Czech Republic 2021

Energy Policy Review

International Energy Agency

INTERNATIONAL ENERGY AGENCY

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Foreword

The International Energy Agency (IEA) has conducted in-depth peer reviews of its member countries' energy policies since 1976. This process supports energy policy development and encourages the exchange of and learning from international best practices. By seeing what has worked – or not – in the "real world", these reviews help identify policies that deliver concrete results.

The Czech Republic has been a member of the IEA for two decades, bringing valuable perspectives to the work of the Agency. I particularly appreciate the Czech government's active involvement in many of the key IEA initiatives in recent years, notably the Clean Energy Transitions Summit in July 2019 and the IEA–COP26 Net Zero Summit in March 2020.

As with many countries, phasing out coal will be a key challenge for the Czech Republic. Today, coal accounts for almost half of the country's electricity generation and a quarter of its residential heating demand. Until recently, it looked as though coal would continue to play an important role in the economy well into the 2030s. However, new energy and climate targets agreed by the European Union for 2030 are likely to drive an earlier phase-out, as CO_2 prices are set to increase in the coming years making coal less competitive relative to other fuels. To prepare for this eventuality, this new IEA policy review recommends that the Czech Republic speed up deployment of low-carbon sources of electricity generation. Energy security is a core area for the IEA and a priority for the Czech government, and the continued diversification of energy sources is crucial in this regard. I would encourage the government to undertake a thorough assessment of the economic potentials of all available forms of low-carbon energy and to plot pathways on how best to exploit the most promising options to ensure adequate supply.

The phase-out of coal and coal mining in the Czech Republic poses economic and social challenges, as the sector is an important employer, including in parts of the country with weaker economies. I therefore welcome the introduction of a comprehensive framework for restructuring and transforming the areas concerned so that the communities affected will not be left behind. This will provide an excellent basis to leverage resources available through the European Just Transition Fund to ensure that Czech citizens benefit from the energy transition.

Since the previous IEA energy policy review of the Czech Republic in 2016, the country has made good progress in energy efficiency through an increasing number of programmes, particularly in the building and industry sectors. I especially welcome the streamlining of administrative procedures for energy efficiency measures in the residential sector. To build on this success, I would encourage the government to study the examples of other IEA countries and consider the creation of a dedicated energy efficiency agency to help implement its support programmes.

I strongly believe that this report can help the Czech Republic advance its energy and climate goals while ensuring a just transition, energy security and economic growth. The IEA will continue to stand side-by-side with the Czech Republic as it moves ahead with the development of a modern energy sector for a healthy and prosperous future.

Dr. Fatih Birol

Executive Director

International Energy Agency

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1. Executive summary

Overview

A key challenge of the Czech Republic's energy sector over the next decade is to prepare for the phase-out of coal from the energy mix. As the country's only domestic fossil fuel, coal has been and still is a key energy source in the Czech Republic. In 2019, it accounted for one-third of total energy supply, 46% of electricity generation and over 25% of residential heating. The role of coal in total energy supply (TES) declined by 19% from 2009 to 2019, primarily driven by reduced coal-fired power generation that was replaced by natural gas, bioenergy, nuclear and solar photovoltaic (PV). Coal still accounts for half of total domestic energy production, despite a 36% decrease since 2009.

In 2020, the Covid-19 pandemic strongly affected coal production, which decreased by 24% compared to 2019 The contribution of coal in TES declined by 15%, mainly driven by a decreased use of coal in electricity generation (-17%). The share of coal in electricity generation decreased to 41% in 2020, and was replaced by natural gas, bioenergy, nuclear and solar PV.

Renewables do not yet play a major role in TES in the Czech Republic, although their share has increased by 71% since 2009, reaching 16% of total final energy consumption (TFEC) in 2019, mainly driven by bioenergy. Renewables accounted for 22% in heating and cooling, 14% in electricity generation, and less than 8% in transport in 2019.

The declining coal consumption between 2009 and 2019 has contributed to a 15% reduction in the carbon intensity of the economy and a 22% reduction of carbon intensity of electricity and heat generation, though for both indicators the Czech Republic remained above the IEA average in 2019. Between 2019 and 2020, both the carbon intensity of the economy and the carbon intensity of electricity generation dropped by 6%, because of the decrease of coal use in TES and electricity generation, due to the Covid-19 pandemic. The country has shown a decoupling between economic growth and energy consumption since 2009, but its energy intensity remains above the IEA average.

The transport and building sectors drove growth in final energy consumption, while demand from industry declined. Overall, total final consumption has increased by 2% since 2009.

After declining noticeably from 2005 to 2015, the Czech Republic's total greenhouse gas emissions have been relatively stable, and more efforts are needed to reach the 2030 target of reducing emissions by 30% compared to 2005 levels. To note, however, that energy-related emissions decreased by 14% between 2009 and 2019, reflecting the reduced role of coal in the energy sector.

Looking forward, the government is revising the country's energy policy and related legal and regulatory framework. This in-depth review and its recommendations are intended to contribute to the development of the new State Energy Policy (SEP) and related policies and measures.

Phasing out coal from the energy mix

The Czech government is studying options of how and when to phase-out coal from its energy mix. For this purpose, the government established a Coal Commission in 2019 that delivered its recommendations in December 2020. It recommended phasing out coal by 2038 at the latest. The government has not yet decided when coal will be phased out and has requested that the Coal Commission analyse options for and the implications of an earlier coal phase-out.

In its recommendation for a phase-out by 2038, the Coal Commission projects that initially coal would be replaced largely by natural gas generation, while the share of renewable sources would increase to 25%, largely in line with the SEP of 2015 and the country's National Energy and Climate Plan (NECP) of 2019. Nuclear capacity would become the single largest generation source if coal were to be phased out in 2038, as new nuclear capacity would become available in 2036. For comparison, according to the NECP, coal would still account for 38% of electricity generation in 2030.

In the heating sector, coal would eventually be replaced by a combination of fuels; a specific heating strategy is currently being prepared. For comparison, the NECP sees coal as still being the dominant source of centralised heat production in 2030, with a share of 47%, down from 55% in 2018. The European Union's (EU) new climate ambitions for 2030 and 2050 and the upcoming changes to the EU Emissions Trading System are expected to accelerate the coal phase-out, regardless of the government's decision concerning which year coal will be phased out. Coal-fired power and heat generation will become less competitive, in addition to stricter air pollution limits set by the EU for power plants as of 2021.

Hence, an earlier phase-out of coal than that recommended by the Coal Commission in 2038 is conceivable purely based on economic considerations. The Czech Republic is not well placed to substitute coal-fired capacity on short notice other than by importing electricity, as there is currently no new large generating capacity of any kind under construction, or in the pipeline. Any new capacity additions to 2030 are likely to come from smaller renewable installations and decentralised sources.

Independent studies show a potential for around 7 gigawatts (GW) of solar photovoltaic (PV) capacity in 2030 and 1.6 GW of wind power, which combined could contribute 15% of total generation in the same year, compared to 3.6% in 2019. However, the renewables shares for 2030, in both the SEP and the NECP, appear to lack ambition to harvest this potential, with just 4 GW of solar PV and just under 1 GW of wind power. The government is encouraged to undertake a thorough review of the potential of each alternative fuel and to plot pathways of how best to exploit them.

For the renewable potential to materialise, the Czech Republic needs to establish a legal and regulatory framework that would enable new business models, such as energy communities and prosumers. The IEA encourages the Czech Republic to swiftly move forward with the implementation of new framework conditions.

Just transition

The phase-out of coal and coal mining in the Czech Republic poses important economic and social challenges. Coal mining is an important sector for the regions' employment and economy. The energy transition cannot be successful unless it is supported by the people.

In recognition of these challenges, in 2015 the government launched the "RE:START Programme" as a comprehensive framework for the restructuring and fair transformation of the concerned mining areas. The Czech Republic is hence well placed to leverage the funding to be provided under the European Just Transition Fund, which can be used, among others, to retrain coal miners and power plant workers.

Applying the "energy efficiency first" principle

The Czech Republic has progressed notably in terms of energy efficiency measures since the IEA's last in-depth review in 2016. The government has deployed an increasing number of public financing programmes, in particular in the building and industry sectors. The IEA welcomes the recently launched public awareness campaign to increase the knowledge about the depth and extent of available support programmes and to ensure full uptake of the programmes.

While the SEP and the NECP identified energy efficiency as a strategic priority, the targets set for 2030 do not seem to fully exploit the energy efficiency potential in the Czech Republic. Applying the "energy efficiency first" principle would help the coal phase-out by, for example, reducing the heating and electricity generation adequacy problems. The upcoming revision of the SEP offers an ideal opportunity to apply the "energy efficiency first" principle at the heart of policy making, and to set more ambitious targets for the period to 2030 and beyond.

In the Czech Republic, energy efficiency policy, legislation and implementation of programmes are the responsibility of the Ministry of Industry and Trade. In most IEA countries, specialised energy agencies prepare and execute the energy efficiency programmes. Having dedicated and specialised teams responsible for the implementation and monitoring of energy efficiency policies can make these policies more effective. The IEA encourages the government to consider creating a dedicated institution for this purpose.

Energy taxation

The effective tax rate on carbon dioxide (CO_2) emissions from energy use in the Czech Republic is among the lowest in the OECD, except in the transport sector. In particular, the Czech Republic levies lower taxes on CO_2 emissions from energy use in sectors outside of the Emissions Trading System (ETS).

This uneven treatment of fuels inside and outside the ETS is of particular concern in the heating sector, where district heating (DH) systems supply over 40% of all households in the country and where coal accounts for 60% of fuels used. Smaller DH systems and individual heating systems using fossil fuels are taxed less than large, co-generating systems, and therefore the share of those larger DH systems has been shrinking in recent years. The government should develop long-term plans for the decarbonisation of DH systems, for instance by promoting large-scale heat pumps. Well-designed large district heating systems can provide heat in a more efficient way, as they are typically based on co-generation plants that ensure a high utilisation of primary energy sources, and with less local pollution than individual systems.

The IEA therefore welcomes that the Czech Republic acted upon a recommendation from the last in-depth review to study the feasibility of introducing a carbon tax outside of the ETS, and for using the revenues to stimulate switching to cleaner fuels and enticing energy efficiency upgrades. The study's comprehensive analysis supported the introduction of a carbon tax, but also highlighted the regressive nature of such a tax, which would have the greatest impact on poorer households. Consequently, the government decided not to act upon the recommendations put forward in the study, but kept the option open for later.

The IEA still sees scope for the Czech Republic to make better use of carbon price signals to reduce CO_2 emissions by steering behaviour towards the use of less carbon-intensive fuels and higher energy efficiency. The idea of such a carbon tax is not to increase the overall tax burden, but to tax different fuels according to their externalities and to shift consumer behaviour. The government could consider redirecting a certain portion of the carbon tax revenues to consumers, either directly as cash transfers to poorer households or as subsidies, for example for energy efficiency and decarbonisation of heating sources.

In the period to 2030, the Czech Republic will have access to various EU funding schemes intended for green investments. Combined with technical and implementation advice, those funds may help increase investments in energy efficiency, renewable energies and in best available technologies in the industry sector.

Energy security

The Czech Republic produces only 3% of its crude oil and 1% of its natural gas consumed and imports the rest. The Czech Republic has been in compliance with the IEA's obligation to hold oil stocks since 2004. As of end-December 2020, the Czech Republic held oil stocks equivalent to 125 days of net imports, including commercial stocks. There is no emergency stockholding obligation on the Czech oil industry and all emergency stocks are owned by the government. At times of minor supply disruptions, the refineries have called on the government to release emergency stocks to avoid curtailing operations, which indicates that industry operational stocks are rather low.

