R&D strategy with clear prioritisation in line with national energy policy goals is essential. Transparency and involvement of major stakeholders in defining a national energy R&D strategy is of key importance.

The energy R&D activities of the Czech Republic are dispersed among many different research organisations, most of which are small compared with their European peers. There is a need for Czech research organisations to strengthen their co-operation so that the concentration of efforts can delivery greater efficiency (cost sharing) when increasing the capacities and capabilities of joint research infrastructures. The Czech energy R&D sector should seek to increase the participation of foreign researchers and integrate the national energy research infrastructures of the Czech Republic into the ERA. The Czech involvement in the construction of JHR and the Czech participation in the EUROfusion consortium established under the Euratom Research and Training Programme can be considered good examples in this respect (MEYS, 2015).

A notable feature of the research environment in the Czech Republic is the use of an external evaluation committee to assess research infrastructures. This is a good model and provides an independent expert basis for political decision making on funding the large infrastructures. Adoption of a similar model should be integrated into the NRDIP in order to provide an effective tool to monitor and evaluate the performance of public-funded energy R&D activities and to maximise the cost-effectiveness of the R&D programmes.

RECOMMENDATIONS

The government of the Czech Republic should:

- ☐ *Define, on the basis of the SEP and the NRDIP, and through a multi-stakeholder involvement process, clear priorities for energy technology RDI alongside a stable funding mechanism.*
- ☐ *Increase the level of funding available to RDI activities in the energy sector.*
- ☐ *Enhance the co-ordinating role of the new ministry responsible for policy in the field of technology RDI and ensure that the energy community plays an active role in this new organisation.*
- ☐ *Develop a monitoring and evaluation mechanism based on the independent international evaluation of research infrastructures models.*

References

IEA (International Energy Agency) (2015), "RD&D budget", *Energy Technology RD&D* (database), www.iea.org/statistics/, OECD/IEA, Paris.

MEYS (Ministry of Education, Youth and Sports) (2015), *Roadmap of Large Infrastructures for Research, Experimental Development and Innovation of the Czech Republic for the years 2016-2022*, MEYS, Prague.

MIT (Ministry of Industry and Trade) (2012), *National Priorities of Oriented Research, Experimental Development and Innovations*, MIT, Prague.

PART IV
ANNEXES

ANNEX A: ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The Shared Goals, which were adopted by the International Energy Agency (IEA) Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

REVIEW TEAM

The IDR team visited Prague from 1 to 6 November 2015. During the visit, the review team met with government officials, representatives from ministries and government agencies, market participants, non-governmental organisations, consumers groups, and other organisations and stakeholders. This report was drafted on the basis of the information obtained in these meetings, the Czech government response to the IEA energy policy questionnaire and information from many other sources. The team is grateful for the co-operation and hospitality of the many people it met during the visit. Thanks to their openness and willingness to share information, the review visit was highly productive.

The team is grateful for the co-operation and assistance of the many people from the many state, public and private institutions it met throughout the visit. Thanks to their openness and willingness to share information, the visit was highly informing, productive and enjoyable. The team wishes to express its gratitude to Mr Pavel Šolc, Advisor to Minister, Ministry of Industry and Trade, and Mrs Lenka Kovačovská, Deputy Minister, Energy Section, the management team and support staff of the Ministry of Industry and Trade, notably Mr Tomáš Smejkal, Head of Unit Strategy, for their input and support throughout the visit. The team is especially thankful to Ms Magdalena Vyslychová for organising the team visit, facilitating our many requests but also for her patience throughout the week. The team is also grateful to Zevo Praha Malesice for hosting the field trip and providing us with a detailed overview of their waste and energy activities.