Given its geographical location, the Czech Republic is an important gas transit hub in Central and Eastern Europe. It has a resilient gas system due to its large gas storage capacity and multiple interconnectors with reversible capacity. Its technical capacity to withstand the failure of the single largest infrastructure component is close to four times the legislative requirement. This will increase even further once the ongoing transmission system expansions are completed after 2021.The Czech gas system has substantial gas storage capacity, with 3.3 billion cubic metres (bcm). Once the ongoing expansion projects are completed in 2022, the country's total storage capacity available will be almost 4 bcm. This is almost half the current annual gas consumption of the Czech Republic, a rather high ratio compared to other countries.

Traditionally, the Czech Republic is a net exporter of electricity, thanks to its large domestic coal resources that, together with nuclear power generation, dominate electricity supply.

The Czech Republic's transmission grid is well connected with its neighbouring countries, with an interconnection capacity of 30%, with more interconnections in the pipeline. This high interconnection capacity will help the country ensure security of supply in the period to 2030, as the outlook on generation adequacy is uncertain. There are no large new generation capacity projects in the pipeline and coal-fired generation will gradually be phased out, driven largely by economic imperatives. By 2030, the Czech Republic could become a net electricity importing country if there is no change to the framework conditions facilitating the construction of new generation capacities.

Key recommendations

The government of the Czech Republic should:

- Anticipate a faster phase-out of coal than is currently envisaged and prepare to accelerate additional deployments of renewable and nuclear power plants.
- Together with stakeholders, assess the full economic potential of all available forms of renewable energies and develop road maps to fully exploit them.
- Place energy efficiency at the centre of energy policy making. Create a dedicated body for the implementation of the energy efficiency policy measures.
- Introduce a carbon tax gradually in sectors not covered by the EU ETS to stimulate low-carbon investment and reduce fossil fuel consumption by stronger price signals, while increasing public acceptance by channelling back revenues to consumers.

2. General energy policy

Key data (2019/20)

Total energy supply (TES)[1] (2020): 40.1 Mtoe (coal 30.3%, oil 21.1%, nuclear 19.5%, natural gas 18.1%, bioenergy and waste 11.9%, solar 0.5%, hydro 0.5%, wind 0.1%, electricity exports -2%), +0.4% in 2009-19, -6% in 2019-20.

TES per capita (2020): 3.75 toe per capita (IEA average:* 3.8 toe), -13% since 2010.

TES per GDP (2020):** 104 toe per USD million (IEA average:* 91 toe per USD million), -24% since 2010.

Energy production (2020): 23.6 Mtoe (coal 43.1%, nuclear 33.3%, bioenergy and waste 20.5%, solar 0.9%, oil 0.6%, natural gas 0.7%, hydro 0.8%, wind 0.3%, heat 0.3%), -15.3% in 2019-19, -12% in 2019-20.

Total final consumption (TFC)[2] (2019): 27.0 Mtoe (oil 34.1%, natural gas 19.6%, electricity 18.6%, bioenergy and waste 12.3%, coal 7.8%, district heat 7.5%, other renewables 0.1%), +2.3% since 2009.

Exchange rates (2020):*** Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* Weighted average of IEA member countries.

** GDP data are in billion USD 2015 prices and PPP (purchasing power parity).

*** OFX (2021)

Country overview

The Czech Republic is a landlocked country in Central-Eastern Europe. It shares borders with Germany to the west, Austria to the south, Poland to the north and the Slovak Republic to the east. The country covers an area of 78 868 square kilometres and is composed of two main regions, Bohemia and Moravia (Figure 2.1). Bohemia in the west consists of plains and plateaus surrounded by low mountains while Moravia in the east is hilly. The country has a temperate continental climate with cool summers and cold, cloudy winters.

In 2020, the Czech Republic had a population of approximately 10.7 million. While the population is expected to grow until 2025, it is projected to decline in the subsequent years.

[1] TES is made up of production + imports – exports – international marine and aviation bunkers ± stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (e.g. power generation and refining) or in final use. Nuclear energy supply in TES includes losses. The primary energy equivalent of nuclear electricity is calculated from the gross electricity generation by assuming a 33% conversion efficiency.

[2] TFC is the final consumption of energy (electricity, heat and fuels, such as natural gas and oil products) by end users, not including the transformation sector (e.g. power generation and refining).

The capital is Prague (1.3 million residents) and other major cities include Brno, Ostrava and Plzen. About 75% of the population lives in or near a metropolitan area (OECD, 2020). The local currency is the Czech koruna (CZK).

Figure 2.1 Map of the Czech Republic

The Czech Republic has a bicameral parliamentary representative democracy with a head of state (the president) and a head of government (the prime minister). The current government is a coalition of the centre-right "ANO 2011" (Action of Dissatisfied Citizens) and the Czech Social Democratic Party. Since 2017, the prime minister is Andrej Babiš from the ANO. The next legislative election is scheduled for October 2021.

The Czech Republic's gross domestic product (GDP) continuously increased from 2015 to 2019. The 2020 *OECD Economic Survey of the Czech Republic* shows a 6.8% annual drop of GDP in 2020 due to the Covid-19 pandemic and forecasts a rebound of 1.5% in 2021 and 3.3% in 2022. The unemployment rate is expected to rise to 3.6% in 2021, up from 2.0% in 2019 (OECD, 2020).

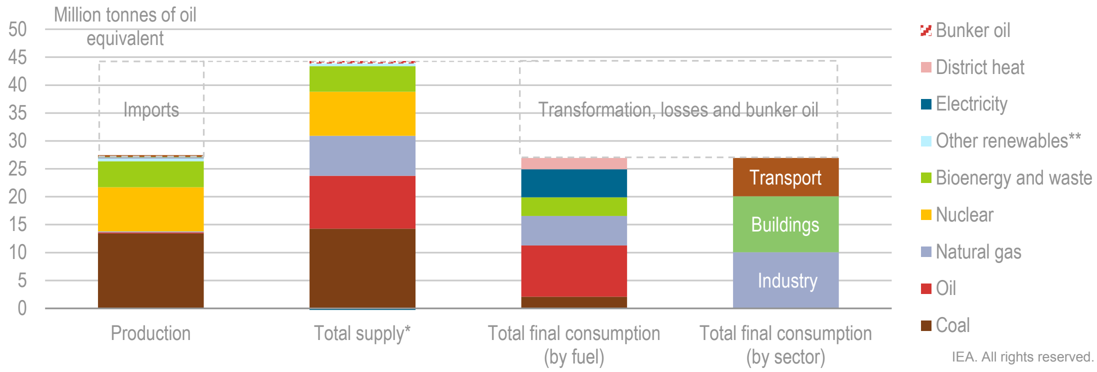
The services sector accounts for the highest share of GDP, at 63%, followed by industry with 29% (OECD, 2019). Benefiting from geographical accessibility to other European countries and a technically skilled labour force, the Czech Republic has received a large amount of foreign direct investment compared to its neighbouring countries since 2015 (UNCTAD, 2020). The inward foreign direct investment stock rose to over 60% of GDP in the 2010s, from 10% of GDP in the early 1990s (Szabo, S. 2019).

Supply and demand

In 2019, the Czech Republic's TES was 43 million tonnes of oil equivalent (Mtoe). More than half of TES was produced domestically (Figure 2.2). Half of domestic energy production consists of coal, while the remainder is nuclear and bioenergy. Coal accounted for one-third of TES in 2019, followed by oil (22%), nuclear (19%) and natural gas (17%).

On the demand side, total final consumption (TFC) was 27 Mtoe in 2019. Oil covered one-third of TFC in 2019, followed by natural gas (20%) and electricity (19%). Industry and buildings each account for 37% of TFC, with transport covering the remaining 26%.

Figure 2.2 Overview of the Czech Republic's energy production, supply and consumption, 2019



Domestic production from coal, nuclear and bioenergy covers more than half of total supply, which is 71% fossil fuels.

* *Total supply* includes total energy supply plus international bunker fuel.

** *Other renewables* includes hydro, wind, geothermal and solar.

Source: IEA (2021).

Supply

TES remained stable, at around 43 Mtoe between 2009 and 2019 (Figure 2.3), while it decreased to 40 Mtoe in 2020, as a result of the Covid-19 pandemic. The supply of coal decreased by -19% between 2009 and 2019 (-3.3 Mtoe), and it sharply declined by 15% in 2020 only (-2.1 Mtoe). The supply of other energy sources was increasing between 2009 and 2019: bioenergy by 1.8 Mtoe, nuclear by 0.8 Mtoe, oil by 0.3 Mtoe and natural gas by 0.4 Mtoe. In 2020, oil supply decreased by 10% (almost 1 Mtoe), as the transport sector was heavily affected by the pandemic, while supply of bioenergy and natural gas kept increasing as their share in electricity generation increased.

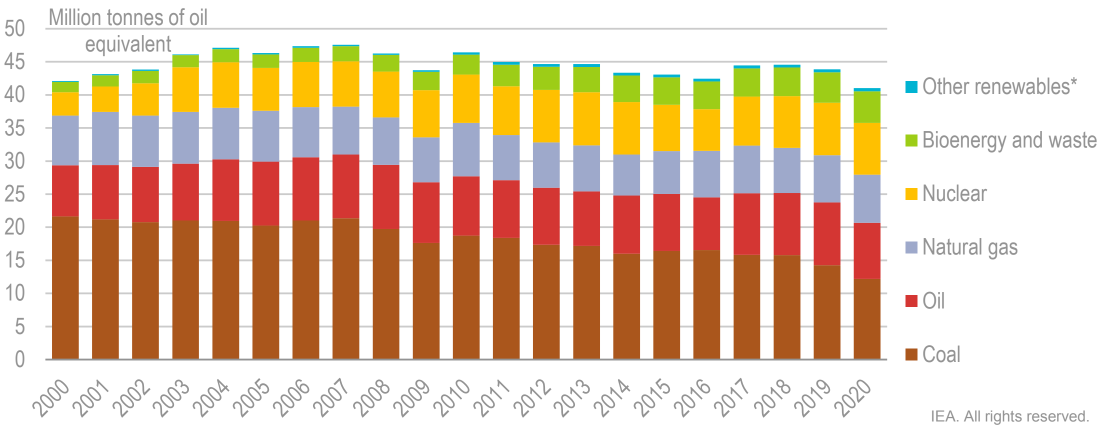
The decrease in coal supply reflects a decrease of electricity production from coal (-9.2 terwatt hours [TWh] in the decade 2009-19). Coal-fired power generation was replaced mainly by natural gas (a 4.8 TWh increase between 2009 and 2019), bioenergy (3.3 TWh), nuclear (3.0 TWh) and solar (2.2 TWh). In 2020, electricity generation overall decreased by 5 TWh (-7%), with generation from coal declining by 6.8 TWh, while production from nuclear decreased only slightly (-0.2 TWh) and electricity from natural gas and bioenergy kept increasing (1.04 TWh and 0.18 TWh respectively)

Domestic production and import dependency

Total domestic energy production in the Czech Republic was 27 Mtoe in 2019, 15% lower than in 2009. Coal still covered half of domestic energy production in 2019, despite a 36% decrease in the decade 2009-19, followed by nuclear (29%) and bioenergy and waste

(17%) (Figure 2.4). In 2020, energy production dropped to 24 Mtoe (-12% compared to 2019), mainly due to decreased production of coal (-3.3 Mtoe).