The members of the review team were:

Team Leader: Mr Andrej Miller, Senior Advisor, Home Energy Directorate, Department of Energy & Climate Change, United Kingdom

Mr Jako Reinaste, Head of Energy Market Co-ordination (Energy Department), Ministry of Economic Affairs and Communications, Estonia

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Ms Ingrid Post, Unit Manager Renewable Energy, Ministry of Economic Affairs, Netherlands

Mr Geoffrey Rothwell, Principal Economist, Nuclear Development Division, Organisation for Economic Co-operation and Development (OECD)

Mr Aad van Bohemen, Head of Division, Country Studies Division, IEA

Mr. David Morgado, Energy Analyst, Energy Efficiency and Environment Division, IEA

Mr Kieran McNamara, Desk Officer, Country Studies Division, IEA

The review was prepared under the guidance of Mr Paul Simons, Deputy Executive Director, IEA, and Mr Aad van Bohemen, Head of Country Studies Division, IEA. Kieran McNamara managed the review and is the author of the report with the exception of Chapter 4 on energy efficiency, which was drafted by Mr. David Morgado, and Chapter 7 on nuclear energy, which was drafted by Mr Geoffrey Rothwell of the Nuclear Energy Agency. Mr. Jan Bartos was a substantial contributor to chapter 10 on oil.

Ms Sonja Lekovic and Ms Yun Ji Suh prepared and drafted the sections relating to energy data contained in each chapter. Mr Carlos Fernandez-Alvarez, Mr Paolo Frankl, Mr Heymi Bahar, Ms Rebecca Gaghen, Ms Costanza Jacazio and Ms Roberta Quadrelli each contributed helpful comments throughout.

Ms Lekovic, Ms Yun Ji Suh, Mr Oskar Kvarnström, Ms Catherine Smith and Mr Bertrand Sadin prepared the figures. Ms Quadrelli and Ms Zakia Adam provided support on statistics. Ms Viviane Consoli and Ms Therese Walsh provided editorial assistance while Ms Muriel Custodio, Ms Astrid Dumond and Ms Katie Russell managed the production process. Ms Catherine Smith, Ms Yun Ji Suh, Ms Sonja Lekovic and Mr Oskar Kvarnström helped in the final stages of preparation.

ORGANISATIONS VISITED

Administration of the State Material Reserves

Asociace poskytovatelů energetických služeb

ČAPPO

ČEPRO

ČEPS

Česká rafinérská

ČEZ

ČEZ Distribuce

Chamber of Renewable Energy Sources

Czech Biomass Association

Czech Gas Association

Czech Nuclear Society

Czech Photovoltaic Association

Czech Solar Association

Czech Society for Wind Energy

Ekowatt

Electricity and gas market operator (OTE)

Energy Regulatory Office (ERO)