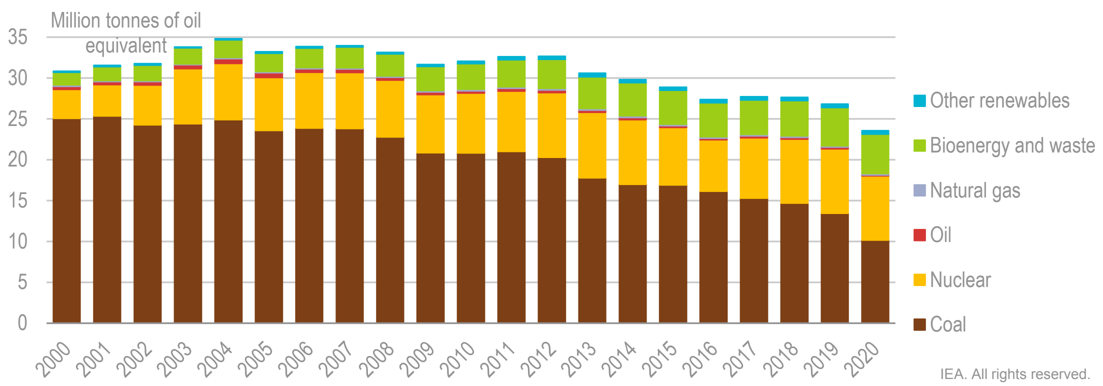
Figure 2.3 Total energy supply in the Czech Republic by source, 2000-20



The share of coal decreased between 2009 and 2020, while the shares of bioenergy, nuclear, oil, and natural gas increased.

* *Other renewables* in 2019 include solar (0.22 Mtoe), hydro (0.17 Mtoe) and wind (0.06 Mtoe).
Source: IEA (2021).

Figure 2.4 Energy production in the Czech Republic by source, 2000-20



Domestic production of coal declined by 36% between 2009 and 2019 and a further 24% in 2020 while nuclear increased by 11% from 2009 to 2019 and stabilised in 2020.

* *Other renewables* in 2019 include solar (0.22 Mtoe), hydro (0.17 Mtoe) and wind (0. 6 Mtoe).
** *Natural gas* is not visible in this scale and has been roughly constant, from 0.18 Mtoe in 2009 to 0.17 Mtoe in 2019.
Source: IEA (2021).

The Czech Republic produces 95% of its coal supply, and was exporting coal (mainly to Austria) until 2015. In 2016, the Czech Republic became a net coal-importing country, as domestic coal production decreased faster than its use in electricity generation. Most of hard coal is imported from Poland (68%), followed by the Russian Federation (12%). As for oil and natural gas, only 2% is produced domestically; the rest is imported. Gas is almost entirely imported from Russia (99.7%); crude oil from Russia (49%), Azerbaijan (28%) and Kazakhstan (13%); and oil products from Germany (60%) and the

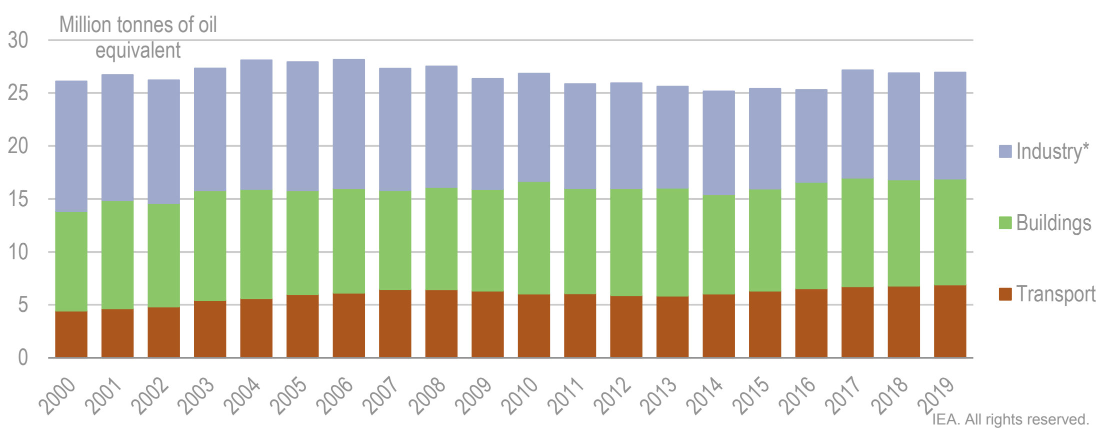
Slovak Republic (26%). The Czech Republic's energy self-sufficiency was 63% in 2019, due to domestic production of nuclear energy and coal. Total energy self-sufficiency decreased by 16% in the decade 2009-19, reflecting the reduced coal production.

Demand

Since peaking in 2006, energy demand in the Czech Republic declined until 2016, before a sudden increase in 2017 to 27.2 Mtoe, driven mainly by the industry sector, as the Kralupy refinery reopened after a failure of the fluid catalytic cracking unit in 2016. Between 2017 and 2019, TFC slightly decreased, reaching 27 Mtoe, the second-highest level since 2008.

In 2019, industry covered more than one-third of TFC (37%). Half of energy consumption in industry comes from the chemical and petrochemical (38%) and non-metallic minerals (12%) sectors. Buildings accounted for 37% of TFC in 2019, of which 68% was from residential buildings and 32% service sector buildings. Transport accounted for 26% of TFC in 2019, 96% of which was from road transport. Between 2009 and 2019, TFC in transport increased by 9% and that of buildings by 4%, while it decreased in industry (-4%).

Figure 2.5 Total final consumption in the Czech Republic by sector, 2000-19

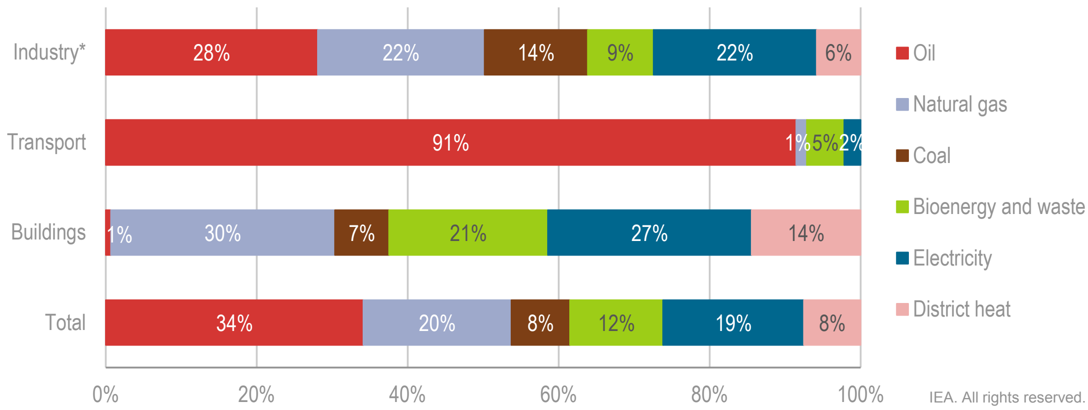


After declining between 2006 and 2016, TFC rebounded in 2017 and remained stable until 2019. Industry and buildings account for more than a third each, followed by transport.

* *Industry* includes non-energy demand.
Source: IEA (2021).

Oil covered about one-third of energy demand in the Czech Republic in 2019, due to its dominant share in transport (Figure 2.6). Natural gas contributed to one-fifth of TFC and 30% to the buildings sector energy demand. Electricity contributes to almost another fifth (19%) of TFC, covering 27% of buildings' and 22% of the industrial energy demand.

Figure 2.6 Total final consumption per sector and per fuel in the Czech Republic, 2019



Oil is the main source of TFC, accounting for one-third of the total, followed by natural gas and electricity at about one-fifth each.

* *Industry* includes non-energy demand.

Source: IEA (2021).

Impact of Covid-19 on the energy sector

The impact assessment of the Covid-19 crisis on the energy sector is ongoing. By mid-2020, no specific impacts other than a reduction of energy demand and specifically of electricity demand were noted. While the reduction of electricity demand resulted in higher balancing costs, the country did not observe any security of supply issues. By November 2020, electricity consumption reached the same level as in November 2019 and has since shown higher demand than the average of the years before the pandemic (CNB, 2021). The demand for oil products declined in March and April 2020, started recovering in May and June, and since July 2020 stabilised at a monthly consumption that is slightly below 2019 levels.

The government has not yet initiated any specific post Covid-19 recovery measures for the energy sector except for including the energy sector under policies to strengthen critical infrastructure. The energy sector is included in the "National Recovery and Resilience Plan" that the European Commission endorsed in July 2021. Energy-related areas of the plan include energy efficiency, modernisation of distribution of heat, clean mobility, circular economy and related research. The national plan is linked to the spending anticipated under the EU "Recovery and Resilience Facility", under which the government anticipates an allocation of CZK 179 billion (EUR 6.8 billion).

Energy policy framework

The government is in the process of revising the country's energy policy and legal frameworks. The "State Energy Policy" (SEP) is the main strategic document guiding energy policy in the Czech Republic (MPO, 2014). The current SEP dates from May 2015 and contains an outlook to 2040. The Ministry of Industry and Trade (MIT) is the central body responsible for the energy sector and is tasked with the development and implementation of energy policies, including the SEPs. The MIT is obliged to report to the government on the achievements and progress under the SEP every five years. Based on the assessment of the 2015 SEP, in March 2021, the government decided to update the SEP with the new version to be prepared by the end of 2023.

The strategic directions of the 2015 SEP are expressed in a number of quantitative targets. Chief among them is the commitment to reduce carbon dioxide (CO_2) emissions by 40% in 2030, compared to the 1990 baseline. The Czech Republic further commits to efforts towards the decarbonisation of the economy by 2050, in line with the country's financial capacity.

The three main objectives of the 2015 SEP are:

(i) security of energy supplies (under normal operations and in emergency situations)
(ii) competitiveness of the energy sector (energy prices are comparable to other countries in the region) and social acceptance
(iii) sustainability (environmental, financial and social dimensions).

Five strategic priorities support these three objectives:

(i) achieving a balanced energy mix
(ii) improving energy efficiency and savings
(iii) developing infrastructure
(iv) investments in energy and industry research and human resources development
(v) ensuring energy security and resilience.

A number of additional high-level strategic documents support the implementation of the SEP by setting detailed policies, targets and measures. Among these are the National Action Plan for Smart Grids and the National Action Plan for Clean Mobility, which were both last updated in 2019 to cover the period to 2030. The National Development Plan for Nuclear Energy dates from June 2015 and anticipates the construction of new nuclear generation capacity to maintain the current level of energy self-sufficiency and to advance the energy transitions towards a low-carbon energy sector.

The 2017 Climate Protection Policy sets the country's low-emission economic development plan to 2050, including targets for 2020 and 2030 and indicative trajectories for 2040 and 2050. An assessment of the Climate Protection Policy is ongoing and should be finalised by the end of 2021. The policy would potentially be updated by 2023. A revised State Environment Policy was adopted in January 2021 and includes a long-term vision for reaching carbon neutrality by 2050 (see Chapter 3).

As an EU member country, the Czech Republic prepared a National Energy and Climate Plan (NECP) for the period to 2030 that came into effect on 1 January 2021 (EC, 2019). The NECP supersedes the earlier national action plans on renewable and energy efficiency policies, which had targets and measures through to the end of 2020.

The Czech Republic has yet to transpose provisions of the EU's "Clean Energy for All" directive into national law. The government is preparing a new Energy Act to provide the legal framework for the participation of a set of new actors and business models in the energy market. The new Energy Act will reflect the growing decentralised nature of the energy market and include provisions for new actors, such as renewable energy communities, prosumers, renewable self-consumption, aggregators and private purchasing to enter the market. The act will also facilitate grid access and introduce a new dynamic tariff structure. Given the upcoming national elections in the second half of 2021, the new Energy Act will become effective at the earliest in 2022.

Also outstanding is the revision of the Renewable Energy Law on supported sources of energy. The existing law provides the legal framework for support schemes to 2020 and the revision provides the framework for the support schemes to 2030. The revised law has been pending in the legislature since April 2020 and is unlikely to be adopted before 2022 at the earliest. The gap between the two legal provisions will likely result in a delay of the provision of operational support for existing renewable projects. However, investment support for renewable projects is not subject to the approval of the revised law and will be provided irrespectively.