Enviros

Glopolis

Greenpeace

Heating Association

Klimatická koalice

MERO

Ministry of Education

Ministry of Environment

Ministry of Finance

Ministry of Foreign Affairs

Ministry of Industry and Trade

Ministry of Transport

NET4GAS

Office of the Government of the Czech Republic

OKD

Radioactive Waste Repository Authority

Research Centre Rez

RWE Gas Storage

Šance pro budovy

SEVEN Energy

Severní energetická

Severočeské doly

Sokolovská uhelná

State Energy Inspection

State Office for Nuclear Safety

Technology Agency of the Czech Republic

Technology Centre

Vršanská uhelná

Zelený kruh

ANNEX B:
ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1980	1990	2000	2010	2013	2014
TOTAL PRODUCTION		**38.51**	**41.21**	**40.94**	**30.57**	**31.65**	**30.16**	**29.26**
Coal		37.82	40.35	36.31	25.05	20.73	17.77	16.93
Peat		0.19	0.10	-	-	-	-	-
Oil		0.04	0.24	0.22	0.38	0.27	0.26	0.26
Natural gas		0.36	0.32	0.20	0.17	0.20	0.21	0.21
Biofuels and w aste[1]		-	-	0.83	1.27	2.77	3.39	3.50
Nuclear		-	-	3.28	3.54	7.32	8.04	7.92
Hydro		0.09	0.21	0.10	0.15	0.24	0.24	0.16
Wind		-	-	-	-	0.03	0.04	0.04
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	..	..	0.09	0.23	0.22
TOTAL NET IMPORTS[3]		**6.73**	**6.10**	**7.39**	**9.23**	**11.09**	**11.47**	**12.24**
Coal	Exports	2.56	8.41	7.26	5.78	5.20	3.88	3.64
	Imports	0.15	1.63	1.57	1.04	2.20	1.97	2.83
	Net imports	-2.42	-6.78	-5.69	-4.74	-3.00	-1.90	-0.81
Oil	Exports	0.03	10.57	6.55	1.08	1.63	1.75	1.99
	Imports	8.88	21.45	15.13	8.60	10.59	9.98	10.80
	Int'l marine and aviation bunkers	-0.24	-0.29	-0.22	-0.16	-0.31	-0.28	-0.29
	Net imports	8.61	10.60	8.36	7.36	8.66	7.94	8.51
Natural Gas	Exports	0.00	-	-	0.00	0.13	0.01	0.00
	Imports	0.73	2.41	4.78	7.48	6.97	6.97	5.95
	Net imports	0.72	2.41	4.78	7.48	6.84	6.96	5.95
Electricity	Exports	0.44	0.45	0.76	1.61	1.86	2.36	2.42
	Imports	0.25	0.32	0.70	0.75	0.57	0.91	1.02
	Net imports	-0.19	-0.13	-0.06	-0.86	-1.29	-1.45	-1.40
TOTAL STOCK CHANGES		**-0.08**	**-0.35**	**1.24**	**1.10**	**1.65**	**0.32**	**-0.29**
TOTAL SUPPLY (TPES)[4]		**45.16**	**46.96**	**49.57**	**40.90**	**44.39**	**41.95**	**41.21**
Coal		35.39	33.36	31.44	21.57	18.31	16.37	15.88
Peat		0.19	0.10	-	-	-	-	-
Oil		8.66	10.84	8.73	7.72	8.97	8.24	8.72
Natural gas		1.02	2.59	5.25	7.50	8.07	6.94	6.18
Biofuels and w aste[1]		-	-	0.83	1.28	2.65	3.32	3.48
Nuclear		-	-	3.28	3.54	7.32	8.04	7.92
Hydro		0.09	0.21	0.10	0.15	0.24	0.24	0.16
Wind		-	-	-	-	0.03	0.04	0.04
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	-0.00	0.09	0.22	0.22
Electricity trade[5]		-0.19	-0.13	-0.06	-0.86	-1.29	-1.45	-1.40
Shares in TPES (%)								
Coal		*78.4*	*71.0*	*63.4*	*52.7*	*41.3*	*39.0*	*38.5*
Peat		*0.4*	*0.2*	-	-	-	-	-
Oil		*19.2*	*23.1*	*17.6*	*18.9*	*20.2*	*19.6*	*21.2*
Natural gas		*2.3*	*5.5*	*10.6*	*18.3*	*18.2*	*16.6*	*15.0*
Biofuels and waste[1]		-	-	*1.7*	*3.1*	*6.0*	*7.9*	*8.4*
Nuclear		-	-	*6.6*	*8.7*	*16.5*	*19.2*	*19.2*
Hydro		*0.2*	*0.4*	*0.2*	*0.4*	*0.5*	*0.6*	*0.4*
Wind		-	-	-	-	*0.1*	*0.1*	*0.1*
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	*-0.0*	*0.2*	*0.5*	*0.5*
Electricity trade[5]		*-0.4*	*-0.3*	*-0.1*	*-2.1*	*-2.9*	*-3.5*	*-3.4*

0 is negligible, - is nil, .. is not available, x is not applicable.

Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1973**	**1980**	**1990**	**2000**	**2010**	**2013**	**2014**
TFC	**31.35**	**34.66**	**32.76**	**25.84**	**26.42**	**25.32**	**24.94**
Coal	20.06	19.53	12.32	4.78	2.27	2.34	2.20
Peat	0.19	0.10	-	-	-	-	-
Oil	7.75	9.23	8.27	7.30	8.57	8.00	8.47
Natural gas	0.81	1.18	4.24	5.91	6.35	5.64	4.93
Biofuels and waste[1]	-	-	0.82	0.98	2.05	2.27	2.33
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	0.01	0.02	0.02
Electricity	2.54	3.26	4.14	4.25	4.92	4.88	4.83
Heat	-	1.37	2.96	2.62	2.25	2.18	2.16
Shares in TFC (%)							
Coal	*64.0*	*56.3*	*37.6*	*18.5*	*8.6*	*9.2*	*8.8*
Peat	*0.6*	*0.3*	-	-	-	-	-
Oil	*24.7*	*26.6*	*25.3*	*28.2*	*32.4*	*31.6*	*34.0*
Natural gas	*2.6*	*3.4*	*13.0*	*22.9*	*24.0*	*22.3*	*19.8*
Biofuels and waste [1]	-	-	*2.5*	*3.8*	*7.8*	*9.0*	*9.3*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	*0.0*	*0.0*	*0.1*
Electricity	*8.1*	*9.4*	*12.6*	*16.4*	*18.6*	*19.3*	*19.4*
Heat	-	*3.9*	*9.0*	*10.1*	*8.5*	*8.6*	*8.7*
TOTAL INDUSTRY[6]	**18.77**	**20.01**	**17.72**	**11.30**	**9.86**	**9.36**	**9.74**
Coal	11.24	11.59	7.21	3.32	1.60	1.59	1.65
Peat	0.19	0.10	-	-	-	-	-
Oil	5.27	6.12	4.70	2.79	2.78	2.41	2.74
Natural gas	0.46	0.28	2.42	2.60	2.39	2.22	2.13
Biofuels and waste[1]	-	-	0.01	0.18	0.54	0.58	0.62
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	1.61	1.91	2.32	1.63	1.94	2.00	1.98
Heat	-	-	1.08	0.78	0.60	0.56	0.63
Shares in total industry (%)							
Coal	*59.9*	*58.0*	*40.7*	*29.4*	*16.2*	*16.9*	*17.0*
Peat	*1.0*	*0.5*	-	-	-	-	-
Oil	*28.0*	*30.6*	*26.5*	*24.7*	*28.2*	*25.8*	*28.1*
Natural gas	*2.4*	*1.4*	*13.6*	*23.0*	*24.3*	*23.7*	*21.8*
Biofuels and waste [1]	-	-	-	*1.6*	*5.5*	*6.2*	*6.4*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	-	-	-
Electricity	*8.6*	*9.6*	*13.1*	*14.4*	*19.7*	*21.3*	*20.3*
Heat	-	-	*6.1*	*6.9*	*6.1*	*6.0*	*6.4*
TRANSPORT[4]	**2.17**	**2.30**	**2.59**	**4.23**	**5.87**	**5.68**	**5.88**
OTHER[7]	**10.41**	**12.36**	**12.45**	**10.31**	**10.70**	**10.28**	**9.32**
Coal	8.70	7.84	5.12	1.46	0.68	0.76	0.54
Peat	-	-	-	-	-	-	-
Oil	0.59	1.11	1.26	0.56	0.36	0.37	0.37
Natural gas	0.35	0.90	1.83	3.28	3.88	3.36	2.75
Biofuels and waste[1]	-	-	0.81	0.74	1.28	1.42	1.39
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	0.01	0.02	0.02
Electricity	0.76	1.15	1.56	2.42	2.84	2.74	2.72
Heat	-	1.37	1.88	1.84	1.65	1.62	1.54
Shares in other (%)							
Coal	*83.6*	*63.4*	*41.1*	*14.2*	*6.3*	*7.3*	*5.8*
Peat	-	-	-	-	-	-	-
Oil	*5.7*	*9.0*	*10.1*	*5.5*	*3.4*	*3.6*	*3.9*
Natural gas	*3.4*	*7.3*	*14.7*	*31.8*	*36.3*	*32.7*	*29.5*
Biofuels and waste [1]	-	-	*6.5*	*7.2*	*11.9*	*13.8*	*14.9*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	*0.1*	*0.1*	*0.2*
Electricity	*7.3*	*9.3*	*12.5*	*23.4*	*26.6*	*26.7*	*29.2*
Heat	-	*11.1*	*15.1*	*17.9*	*15.4*	*15.8*	*16.5*

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1980**	**1990**	**2000**	**2010**	**2013**	**2014**
ELECTRICITY GENERATION[8]							
Input (Mtoe)	9.69	13.70	18.92	20.41	23.83	23.34	22.70
Output (Mtoe)	3.54	4.53	5.36	6.27	7.34	7.41	7.31
Output (TWh)	41.17	52.66	62.27	72.91	85.32	86.16	84.97
Output Shares (%)							
Coal	*85.1*	*84.8*	*76.4*	*75.4*	*58.8*	*51.4*	*51.5*
Peat	-	-	-	-	-	-	-
Oil	*11.3*	*9.6*	*0.9*	*0.5*	*0.2*	*0.1*	-
Natural gas	*0.9*	*1.1*	*0.6*	*2.3*	*1.3*	*2.0*	*1.9*
Biofuels and waste [1]	-	-	-	*0.7*	*2.6*	*4.8*	*5.6*
Nuclear	-	-	*20.2*	*18.6*	*32.8*	*35.7*	*35.7*
Hydro	*2.6*	*4.6*	*1.9*	*2.4*	*3.3*	*3.2*	*2.2*
Wind	-	-	-	-	*0.4*	*0.6*	*0.6*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	*0.7*	*2.4*	*2.5*
TOTAL LOSSES	**15.13**	**13.78**	**14.34**	**14.88**	**17.53**	**16.86**	**16.16**
of which:							
Electricity and heat generation[9]	6.15	7.46	9.86	10.81	13.41	12.97	12.50
Other transformation	7.41	3.88	1.64	1.24	0.94	0.87	0.94
Own use and transmission/distribution losses[10]	1.57	2.44	2.83	2.82	3.18	3.01	2.72
Statistical Differences	**-1.31**	**-1.48**	**2.48**	**0.18**	**0.44**	**-0.22**	**0.11**
INDICATORS	**1973**	**1980**	**1990**	**2000**	**2010**	**2013**	**2014**
GDP (billion 2010 USD)	106.95	126.86	144.13	151.44	207.02	208.08	212.20
Population (millions)	9.92	10.33	10.36	10.27	10.52	10.51	10.53
TPES/GDP (toe/1000 USD)[11]	0.42	0.37	0.34	0.27	0.21	0.20	0.19
Energy production/TPES	0.85	0.88	0.83	0.75	0.71	0.72	0.71
Per capita TPES (toe/capita)	4.55	4.55	4.78	3.98	4.22	3.99	3.92
Oil supply/GDP (toe/1000 USD)[11]	0.08	0.09	0.06	0.05	0.04	0.04	0.04
TFC/GDP (toe/1000 USD)[11]	0.29	0.27	0.23	0.17	0.13	0.12	0.12
Per capita TFC (toe/capita)	3.16	3.36	3.16	2.52	2.51	2.41	2.37
CO_2 emissions from fuel combustion ($MtCO_2$)[12]	149.4	168.1	150.3	121.3	111.4	101.2	96.6
CO_2 emissions from bunkers ($MtCO_2$)[12]	0.7	0.9	0.7	0.5	0.9	0.8	0.9
GROWTH RATES (% per year)	**73-80**	**80-90**	**90-00**	**00-10**	**10-12**	**12-13**	**13-14**
TPES	0.6	0.5	-1.9	0.8	-2.0	-1.5	-1.8
Coal	-0.8	-0.6	-3.7	-1.6	-2.9	-5.3	-3.0
Peat	-8.8	-100.0	-	-	-	-	-
Oil	3.3	-2.1	-1.2	1.5	-2.2	-3.9	5.9
Natural gas	14.2	7.3	3.6	0.7	-7.8	1.3	-11.0
Biofuels and waste[1]	-	-	4.4	7.6	6.6	10.3	4.7
Nuclear	-	-	0.8	7.5	4.0	1.4	-1.4
Hydro	12.0	-7.0	4.2	4.7	-12.7	28.4	-30.2
Wind	-	-	-	-	11.4	13.9	-
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	..	..	61.7	-3.0	-0.4
TFC	1.4	-0.6	-2.3	0.2	-2.2	0.2	-1.5
Electricity consumption	3.6	2.4	0.2	1.5	-0.5	0.1	-0.8
Energy production	1.0	-0.1	-2.9	0.3	1.6	-7.6	-3.0
Net oil imports	3.0	-2.4	-1.3	1.6	-2.9	-2.7	7.2
GDP	2.5	1.3	0.5	3.2	0.5	-0.5	2.0
TPES/GDP	-1.9	-0.7	-2.4	-2.3	-2.5	-1.0	-3.7
TFC/GDP	-1.0	-1.8	-2.8	-2.9	-2.7	0.7	-3.5