The envisioned energy mix to 2040

To support the energy transition goals, the SEP sets targets for the energy mix toward 2040 (Table 2.1). However, they are not set as absolute targets, but along so-called "relative target corridors", which are, indeed, rather wide. Nuclear energy will replace coal and other solid non-renewable fuels as the largest fuel in total primary energy supply. The share of renewables and secondary energy sources and that of gas will also increase, while the share of oil will decrease (MIT, 2014).

Table 2.1 Total primary energy supply in the Czech Republic by source

Fuel source	2016 level	2040 target level
Coal and other solid non-renewable fuels	40%	11-17%
Oil and petroleum products	20%	14-17%
Gaseous fuels	16%	18-25%
Nuclear energy	15%	25-33%
Renewable and secondary energy sources	10%	17-22%

Source: MIT (2015).

The SEP also sets out the share of fuels in gross electricity generation to 2040 along a relative target corridor. The share of coal, which currently dominates electricity generation with 46%, is expected to decline by more than half by 2040, while the share of nuclear is expected to increase by at least 50% to become the largest power generation source by 2040. Renewable and secondary energy sources would increase too, but would not exceed 25% of total generation. Gas-fired generation would continue to be only of limited significance (see Chapter 7). The NECP broadly confirms the SEP's target corridors for electricity generation. For 2030, the NECP shows a share of 22% of renewables in gross final consumption (EC, 2019).

The renewables shares in both the SEP and the NECP appear to lack ambition compared to the country's renewable energy potential. While the NECP's measures and policies anticipate the installation of 4 gigawatts (GW) of solar PV and just under 1 GW of wind power in 2030, other estimates point towards a potential of just above 7 GW solar PV and 1.6 GW of wind power for the same year. Combined, solar PV and wind could contribute 15% of total generation by 2030, compared to 3.6% in 2019. However, for this potential to materialise, an enabling legal and regulatory framework must be put in place and grid management would need to be adapted too. It should be noted that the government is, at least, currently considering other renewable sources, such as bioenergy, which is currently considered to be more important for the energy mix.

In light of the newly agreed targets that the European Union (EU) will become carbon-neutral by 2050 and reduce emissions by at least 55% by 2030 (compared to 1990 levels), reach a share of 38-40% of renewables by 2030 and improve energy efficiency by at least 32.5% by 2030, there is a need to also raise the ambitions of the Czech Republic (see Chapter 3).[3] The upcoming review and subsequent revision of the SEP is a logical starting point for sketching the decarbonisation and energy transition pathway of the Czech energy system to 2050. The government should develop scenarios and pathways for the new 2030 target in line with the enhanced European-wide commitments, but also with a view to the decarbonisation target to 2050.

Phasing out coal from the energy mix

As many other IEA countries, the Czech Republic is analysing options to phase out coal from the energy mix, and in particular from electricity generation. For this purpose, the government created a Coal Commission in 2019, which delivered its recommendations at the end of 2020. It recommended phasing out coal from the electricity sector by 2038 at the latest. In May 2021, the government requested that the Coal Commission reassess the possibility of an earlier exit and the impact on the Czech energy market (Reuters, 2021) (see Chapters 7 and 9). An early decision on the exit date is desirable, as it would provide needed certainty to the coal industry and to industries using coal, as well as to investors with a view to ensuring security of electricity supply.

However, the future of coal in the Czech Republic is equally determined by the EU's energy and climate targets for 2030 and 2050, to which the country has to contribute, and the expected trajectory of prices for allowances under the EU Emissions Trading System (ETS). Increasing ETS prices will render coal less and less competitive and will advance the phase-out of coal purely due to economic considerations. Moreover, strict emissions regulations for power producers as of 2021 will put further pressure on the Czech Republic's coal-fired generation. By 2023, 1.3 GW of coal-fired generation capacity, equivalent to about 11% of total installed coal capacity, will likely retire and another 2 GW of coal-fired generation is expected to follow by 2026 (ČEPS, 2019). This would reduce total coal-fired capacity already by around one-third of its current installed capacity (see Chapter 7).

The Czech Republic does not currently have a sufficient pipeline of new large generation capacity additions for the period to 2030. One new nuclear reactor is currently under preparation, but it will only become available in 2036 – too late to compensate for a possible earlier coal exit driven by market forces (see Chapter 8). There are no dedicated new gas-fired generation projects under discussion, although the Coal Commission sees natural gas generation as the principal replacement for coal. Some co-generation plants are, however, under discussion. And an accelerated build-up of renewable capacity is hampered by the lack of an enabling support framework pending the approval of the new Renewables Law and the Energy Act. Against this backdrop, the Czech Republic will likely become a net importer of electricity by 2030 (ČEPS, 2019).

Beyond the electricity sector, the impact of any accelerated coal phase-out will be particularly strongly felt in the heating sector, where coal accounts for about 25% of the

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[3] The EU targets will be updated upon publication of the new package on 14 July 2021. Currently, the share of renewables for 2030 is 32%.

total fuels consumed. Around half of total heat consumption in the Czech Republic is supplied by district heating (DH) systems and 58% of heat produced by DH is coal based.

Large coal-fired DH systems fall under the EU ETS system and are also subject to EU legislation for pollutants. Heating plants that receive their revenues mainly from heat sales are facing the most difficult situation, as they are unable to pass on higher ETS prices to end-consumers. As such, they become less and less economically viable, compared to decentralised heating sources and have already lost market shares in recent years, from 68% in 2010 to 60% in 2019 (see Chapter 4).

However, DH systems are usually more energy efficient than individual heating systems as they often rely on co-generation, which allows for a higher use of primary energy sources. From an energy efficiency point of view, it is therefore desirable to maintain the efficient heating networks and to convert them to the most suitable replacement fuels. Those could include natural gas, as the gas infrastructure already exists and could be used for biogas and synthetic gases in the future. The government has already anticipated the introduction of these gases. Other options include the use of heat pumps, waste heat recovery and even small modular nuclear reactors (see Chapters 4, 5 and 8).

Against this background, the government should consider developing different scenarios for the energy and electricity mix to 2030, based on an accelerated coal phase-out and a more aggressive scenario for renewable energies and accumulators in line with potentials. For this, the government may wish to undertake its own study of the economic potential of renewables, including accumulators and new business models such as prosumers and energy communities. It could then develop a strategy on how to translate the potential into actual projects. Independent studies point towards a much greater potential for renewables than currently assumed in official models. Such an assessment would also be useful to articulate the potential role of different energy sources post-2030, with a view to reaching climate neutrality by 2050.

In addition, a speedy implementation of the two new laws under discussion (see above) is important to ensure that new generation and heating capacities and related infrastructure will materialise between now and 2030. Uncertainty regarding the future of coal is likely supressing investment in needed infrastructure and production assets.

In April 2021, the Czech government announced that it will establish a "Green Deal" Commission, modelled on the Coal Commission. The objective is to assess the social and economic impact of the European Green Deal on the Czech Republic; however, no specific details about the exact scope of work, composition or timeline of this commission is available yet (Zachová, 2021).

Just transition

Coal is still an important economic sector in the Czech Republic and in particular in remote and economically weaker regions. The phase-out of coal in the Czech Republic therefore has a strong social and economic impact, and the Coal Commission consequently set up a working group to analyse the impacts of a coal phase-out (see Chapter 9). This working group is led by the Ministry for Regional Development and includes representatives from the three most affected regions, which are also eligible to access the EU Just Transition Funds (JTF). The JTF will have a total budget of around EUR 17.5 billion and can be drawn on during the programming period 2021-27. Around EUR 1.64 billion will be available for the Czech Republic, including for technical support (EC, 2020a).

However, the work of this group is dependent on setting a date and pathway for the coal phase-out before it can commence its analysis in earnest. The government should thus expedite a decision of the likely exit date to kick-start these important deliberations. Moreover, the government should consider broadening the working group's mandate to consider the impacts of an accelerated coal phase-out due to changing external factors impacting the future of coal in the country.

Ensuring a just transition is of critical importance to ensure that the energy transition is supported by the population. The Covid-19 pandemic has already accelerated the phase-out of coal mining and the closure of coal mines (see Chapter 9). The government has launched the RE:START Programme for coal regions in transition and can expect to receive substantial financial support from the European Commission from the JTF. The JTF targets overall economic restructuring and is not limited to the energy sector; it can finance retraining for miners and power plant workers for new, emerging employment opportunities (see Chapter 9). However, the JTF is designed to respond to project proposals originating from the affected regions themselves (bottom-up). It will be important that the Czech Republic prepares solid project proposals as quickly as possible to be able to draw funds from the JTF, as there is no set allocation by country. In addition, the Czech Republic can also draw on the European Recovery and Resilience Facility for the transformation of its coal regions.

In total, the Czech Republic is expecting to receive over EUR 45 billion from various European funds over the period to 2030, including the Modernisation Fund (EC, 2020b). Part of the spending is linked to certain conditions; around one-third needs to be spent on climate projects, while the remainder can be more freely allocated, provided the supported projects do not harm the environment. The newly established European Modernisation Fund is funded by revenues from the auction of allowances under the ETS. The available funding therefore depends on the EU ETS prices. Based on the estimates prepared in 2020, the Czech Republic expects revenues of at least CZK 154 billion. The objective of the fund is to advance the transformation of the energy sector in Central European countries, where coal still plays an important role.

The government plans to allocate significant amounts to energy efficiency and renewable energy projects, including for the modernisation of heating systems, which is an ongoing and successful policy (see Chapter 4). It will be important to combine the largesse of available funds in an optimal way to accelerate the energy transition and, in particular, to firmly put energy efficiency at the centre of the country's energy policy.

Putting energy efficiency at the heart of policy making

Improving energy efficiency is one of the strategic priorities of the SEP. Yet, energy consumption is expected to decline only slightly, as the expected savings from efficiency improvements are, to a large extent, offset by increased energy demand due to economic growth (Table 2.2).

Energy efficiency is a cost-effective way to accelerate the energy transition and achieve climate and sustainability targets. Especially in light of the expected decline in electricity generation and heat production from co-generation of coal-fired plants, energy efficiency will help reduce the need for heating and help ease the investment needs in heat production.

Table 2.2 Overview of energy efficiency targets in the Czech Republic

	2020	2030
Primary energy consumption	1 855 PJ	1 735 PJ
Final energy consumption	1 060 PJ	990 PJ

Note: PJ = petajoule.

Source: EC (2019).

The upcoming revision of the SEP offers an ideal opportunity to apply the “energy efficiency first” principle at the heart of policy making and to set more ambitious targets for the period to 2030 and beyond. The targets should be supported by quantified annual savings objectives in each sector (industry, buildings and transport) to allow early government intervention if a sector is off-track.

Since the last IEA in-depth review, the Czech Republic has commendably increased and broadened the number of support programmes available for various beneficiary groups to support energy efficiency improvements. It has also increased the amount of available funds. In addition, the government is offering a wide set of advisory services for various groups of beneficiaries through a network of energy consultation and information centres that provide free advice to support the uptake of energy-saving measures (see Chapter 4).

Yet, the financial resources of several support programmes were not exhausted in the period to 2020. This is largely due to the lack of awareness among the general public about the multiple benefits of energy efficiency in general, and about the available support programmes specifically. The awareness campaigns that started in late 2020 are important initiatives to rectify this and the government should closely monitor and evaluate their impacts and, if needed, stand ready to extend or broaden them.