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
2. Other includes tide, wave and ambient heat used in heat pumps.
3. In addition to coal, oil, natural gas and electricity, total net imports also include peat, biofuels and waste, and trade of heat.
4. Excludes international marine bunkers and international aviation bunkers.
5. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.
6. Industry includes non-energy use.
7. Other includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
8. Inputs to electricity generation include inputs to electricity, combined heat and power, and heat plants. Output refers only to electricity generation.
9. Losses arising in the production of electricity and heat at main activity producer utilities and auto-producers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for nuclear and solar thermal, 10% for geothermal, and 100% for hydro, wind and solar photovoltaic.
10. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
11. Toe per thousand United States dollars at 2010 prices and exchange rates.
12. "CO_2 emissions from fuel combustion" have been estimated using the Intergovernmental Panel on Climate Change (IPCC) Tier I Sectoral Approach from the 2006 IPCC Guidelines. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2013 and applying this factor to forecast energy supply. Projected emissions for coal are based on product-specific supply projections and are calculated using the IPCC/Organisation for Economic Co-operation and Development (OECD) emission factors and methodology.

ANNEX C: INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydropower, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993, Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

ANNEX D: GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

ACER	Agency for the Co-operation of Energy Regulators
AS	ancillary services
ASMR	Administration of State Material Reserves
CAO	Central Allocation Office
CCS	carbon capture and storage
CEE	Central Eastern Europe
CEF	Connecting Europe Facility
CH_4	methane
CHP	combined heat and power
CF	Cohesion Fund
CMP	congestion management procedures
CNG	compressed natural gas
CO_2	carbon dioxide
CZK	Czech Republic koruna
D&D	decontamination and demolition
DERlab	European Distributed Energy Resources Laboratories
DGR	deep geologic repository
DSO	distribution system operator
EFEKT	State Programme for Support of Energy Savings and Use of Renewable and Secondary Energy Sources
ENEF	European Nuclear Energy Forum
ENSREG	European Nuclear Safety Regulators' Group
ENTSO-G	European Network of Transmission System Operators for Gas
EPBD	Energy Performance of Buildings Directive
EPC	energy performance certificates
EPR	European Pressurised Reactor
ERA	European Research Area
ERDF	European Regional Development Fund
ERO	Energy Regulatory Office
ESCO	energy service companies
EU	European Union
EU-28	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom).
EU ETS	EU Emissions Trading Scheme

F-gases	fluorinated gases
FAME	fatty-acid methyl esters
FIP	feed-in premiums
FIT	feed-in tariff
GCV	gross calorific value
GDP	gross domestic product
GHG	greenhouse gas
GSP	Green Savings Programme
HFC	hydrofluorocarbon
HGV	heavy goods vehicle
HLW	high-level waste
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IDR	in-depth review
IGCC	integrated gasification combined cycle
IKL	Ingolstadt-Kralupy-Litvinov pipeline
INPRO	International Project on Innovative Nuclear Reactors and Fuel Cycles
IPCC	Intergovernmental Panel on Climate Change
IROP	Integrated Regional Operational Programme
ITER	International Thermonuclear Experimental Reactor
JHR	Jules Horowitz Reactor
LILW-SL	short-lived low- and intermediate-level waste
LNG	liquefied natural gas
LPG	liquefied petroleum gases
LULUCF	land use, land-use change and forestry
MEPS	minimum energy performance standards
MEYS	Ministry of Education, Youth and Sports
MIT	Ministry of Industry and Trade
MND	*Moravske Naftove Doly*
MOE	Ministry of the Environment
MRD	Ministry of Regional Development
MTBE	methyl tertiary-butyl ether
N_2O	nitrous oxide
NAlP	national allocation plan
NAP	national action plans
NAP CM	National Action Plan on Clean Mobility
NAP NE	National Action Plan for the Development of Nuclear Energy
NAP SG	National Action Plan for Smart Grids
NATO	North Atlantic Treaty Organization
NEEAP	National Energy Efficiency Action Plan
NESO	National Emergency Strategy Organisation
NGL	natural gas liquids
NH_3	ammonia
NIS	National Innovation Strategy of the Czech Republic
NO_x	generic term for mono-nitrogen oxides NO and NO_2
NPOREDI	National Priorities of Oriented Research, Experimental Development and Innovations

NPP	nuclear power plant
NREAP	National Renewable Energy Action Plan
NRP	National Reform Programme
NRDIP	National Research, Development and Innovation Policy
OECD	Organisation for Economic Co-operation and Development
OTE	electricity and gas market operator
PCI	Projects of Common Interest
PCR	Price Coupling of Regions
PFC	perfluorocarbons
PM	particulate matter
PM2.5	fine dust particles
PPP	purchasing power parity
PV	photovoltaic
PXE	Power Exchange Central Europe
RAWRA	Radioactive Waste Repository Authority
R&D	research and development
RD&D	research, development and demonstration
RDC	Research and Development Council
RDI	research, development and innovation
REBCO	Russian Export Blend Crude Oil
RES	renewable energy sources
RES-E	renewable electricity
RME	rapeseed-oil methyl ester
RON	research octane number
SEF	State Environmental Fund
SEI	State Energy Inspection
SEnvP	State Environmental Policy
SEP	State Energy Policy
SF_6	sulphur hexafluoride
SME	small and medium-sized company
SNF	spent nuclear fuel
SO_2	sulphur dioxide
SONS	State Office for Nuclear Safety
SSO	storage system operators
TAL	Trans-Alpine Pipeline
TA CR	Technology Agency of the Czech Republic
TFC	total final consumption
TPES	total primary energy supply
TSO	transmission system operator
TYNDP	ten-year network development plans
UCTE	Union for the Co-ordination of Transmission of Electricity
UF_6	uranium hexafluoride
UGS	underground gas storage
UNFCCC	United Nations Framework Convention on Climate Change
ÚOHS	Office for the Protection of Competition
USD	United States dollars
USD/L	United States dollars per litre

VAT	value-added tax
VOC	volatile organic compounds

Units of measurement

bcm	billion cubic metres
gCO_2/km	grammes of CO_2 per kilometre
GW	gigawatts
bcm	billion cubic metres
GJ	gigajoule
GJ/t	gigajoules over tonne
GW	gigawatt
GWh	gigawatt hour
kb/d	thousand barrels per day
kg-SWU	kilogramme separative work units
km^2	square kilometres
kt	kilotonne
ktoe	kilotonnes of oil-equivalent
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
L	litre
m^2	square metre
m^3	cubic metre
mb	million barrels
mcm	million cubic metres
MJ/t	megajoules per tonne
Mt	million tonnes
MTBE	methyl terta-butyl ether
$MtCO_2$-eq	million tonnes of carbon dioxide-equivalent
Mtcoe	Mt of crude oil-equivalent
Mtoe	million tonnes of oil-equivalent
MW	megawatt
MW_e	megawatt electrical
MWh	megawatt-hour
MW_{th}	megawatt-hour of thermal heat
PJ	petajoule
ppm	parts per million
tCO_2-eq	tonnes of carbon dioxide-equivalent
TJ	terajoule
toe	tonnes of oil-equivalent
tU	tonnes of uranium
TWh	terawatt-hour
W	watt
y	year

ANNEX E: ENERGY EFFICIENCY

EUROPEAN UNION DIRECTIVES AND REGULATIONS

The Czech Republic's energy efficiency policies are aligned with several European Union (EU) regulations and directives. Since 2006, European policies have been designed to help reach indicative (non-binding) EU targets for energy efficiency for 2016 and for 2020. The 2016 target is to reduce final energy use in the sectors outside the EU Emissions Trading Scheme (EU-ETS) by 9% from the early 2000s. The 2020 target, agreed upon in 2007, is to reduce primary energy use in the European Union by 20% compared with baseline projections.

The 2016 target was embedded in the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC). The directive encourages energy efficiency through the development of a market for energy services and the delivery of energy efficiency programmes and measures to end users. It requires member states to create national energy efficiency action plans for meeting the target. The directive also sets the framework for measures such as financing, metering, billing, promotion of energy services, and obligations for the public sector. In addition, it requires member states to oblige energy distributors or retailers to offer either competitively priced energy services, audits or other measures to improve energy efficiency.