Beyond raising the awareness of the Czech population, it is also important to streamline the institutional set-up and administrative processes for energy efficiency programmes. For example, until 2021, programmes for the building sector were operated by multiple agencies with individual processes and eligibility. Streamlining building efficiency programmes under one ministry is an important step in the right direction. However, there are still multiple programmes targeting, for example, the building sector with different eligibility conditions and this should not become a hurdle for potential beneficiaries to access the available funding.

Therefore, the government may wish to consider creating a dedicated agency for the implementation of energy efficiency programmes that is properly staffed and resourced. The burden of implementation would also be lifted from the ministries so that they could then concentrate on policy making. Moreover, a dedicated agency for energy efficiency could also directly work with local authorities, who sometimes lack the competencies required for complex, multi-year, deep renovation projects.

Taxing fossil fuel use

The effective tax rate on CO_2 emissions from energy use (that is, the price imposed on each tonne of CO_2 emitted from energy use, considering all energy excise taxes and the climate change mitigation tax) in the Czech Republic is among the lowest in the OECD, except in the transport sector. The country does not levy a specific carbon tax outside of the EU ETS. Beyond the ETS, effective tax rates on carbon emissions in the Czech Republic consist primarily of fuel excise taxes (OECD, 2021).

There have only been minor changes in energy taxation since 2016, at the time of the IEA's last in-depth energy policy review. In particular, taxation of heating fuels remains low compared to other EU countries. The lack of explicit carbon taxation on heating fuels outside the EU ETS has resulted in a lack of a level playing field, as most DH systems fall under the EU ETS while individual heating systems based on carbon fuels are not taxed in a similar way.

Based on an international comparison, the IEA sees scope for the Czech Republic to make better use of price signals to reduce CO_2 emissions by steering behaviour, both of end-consumers and of the industrial sector, and to redirect industrial investments to innovative technologies. In its 2016 in-depth review, the IEA had suggested that the Czech government study the feasibility of introducing a carbon tax outside of the ETS and using the revenues to stimulate switching to cleaner fuels and enticing energy efficiency upgrades. Such an analysis was undertaken from 2017 to 2019 jointly by the Ministry of Finance, the MIT and the Ministry of the Environment. The study analysed the possible impacts of a carbon tax on other taxes, prices, households and the public budget and also looked at a possible differentiation of carbon taxation among producers by including other characteristics, such as particulate matter.

The study found that a carbon tax of EUR 10 per tonne of CO_2 on heating fuels would move the country to the middle in an EU comparison and would result in revenues of about CZK 3.2 billion. However, the tax was found to be regressive, with the greatest impact on poorer households. Prices for lignite, which is still an important fuel for heating, would increase by 12.5%. It is even still used directly by poor families in coal-mining regions.

In light of the possible increase in tax burden on some segments of the Czech society, the government decided not to pursue the recommendations of the study any further. However, it kept the option open to use the analysis at some point in the future.

The government still has to implement the revised EU Energy Taxation Directive 2003/96/EC that aims to establish a minimum rate of taxation of the CO_2 component for all uses of energy products. The legislative proposal is expected in 2021. This revision could set the basis for more significant changes in energy taxation, in particular with a view to the EU's new energy climate ambitions.

The IEA encourages the government to reconsider the introduction of a carbon tax on energy use. The idea of such a carbon tax is not to increase the overall tax burden, but to tax different fuels according to their externalities and to shift consumer behaviours The various EU funding schemes such as the Recovery and Resilience Facility offer a unique opportunity for the Czech Republic to reconsider its position on the introduction of a domestic carbon tax on sectors not covered under the EU ETS. A designated portion of the EU funds is intended for green investments. If the government combines these funds with technical and implementation advice and awareness-raising campaigns, and considers redirecting a certain portion of the carbon tax revenues to consumers, this may help to increase investments in energy efficiency, renewable energies and in best available technologies in the industry sectors.

Assessment

The 2015 SEP and the 2019 NECP are the key documents for the transition of the Czech Republic's energy system. Following the assessment of the 2015 SEP, the government decided in March 2021 to update the SEP with the new version to be prepared by the end of 2023. This in-depth review is intended to provide useful input to the process.

The SEP, the NECP and the Climate Protection Policy set targets for key energy and climate indicators. The binding national 2030 target for non-ETS emissions is a reduction of 14% compared to 2005 levels. The overall share of renewables should increase from 15% in 2018 to 22% in 2030, while final energy consumption is targeted to decrease by 6.6% from 2018 levels to 2030. For the development of the energy mix, so-called "strategic corridors" are outlined for the use of energy sources until 2040.

Energy demand in the Czech Republic is slowly decreasing, while the decoupling of value creation in terms of GDP from energy demand is becoming more pronounced. Also, in terms of greenhouse gas emissions, the trend from the last 25-30 years is a step in the right direction, with emissions decreasing by one-third since 1990. However, a large portion of this decrease happened in the period 1990-2000; since then, progress has slowed down.

Fossil fuels are still essential building blocks of the energy mix in the Czech Republic. Coal is available domestically in vast resources and is used intensively in heating and power production, and contributes, along with nuclear power generation, to the moderate degree of energy self-sufficiency of the country.

The energy supply of coal decreased by 19% in the decade from 2009 to 2019, and dropped by 15% in 2020 due to the Covid-19 pandemic. Oil consumption was increasing due to its central role in the transport sector, and its 10% decrease in 2020 is mainly attributed to the impact of the pandemic on the transport sector. Natural gas is expected to gain momentum in the decades to come following the phase-out of coal. It will be important for the Czech Republic, in its long-term efforts, to substantially reduce carbon emissions, not to lock itself into another carbon-emitting fuel, although a low capital-intensive contribution of switching to gas from coal will be beneficial for emissions reductions.

Along with other countries in Europe, the Czech Republic sees a need for assessing when and how to end the use of coal. The national Coal Commission was established in July 2019 and delivered its recommendations to the Czech government by the end of 2020. It recommended phasing out coal from the electricity mix by 2038 at the latest. In May 2021, the government requested that the Coal Commission evaluate options for an earlier exit and assess the impact on the Czech energy market.

Stakeholders and the general public alike are eager to know the government's final decision, as it will be the base for the country's mid- to long-term energy policy. A clear signal on the transitional path away from coal, along with incentives for the decarbonisation of the energy system, may spur investors to take concrete steps to seize emerging opportunities. It is also expected that EU ambitions will be raised, and the Czech Republic should be prepared to contribute to meeting them.

Due to increasing prices in the EU ETS, an earlier and more aggressive phase-out of coal is possible on purely commercial terms. This is already happening in several other European countries. The government should prepare for this.

The future of coal will also have great importance for the district heating sector, which serves 4 million people, which is nearly half of the population. Coal accounts for 58% of the fuels used in district heating and will need to be replaced by other energy sources in order to allow for decarbonisation and to futureproof district heating.

The larger co-generation plants that use coal are part of the EU ETS and thus have to cover the costs of their emissions and charge their customers accordingly. Households and other customers with the opportunity to do so can choose to replace district heating with individual boilers that can also use coal or gas, but these will not have to pay for emissions. This threatens undermining the competitiveness of district heating. In order to provide incentives to reduce emissions also from these small individual installations, a carbon tax should be considered. Such a tax could also contribute to emission reductions in the transport sector, which is not covered under the ETS.

Following a recommendation of the IEA's last in-depth review in 2016, the Czech Republic studied and considered the introduction of a carbon tax, but decided to refrain from implementing one due to an overall political commitment to not raise taxes. There are, however, several examples of other IEA countries that have successfully introduced carbon taxes. The purpose of such a tax is not to add net revenue to the national budget, as the income from the carbon tax is often offset by lowering other taxes or using the revenues for programmes directly benefiting the population, like building renovation or subsidies for electric vehicles. The crucial element of the design should be to internalise the costs of emissions, provide incentives to invest in and use less carbon-intensive fuels, and to steer consumer behaviour more generally towards the use of low-carbon energy sources.

The Czech Republic has a tangible share of renewables in the electricity sector. This capacity consists of bioenergy, hydro, small shares of wind and roughly 2 GW of solar PV, which was mainly installed in the early 2010s. Renewables accounted for 11.8% of total electricity generated in 2019 based on the IEA methodology. They accounted for 14% of total electricity consumed based on the Eurostat methodology. The Czech Republic's NECP foresees a further development in the share of renewables in electricity, which is expected to reach 17% in 2030 using the Eurostat methodology.[4] However, independent from the methodology used, neither share is particularly ambitious in light of the country's resource potential and the new energy and climate targets for 2030 at the EU level. Moreover, the projections are not clearly supported by concrete measures and rely mainly on the programmes and (associated) funds available within the EU.

There is scope to strengthen the ambition for renewables and to realise the substantial technical potential. The IEA appreciates the concerns stemming from the experiences with earlier subsidy programmes, but that should not refrain the country from rebooting its policy to better target subsidies to current market circumstances and cost price developments. A higher share of renewables could contribute to increased self-sufficiency in the short term,

[4] Eurostat definitions include normalisation of wind and hydro renewable electricity generation, and multiplication factors for advanced biofuels and renewable electricity in transport.

thereby contributing to one of the preconditions given to the Coal Commission. With construction costs for solar PV and wind rapidly decreasing and a stable policy environment, the investments and operational support can be less costly than previous schemes.

Energy efficiency can play an important role in facilitating the transition of the Czech energy sector and contribute to meeting several of its climate targets. There is significant potential to raise ambitions in the upcoming revision of the SEP; the country should apply the “energy efficiency first” principle, as every unit of energy that is not consumed would lower the bar towards reaching a cleaner energy supply. Funding is generally available, but access to funding by all market participants appears a challenge due to a lack of awareness about the benefits of energy efficiency and the wide range of support programmes available. An increased focus on the implementation of energy efficiency measures could be attained by establishing a dedicated energy agency equipped with sufficient financial, human and technical resources. Such a dedicated energy agency could also help further exploit the existing energy efficiency potential in the (public) building sector in rural areas. Several initiatives are already being implemented to facilitate energy efficiency improvements in certain public buildings such as hospitals and schools.

Nuclear power is an established generation technology in the Czech Republic, enjoying strong public support. Plans for the expansion of the current capacity seem solid. A new 1 200 megawatt (MW) reactor is planned to be operational at the Dukovany site by 2036. However, the final financial arrangements still need to obtain state-aid approval from the European Commission. The added nuclear capacity would strengthen generation adequacy in the Czech power system after the coal phase-out. In the future, the emerging small modular reactors may prove to be a good fit to the Czech energy system by their ability to also provide heat for district heating.

Recommendations

The government of the Czech Republic should:

- ☐ Develop a clear road map with key milestones for the necessary transition of the energy system towards less carbon dependency or even carbon neutrality by 2050. Firm commitments, targets and programmes should be clearly communicated.
- ☐ Prepare for a faster than anticipated phase-out of coal, for instance due to rising prices of EU ETS allowances. The shortfall of power generation capacity that may result could be alleviated by a proactive stimulus of renewable and nuclear electricity production.
- ☐ Place energy efficiency at the centre of energy policy making. Create a dedicated body for the implementation of the energy efficiency policies.
- ☐ Introduce a carbon tax to provide incentives for reducing carbon intensity, and to level the playing field between fuels used in different systems for heating. To be revenue neutral and alleviate the impact on vulnerable customers, revenues could be used, for instance, to lower other taxes or for supporting energy efficiency in the residential building sector for low-income households.

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3. Energy and climate change

Key data (2019/20)

GHG emissions with LULUCF (2019):* 136.2 Mt CO_2-eq, -2.5% since 2005, -3.1% since 2000, -28.4% since 1990.

GHG emissions without LULUCF (2019):* 122.6 Mt CO_2-eq, -17.0% since 2005, -17.8% since 2000, -37.8% since 1990.

Energy-related CO_2 emissions:

CO_2 emissions from fuel combustion (2020):** 84.3 Mt CO_2, -14% between 2009-19, - 11% between 2019-20, -22.4% between 2000-2019, -37.4% between 1990-2019.

CO_2 emissions by fuel (2019): coal 58%, oil 23%, natural gas 17%, other 2%.

CO_2 emissions by sector (2019): electricity and heat generation 51.0%, transport 20.0%, industry 18.2%, buildings 10.9%.

CO_2 intensity per GDP (2020):*** 0.22 kg CO_2/USD (IEA average:**** 0.19 kg CO_2/USD).

Exchange rates (2020):***** Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* Land use, land-use change and forestry (Source: UNFCCC).

** Data for 2020 are available for total CO_2 emissions only, while the most recent breakdown by source and sector is from 2019.

*** Gross domestic product in 2015 prices and purchasing power parity (PPP).

**** Weighted average of IEA member countries

***** OFX (2021)

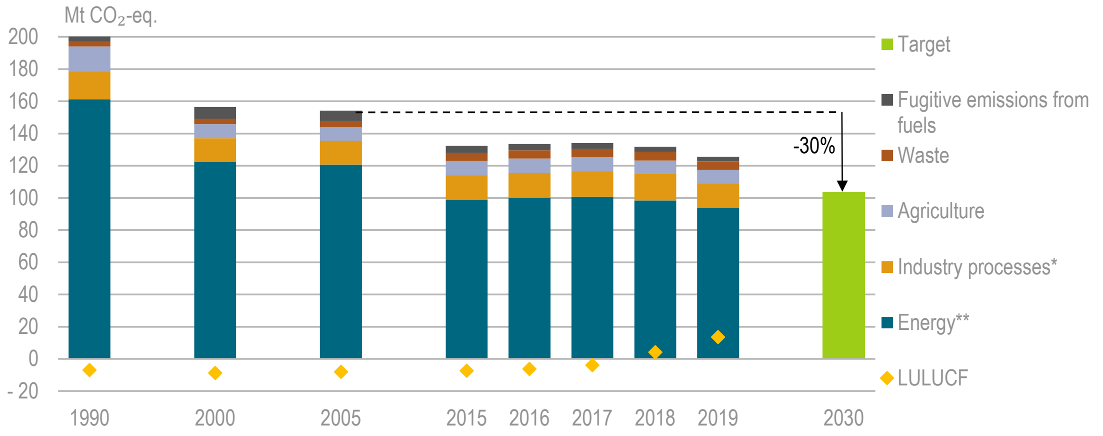
Overview

In December 2019, the Czech Republic submitted a ten-year National Energy and Climate Plan (NECP) to the European Commission. According to the NECP, the Czech government set a target of reducing greenouse gas (GHG) emissions by at least 44 million tonnes of carbon dioxide equivalent (Mt CO_2-eq), corresponding to a 30% reduction compared to 2005. The country is currently not on track to reach this goal.

In 2019, GHG emissions, excluding emissions from land use, land-use change and forestry (LULUCF), amounted to 123 Mt CO_2-eq, 17% below the 2005 level, corresponding to a 38% reduction since 1990 (Figure 3.1). However, while significant progress was made between 2005 and 2015, emissions have remained relatively stable since then. The energy sector is the largest contributor to total GHG emissions, accounting for 76% in 2019, followed by industrial processes at 13%, agriculture at 7% and waste at 4%.

Until 2017, LULUCF had absorbed GHG emissions in the Czech Republic. But it released an extra 5.8 Mt CO_2-eq in 2018 and 13.6 Mt CO_2-eq in 2019. The major causes of this change were an extreme drought and the unprecedented bark beetle outbreak affecting coniferous forest stands (eAGRI, 2019).

Figure 3.1 Greenhouse gas emissions by sector in the Czech Republic, 1990-2019 and 2030 target



Total GHG emissions have fallen by 17% since 2005, mostly driven by a drop in energy-related emissions, but more effort is needed to reduce them by 30% by 2030.

* *Industry processes* includes mineral, chemical, metal, manufacturing and construction industries.

** *Energy* includes electricity and heat generation, commercial, households, industrial energy consumption, and transport.

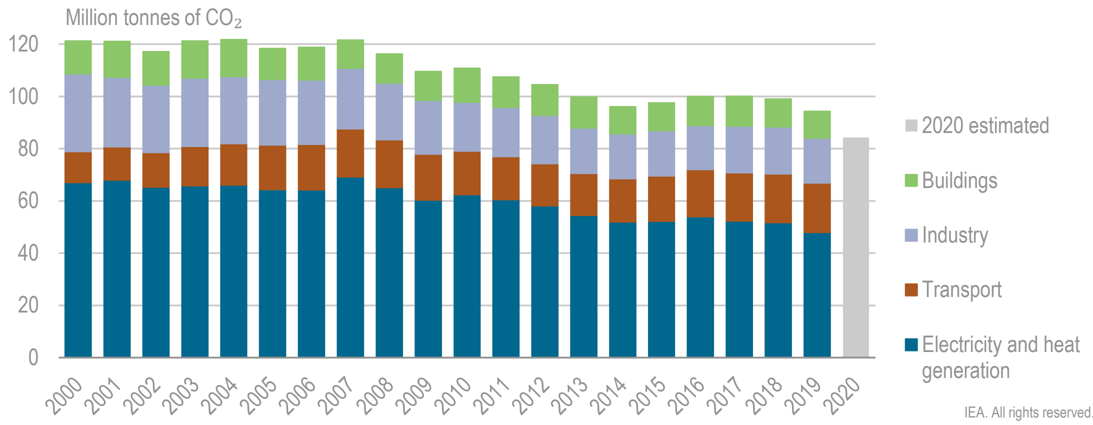
Source: UNFCCC (2020).

Energy-related CO_2 emissions

In 2019, energy-related CO_2 emissions were 94 Mt CO_2, 14% below the 2009 level (Figure 3.2). A considerable 5% decrease was recorded between 2018 and 2019, mainly due to a drop in the use of coal for electricity generation, as coal became less and less competitive compared to other energy sources, such as natural gas and renewables. In 2020, the Covid-19 pandemic contributed to an 11% decrease of CO_2 emissions to 84 Mt CO_2, compared to 2019.

The largest CO_2 emitter in the Czech Republic was electricity and heat generation, which accounted for 51% of the total emissions from combustion in 2019, followed by transport at 20%, industry at 12%, residential at 8%, services at 5% and other energy at 4%. CO_2 emissions in electricity and heat generation have decreased by 21% since 2009. The transport sector was the second-largest CO_2 emitter in 2019; emissions in this sector decreased after 2008, but have rebounded again by 18% since 2013. Emissions from the industry sector declined by 32% between 2009 and 2019, while emissions from other energy industries increased slightly.

Figure 3.2 Energy-related CO_2 emissions in the Czech Republic by sector, 2000-2020

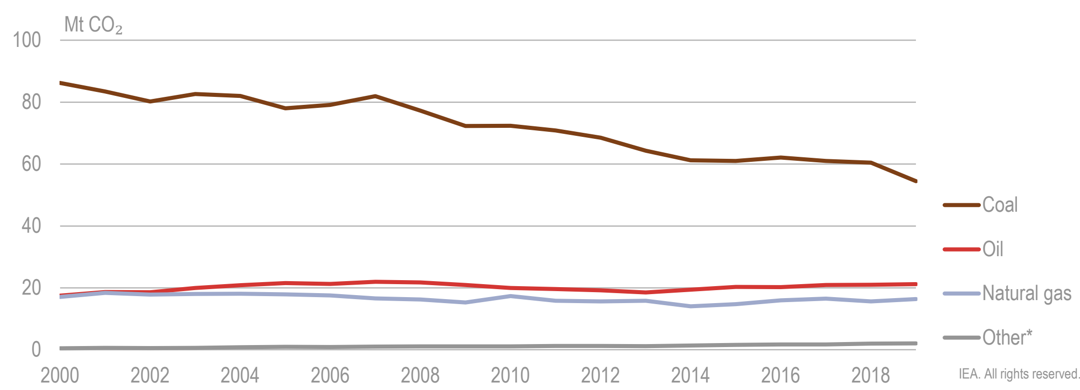


Since 2009, energy-related CO_2 emissions have declined across all sectors, except for the transport sector, due to the increasing vehicle fleet and subsequent oil consumption.

Note: only the total CO_2 emissions are available for 2020, while the most recent breakdown by sector is from 2019.
Source: IEA (2021).

Coal accounted for 58% of energy-related CO_2 emissions in 2019, followed by oil at 23%, natural gas at 17% and other at 2% (Figure 3.3). Emissions from coal combustion have significantly fallen by 25% since 2009, in line with decreasing coal demand in the electricity sector due to the expansion of nuclear and renewable power generation. With the growth of oil demand in the transport sector, the oil share of total emissions increased from 19% in 2009 to 23% in 2019. Total emissions from oil use decreased notably from 2007 to 2013 and have rebounded since, though their 2019 level was below the peak in 2017. Emissions from natural gas remained stable at around 16 Mt CO_2.

Figure 3.3 Energy-related CO_2 emissions in the Czech Republic by energy source, 2000-19



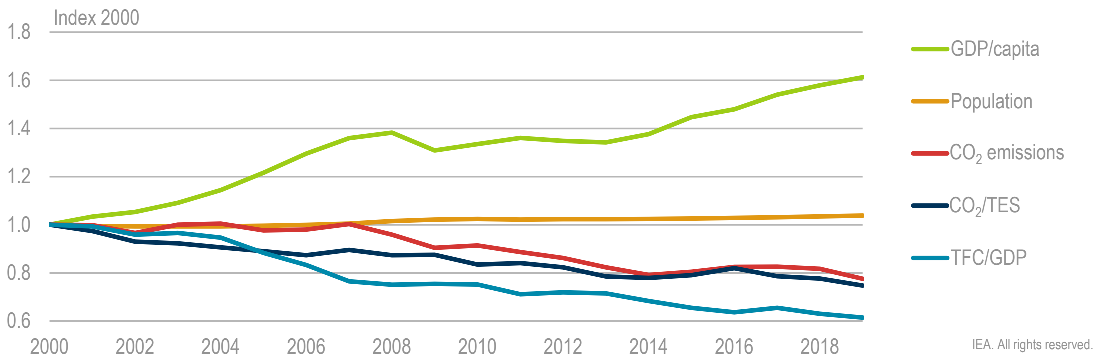
Coal-related CO_2 emissions accounted for more than half of the total in 2019, although they have declined by one-quarter over the last decade.

* *Other* includes emissions from non-renewable waste.
Source: IEA (2021).

CO_2 emissions drivers and carbon intensity

Energy-related CO_2 emissions in the Czech Republic decreased by 14% from 2009 to 2019, despite an increase in gross domestic product (GDP) per capita by 23% over the same period (Figure 3.4). This was achieved by a 15% reduction in the carbon intensity of the energy mix (CO_2/TES) and a 20% decline in the energy intensity of the economy (TFC/GDP) between 2009 and 2019, showing a decoupling between economic growth and energy-related carbon emissions.