The Energy Efficiency Directive 2012/27/EC (EED) was developed and adopted out of concern that the European Union was unlikely to reach the 20% energy efficiency target for 2020. The EED replaces the previous directive (2006/32/EC) and strengthens many of its elements. The EED comprises a series of binding measures and requires each member state to:

- Set an indicative national energy savings target for the period 1 January 2014 to 31 December 2020 in line with the EU-wide 20% by 2020 target.
- Oblige energy providers to achieve cumulative end-use energy savings by 2020 equivalent to 1.5% of annual energy sales over the seven years from 2014 to 2020. Member states may pursue alternative ways to achieve equivalent energy savings.
- Carry out a comprehensive assessment of national heating and cooling systems to identify and implement the cost-effective potential for deploying highly efficient co-generation, efficient district heating and cooling, and other efficient heating and cooling solutions by the end of 2015.[1]
- Assess the energy efficiency potential of its gas and electricity infrastructure in particular regarding transmission, distribution, load management and

1. Co-generation refers to the combined production of heat and power.

interoperability, and identify measures and investments for the introduction of cost-effective energy-efficient improvements in the network infrastructure by 30 June 2015.

- Ensure that the metering and billing of actual energy consumption in all sectors occur at a frequency that enables end users to take informed decisions about their energy consumption; and that meters are installed for all energy sources at end users' premises, if technically possible and economically feasible.
- Develop public procurement rules ensuring that central governments purchase only high-efficiency products.
- Facilitate the development of national financing facilities for energy efficiency measures.

In addition to the horizontal EED, several sectoral EU regulations and directives to increase energy efficiency are in force.

The Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC, recast as 2010/31/EU) sets requirements for energy efficiency in building codes, including minimum energy performance requirements and energy certificates. The 2010 recast requires all new public buildings to be at least "near-zero energy" by the end of 2020, and all new buildings to reach this target by the end of 2020.

The recast Directive Establishing a Framework for Setting Ecodesign Requirements for Energy-Related Products (Ecodesign, 2009/125/EC) aims to improve energy efficiency throughout a product's life cycle. It applies to products that use energy and to products that have an impact on energy use, such as building components. Product-specific standards are set by EU regulations based on the directive.

Requirements for energy labelling of household appliances are based on several directives adopted since 1992. The recast of the Energy Labelling Directive (2010/30/EU) expands the mandatory labelling requirement to cover commercial and industrial appliances and also energy-related appliances; product-specific labelling standards are set up under this directive.

Current EU transport policies aim to reduce carbon dioxide (CO_2) emissions from new passenger cars, which in practice will lead to efficiency improvements in the car fleet. Under Regulation 443/2009, car manufacturers and importers are obliged to limit CO_2 emissions from new passenger cars to a weight-based fleet-wide average of 130 grammes of CO_2 per kilometre (gCO_2/km) by 2015 and to 95 gCO_2/km by 2020. In terms of fuel consumption, the 2015 target roughly corresponds to 5.6 litres per 100 kilometres (L/100 km) of petrol or 4.9 L/100 km of diesel. The 2020 target equates to around 4.1 L/100 km of petrol or 3.6 L/100 km of diesel. A similar regulation for new vans was introduced in 2011 (Regulation 510/2011), with a limit of 175 gCO_2/km by 2017 and 147 gCO_2/km by 2020.

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Energy Policies of IEA Countries

Czech Republic

The Czech Republic recently approved a new National Energy Policy (SEP) that aims to reduce energy consumption and improve the economy's energy intensity. This IEA country review provides a snapshot of the energy sector in the Czech Republic and examines the impact of the SEP. The review warns that reaching long-term energy targets will require greater effort if the country is to play its part in the on-going global energy transition.

The SEP broadly seeks to strengthen security of energy supply and build a competitive and sustainable energy sector. While the Czech Republic has experienced strong growth in the renewable energy sector – notably solar PV – policy changes have created uncertainty. Meanwhile, greenhouse gas emissions, which have been falling since 2000, are expected to increase. Coal dominates the power sector and is the largest source of carbon emissions and also poses a substantial threat to local air quality.

The review finds that natural gas supply security remains strong, and the country is expected to remain a net exporter of electricity. The expansion of nuclear power is one of the main pillars of the SEP, and will play a greater role in coming years. The SEP also establishes key targets for energy security, emissions, energy savings, electricity generation and affordability.

This review also provides recommendations for further policy improvements that are intended to help guide the country towards a more secure and sustainable energy future.