Figure 3.4 Energy-related CO_2 emissions and key drivers in the Czech Republic, 2000-19



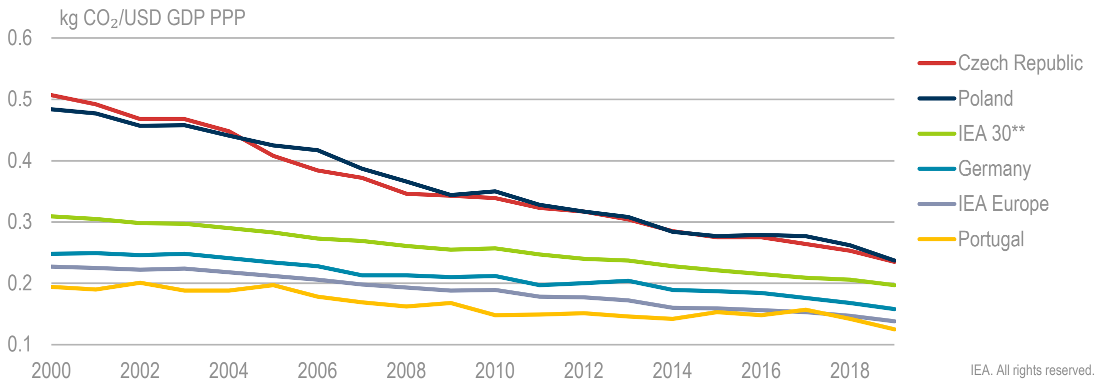
Despite economic growth per capita, energy-related CO_2 emissions have decreased in line with a decline in energy and carbon intensity of the economy.

TES = total energy supply. TFC = total final consumption.
Source: IEA (2021).

In 2019, the carbon intensity of the country's economy (measured as the ratio of emissions per unit of GDP) was 0.24 kilogrammes of carbon dioxide (kg CO_2) per US dollar (USD) (Figure 3.5), which is significantly lower than the 2000 level (-53%). Despite the significant decrease since 2000, the carbon intensity of the Czech Republic in 2019 was higher than the weighted average (0.20 kg CO_2/USD) of all IEA countries. In 2020, due to the decreased supply of coal, the carbon intensity of the economy decreased to 0.22 kg CO_2 per USD, still higher than the IEA weighted average of 0.19 kg CO_2 per USD.

Emissions from electricity and heat generation were 406 grammes of CO2 per kWh (g CO_2/kWh) in 2019, a 22% reduction since 2009 due to the lower use of coal (Figure 3.6). However, the carbon intensity of the electricity sector is still higher than the IEA weighted average (337 g CO_2/kWh), as coal is still the largest electricity generation source in the Czech Republic, accounting for almost half of total electricity generation in 2019. In 2020, the share of coal in electricity generation dropped to 41%, lowering the carbon intensity of electricity generation to 379 g CO_2 per kWh, versus an IEA weighted average of 282 g CO_2 per kWh.

Figure 3.5 CO_2 intensity per GDP* in the Czech Republic and selected IEA countries, 2000-19



The Czech Republic's CO_2 intensity per GDP has decreased faster than the IEA weighted average, but has remained at a higher level.

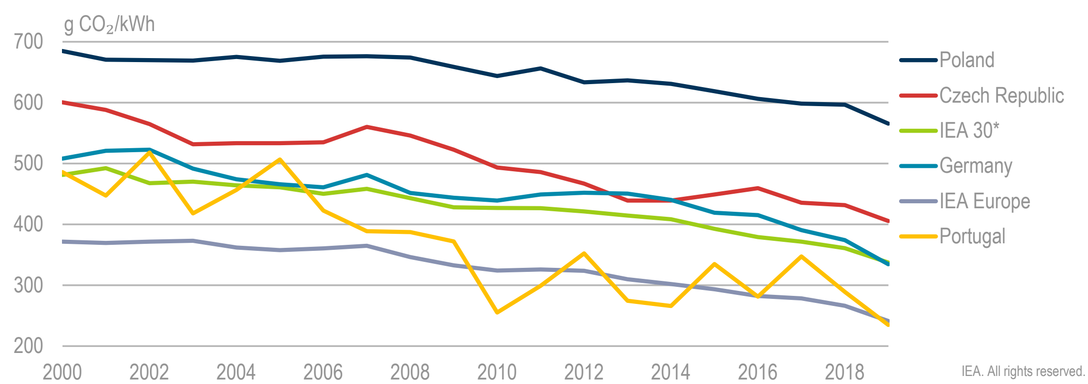
* *GDP* data are in billion USD 2015 prices and purchasing power parity (PPP).

** *IEA30* is the equivalent of a weighted average of 30 IEA countries.

Notes: kg CO_2/USD PPP = kilogrammes of carbon dioxide per US dollar in purchasing power parity. 2019 data for Germany, IEA 30 and IEA Europe are estimated.

Source: IEA (2021).

Figure 3.6 CO_2 intensity of electricity and heat generation in the Czech Republic and selected European IEA countries, 2000-19



CO_2 intensity in electricity and heat generation has dropped noticeably in the Czech Republic, mainly due to the expansion of renewables and nuclear energy.

* *IEA30* is the equivalent of a weighted average of 30 IEA countries.

Notes: 2019 data for Germany, IEA 30 and IEA Europe are estimated.

Source: IEA (2021).

Emissions targets and strategy

As a European Union (EU) member state, the Czech Republic's climate policy is guided by the framework of EU climate policies: the 2020 climate package and the 2030 climate framework. EU member states are jointly committed to reducing EU-wide GHG emissions by 20% below 2005 levels by 2020 and by at least 40% by 2030 compared to 2005 levels, while the EU draft Climate Law, once accepted, will increase the 2030 ambition to a 55% reduction. Large combustion facilities in the power and industry sectors are part of the EU Emissions Trading System (ETS), whereas non-ETS emissions are subject to the Effort Sharing Decision (ESD) until 2020 and the Effort Sharing Regulation (ESR) until 2030.

The EU-level reduction targets for GHG emissions in the non-ETS sectors are 10% by 2020 and 30% by 2030, compared with 2005 levels, and are translated into binding targets for each member country. The target for the Czech Republic under the ESD is to limit its emission growth to 9% above the 2005 level by 2020. The Czech Republic is likely to have achieved its 2020 target, with emissions expected to exceed 2005 emissions by only 2%. The target to 2030 is to reduce emissions by 14% compared to 2005. On current trends, the Czech Republic is expected to also meet its EU 2030 target with existing measures.

Emissions and removals from the LULUCF are included for the first time in the EU climate target for the period 2021-30 through the so-called LULUCF regulation. According to this legislation, each member state has to ensure that the LULUCF sector does not create debits. However, the Czech Republic will probably not comply with the LULUCF regulation, as the unprecedented bark beetle calamity in 2018 required an extraordinary amount of logging, which has turned the country's LULUCF sink into a source of net emissions. To cover this expected debit, the country will probably need to purchase annual emission allocation units that are provided under the ETS from other EU member states (see below).

The EU and its member states, including the Czech Republic, share a joint Nationally Determined Contribution (NDC) under the United Nations Framework Convention on Climate Change (UNFCCC) process. The NDC is a net reduction of at least 55% in GHG emissions by 2030 compared to 1990, which was increased in December 2020 from the previous target of at least 40%. Furthermore, the EU is also committed to achieving climate neutrality by 2050 (Box 3.1).

Several policy documents guide the Czech Repubic's climate change strategy, namely: the Climate Protection Policy (CPP) to 2050, the State Environment Policy, the NECP to 2030 and the National Action Plan for Adaptation to Climate Change. All of these strategies, except the NECP, are currently undergoing evaluation and revision. In particular, the revised State Environmental Policy was adopted in January 2021 and includes a long-term vision for reaching carbon neutrality in 2050 and a dedicated chapter and targets for a circular economy. In addition, the government has developed sector-specific strategies, for example for clean mobility and the building sector. However, these sector strategies do not contain specific emissions reduction targets.

It should be noted that the Czech Republic has not adopted any significant new policies or measures in the energy sector since the IEA's last in-depth review in 2016. The most recent and complete list of policies and measures is included in the submission of the Fourth Biennial Report to the UNFCCC of 2019 (MoE, 2019a).

Box 3.1 EU Climate Law and the role of the national energy and climate plans

In December 2020, European Union (EU) leaders agreed on an enhanced 55% emissions reduction target for 2030 compared to 1990 levels. The new goal includes so-called "carbon sinks", which implies that the 55% reduction is in fact a "net" target. This comes just a year after the EU agreed on a net-zero emissions target for 2050.

Both decisions need to be transposed into European and subsequently national laws. The so-called "Climate Law" will set into legislation the objective of a climate-neutral EU by 2050 and create a system for monitoring progress and adjusting national and EU-wide action, if needed.

In mid-2021, the European Commission is set to present a range of proposals to achieve the higher emissions reduction, including rules for reducing greenhouse gas emissions and proposals to revise the Energy Efficiency and Renewable Energy Directives, including their target levels.

In line with the Paris Agreement, the EU Climate Law will provide for a five-year stock-taking process. EU member countries' national energy and climate plans (NECP) are at the heart of this process. The first NECPs cover the ten-year period up to 2030. EU member states are required to report on the implementation of their NECPs and the first report is due by 15 March 2023. They then need to provide a draft update of their NECP by 30 June 2023 and a final updated NECP by 30 June 2024, which will then reflect the increased EU ambitions for climate, renewables and energy efficiency.

Climate Protection Policy

Overall responsibility for climate change and environmental policy making lies with the Ministry of the Environment.[1] A number of national institutions are involved in implementation including, for the energy sector: the Ministry of Industry and Trade, the Ministry of Transport, and the Ministry of Regional Development. They are responsible for drafting, implementing and monitoring sector-specific policies and measures aimed at reducing emissions and adapting to climate change.

The CPP of 2017 is the main strategic document dealing with climate change mitigation in the Czech Republic. It outlines the country's low-emission economic development plan towards 2050, sets GHG reduction targets for 2020 and 2030, and includes indicative trajectories and objectives for 2040 and 2050 (MoE, 2017). As such, the CPP represents the country's long-term strategy of low-emission development in line with the 2015 Paris Agreement and was submitted to the UNFCCC in 2018.

While the CPP defines policies and measures for specific sectors at the national level towards reaching the overall climate target, it has not set specific GHG emissions reduction targets for each sector. The CPP will be evaluated in 2021 and updated by the end of 2023.

[1] Annex A provides detailed information about institutions and organisations with responsibilities related to the energy sector.

Table 3.1 shows the national GHG emissions reduction targets for 2030 and the indicative targets up to 2050 as set by the CPP. The CPP's targets are more ambitious than the targets for the Czech Republic under the EU climate framework to 2030.

Table 3.1 Overview of greenhouse gas reduction targets and ambitions (compared to 2005)

Year	Absolute reduction	Relative reduction
2020	32 Mt CO_2-eq	20%
2030	44 Mt CO_2-eq	30%
2040	78 Mt CO_2-eq	53%
2050	109 Mt CO_2-eq	80%

Source: MoE (2017).

The Czech Republic was not on track to meet the domestic targets set out in the CPP. In 2019, GHG emissions reductions reached 25.1 Mt CO_2-eq, or 17.0%, compared to 2005 levels (excluding LULUCF). However, as the Czech Republic saw notable emissions reductions in 2019, and with the Covid-19 pandemic in 2020, it is likely that it will have achieved its 2020 domestic emissions target after all. Final data for 2020 were not available at the time of publishing. Emissions reductions are projected to reach about 39 Mt CO_2-eq by 2030 without additional measures (UNFCCC, 2020).

National Energy and Climate Plan

The NECP of the Czech Republic for the period 2021-30 was submitted to the EU in late 2019 and approved by the Czech government in January 2020. Its emissions reductions for 2030 are the same as those set under the CPP (EC, 2019).

The NECP has a strategy for reducing emissions that includes measures to improve energy efficiency in buildings through renovations and to reduce fossil fuel consumption in the transport sector by promoting electro mobility and sustainable transport (see Chapter 4). The share of renewables is set to increase to 22% of gross final consumption by 2030, and annual energy savings to 2030 of 8.4 petajoules (PJ) (or 462 PJ cumulatively) would need to be achieved based on the preliminary calculations contained in the NECP (EC, 2019). However, the NECP does not set any quantitative targets for reducing emissions in the transport and buildings sectors by 2030.

From an investment perspective, the NECP does not contain details about the total investments needed to achieve its ambitions, beyond indicating that investments in the order of CZK 1 trillion to CZK 5 trillion are required (EC, 2019; 2020). However, the plan does provide information about the financing needed for renewable energy, energy efficiency and electricity sector infrastructure. The detailed investment flows for these three areas will be prepared and will be included in the progress reports and any updated NECP. The government has set out the various funding sources on which the implementation of the NECP can draw, including various EU funding sources, ETS-related revenues and additional budgetary means. Approximately 30% of the overall investments to 2030 is expected to come from EU Structural and Investment Funds (EC, 2020). However, the NECP does not include an impact assessment of the planned policies and measures.

Total public sector spending related to renewable energy in the period to 2030 is estimated at around CZK 563 billion. The expansion of the share of renewables would require investment aid of CZK 51.6 billion, with the largest amount supporting the installation of solar in buildings (CZK 12.79 billion), followed by the installation of heat pumps (CZK 11.97 billion), and biomass boilers and stoves (CZK 11.18 billion) (EC, 2019).

However, it is noteworthy that the government estimates that by far the largest public spending in the period to 2030 will be operational support for renewable energy sources already in operation (CZK 464.85 billion), or put into operation between 2021 and 2030 (CZK 46.4 billion). In fact, spending on existing facilities is estimated to be almost ten times greater than spending for investments in new facilities (EC, 2019).

To improve energy efficiency in line with the savings target for 2030, a total investment of CZK 634.5 billion is required; the public sector has so far allocated CZK 157.8 billion towards this goal. However, the NECP indicates that more overall funding, including more public funding, would be needed to meet the targets of the EU Energy Efficiency Directive (EC, 2019).

Finally, the NECP shows cumulative investment needs in the power sector of CZK 651 billion, of which almost two-thirds would be needed for power plants and storage (accumulation) and 28% for the distribution sector, including for the roll-out of smart grids. Transmission sector investments account for the remaining CZK 52 billion (EC, 2019).

The NECP pays particular attention to the interaction between air quality and emissions policy, which is of special concern in the country.

Local air pollution

The Czech Republic has made notable progress in improving air quality since 1991, with annual fluctuations due to adverse meteorological conditions. The requirement to comply with European legislation for certain atmospheric pollutants, especially from industry, is a further driver for emissions reductions.

The reason for the reductions notably of sulphur dioxide (SO_2) and nitrogen oxide (NOx) is the introduction of technologies and production processes based on best available technologies, fuel switching and the reduced energy intensity of the economy. Conversely, the fact that the Czech Republic is a net exporter of mainly fossil fuel-based electricity is partly negating the positive impact of the above measures on the total level of SO_2 and NOx emissions.

Yet, air quality remains a concern. The level of air pollution by substances posing considerable health risk remains unsatisfactory in number of Czech municipalities. In 2019, 0.9% of the Czech population was affected by PM_{10} pollution levels that exceeded standards. For the same year, it was estimated that the level of air pollution of suspended particles contributed to more than 5 000 premature deaths (MoE, 2019b). A large part of this is due to the dominant role of solid fuels in the energy mix and, in particular, the use of coal (but also wood) for heating in the residential sector. The residential heating sector is the dominant source of emissions such as benzo(a)pyrene, $PM_{2.5}$, SO_2 and volatile organic compound (VOC) and accounts for 41% of emissions that are precursors for secondary particulate matters; it is expected to remain in this position until 2030 (EC, 2019). The other major contributor is the transport sector, which is characterised by a rather old vehicle fleet (with an average age of 14.9 years in 2019, compared to 11.5 years for the EU in total) and accounts for about 32% of total NOx emissions (EC, 2019; ACEA, 2021).

Commendably, the Czech government has linked the preparation of its NECP to the update of the National Air Pollution Control Programme, which includes measures to specifically target air pollution generated in the energy generation, domestic heating and transport sectors (EC, 2020). Emissions projections modelled during the preparation of the plans showed that the country expects to meet all of its 2020 national emissions reductions commitments that are set for NOx, SO_2, $PM_{2.5}$, ammonia and VOC. To achieve emissions reduction targets for 2030, new measures to reduce all specific air pollutants except for SO_2 have been set and approved by the government (MoE, 2019c) (see next section).

The government developed a set of measures to address in particular the PM_{10} and $PM_{2.5}$ pollutants by targeting the residential stationary combustion sector to replace the combustion of solid fuels by other means and also the replacement of local boilers in, for example, the district heating sector with low-emission or even emission-free fuels (see Chapter 4) (MoE, 2019a). In fact, the transition towards highly efficient and low-emission heating systems is codified in the two amendments to the 2012 Act on Air Protection, the last of which was in 2019, and it prescribes the minimum energy efficiency requirements and maximum emissions for solid fuel boilers that can be sold in the Czech Republic. Compliance with the European eco-design requirements for space heaters became effective on 1 January 2020, two years earlier than in the rest of the EU (MoE, 2019c) (see below). Beyond the focus on the residential heating sector, the Czech Republic has created a Coal Commission to analyse scenarios for the phase-out of coal from the power sector, although no final decision has yet been taken.

In addition, the amended 2012 Act on Air Protection also requires the gradual introduction of biofuels into petrol and diesel. Fuel suppliers are legally obliged to reduce GHG emissions per unit of energy contained in the fuel over the life cycle of the fuel. This share increased from 2% at the end of 2014 to 6% at the end of 2020. Certified biofuels benefit from a reduced excise tax (EC, 2019). Similarly, the Czech National Emissions Reduction Programme requires that by 2020, at least 25% of the total public transport vehicle fleet be alternative-drive vehicles and that the share should reach 50% by 2030. The government is encouraging the shift towards electric mobility and the ongoing shift towards a less carbon-intensive electricity generation mix will further enhance the full benefits of electric mobility for the Czech Republic (see Chapters 7 and 9).

Looking forward to 2030, the Czech Republic is shifting its focus more to the transport sector, which is witnessing a continuously increasing demand and emissions growth, accounting for 16% of all GHG emissions in 2019. A key policy is the road toll for trucks weighing more than 3.5 tonnes, and economic and tax tools to support the purchase of low-emission vehicles; both measures were implemented in 2020. Changes to the procurement policy for public sector road vehicles and changes to the existing government order on biofuel sustainability criteria will enter into force by August 2021 (see Chapter 4).

However, in its 2019 update of the National Emission Reductions Programme, the government set out that up to 50% of annual PM_{10} suspended particulate concentration and up to 60% of annual $PM_{2.5}$ particle concentration may be generated outside of its borders (EC, 2019).

Decarbonisation of the residential heating sector

Local air pollution remains a key priority of the Czech Republic's energy and environmental policy. At the heart of the government policy is the boiler replacement scheme in the residential sector that has been operating since 2013. The programme originally targeted the replacement, by the end of 2020, of 100 000 boilers that are using inefficient solid fuels energy sources, mainly coal, with less polluting alternative fuels and higher efficiency equipment to reduce the exposure of the population to above-limit concentrations of pollutants. Once achieved, there would still be another 300 000 boilers left to be replaced.

The government has provided grants and interest-free loans for the replacement of inefficient solid fuel boilers in single-family houses under the Operational Programme Environment. The programme was open for applications from 2015 to 2020 and has resulted in the replacement of over 82 000 boilers so far. By the end of 2023, a total of 100 000 boilers should have been replaced. The government estimates that the exchange of the 82 000 boilers realises yearly emission reductions of 3.4 kilotonnes (kt) of $PM_{2.5}$, 1.8 kt of SO_2 and 512 kt of CO_2.

In the first phase of the programme, from 2014 to 2015, subsidies for replacing inefficient coal boilers with high-efficient modern coal-fired boilers were still eligible and more than 2 700 households applied for them. An additional 9 000 households applied for support to install combined coal and biomass boilers. The second phase, from 2016 to 2017, abandoned the support for high-efficient coal-only boilers, but still subsidised the acquisition of co-fired coal and biomass boilers. This possibility was used by over 6 500 households. The third phase, which started in 2018, only provides subsidies for heat pumps, gas condensing boilers and biomass boilers to replace coal boilers. The public has shown strong interest in the programme and the allocated financial means under the programme have been almost completely exhausted (MoE, 2019a).

In parallel to the third phase, the government kick-started a pilot programme in the coal regions of Karlovy Vary, Moravian-Silesian and Usti nad Labem. These regions suffer from particularly high levels of local air pollution and the use of sub-standard coal boilers is particularly high, as coal is often provided at a subsidised price. The special feature of this pilot programme is the combination of financial support for the boiler replacement with the provision of comprehensive advisory services provided by technical specialists that counsel individual households on the best options available for the boiler replacement and monitor that they are installed properly.

In addition to the financial incentives described above, the government also uses regulatory and legal measures. The sale of Class 1 and Class 2 boilers (out of a total of five classes) was banned on 1 January 2014 during the first phase of the replacement programme. This condition also targeted the emissions due to the increasing use of biomass for domestic heating in technologically outdated equipment that strongly impacts local air quality (see above) (EC, 2019; MoE, 2019a). The sale of Class 3 boilers was banned on 1 January 2018 with the beginning of the second phase. And finally, since 1 January 2020, the eco-design regulation is applicable and only the fifth-highest emissions class can now be sold in the Czech Republic.

The 2019 amendment of the Air Protection Act moreover empowered local authorities to issue local ordinances to limit the use of certain fuels in appliances in the residential sector that are not complying with the set emission parameters. This legal amendment also strengthens the impact of the mandatory regular inspections of solid fuel boilers and heaters by creating an obligation for online reporting of the findings of the inspections that is accessible to municipal authorities (MoE, 2019c).

Moreover, the Air Protection Act prohibits the use of first and second emission-class boilers after September 2022. Enforcement of this measure is already provided for in the amended Air Protection Law that includes, among other provisions, for the possibility to control the use of combustion heaters and boilers in the residential sector (MoE, 2019b). An estimated 450 000 boilers will be affected by this legislation. One key challenge is that replacement of those boilers are only eligible for government support if the application is filed before the due date of 1 September 2022. Given the large number of affected boilers and the replacement rate, it is unlikely that all Class 1 and 2 boilers will be replaced in time.

The government is currently not considering banning any other classes of boilers. Instead, it is considering implementing awareness-raising initiatives concerning the proper operation of boilers and efforts for improving the quality of fuel wood.

In addition, the New Green Savings Programme provides grants for measures that combine general energy efficiency improvements of buildings in the residential sector with a switch to less emission-intensive heating sources. The main objective of the programme is to increase the energy efficiency of buildings. The secondary objective is to reduce GHG emissions and air pollutants.

As a special feature, the New Green Savings Programme allows combining support measures with those under the Operational Programme Environment if certain conditions are met. Starting with the second phase of the boiler replacement programme, subsidies under the New Green Savings Programme complement other support measures if the applicant opts for the installation of a solar system to replace the old boiler.

The government plans to continue the replacement policy scheme in the period up to 2030, as there are still approximately 300 000 old inefficient solid fuel boilers left. For this, the government will renew the Operational Programme Environment and the New Green Savings Programme.

From 2022 onwards, the focus will be on the replacement of existing non-compliant heaters in an estimated 80 000 households and possibly the replacement of emission Class 3 boilers and solid fuel space heaters, if used as the main source of heat (MoE, 2019a). Half of the targeted households are low-income households for which the support could be funded up to 100% under the Operational Programme Environment, while the other half would be eligible of funding of up to 60% of the replacement cost, under the New Green Savings Programme.

Carbon pricing

The Czech Republic participates in the EU ETS, which is a cap-and-trade system for large power and heat plants and heavy industry. The emissions reductions target under the ETS, set at the EU level, is a 21% reduction from 2005 levels by 2020 and a 43% reduction by 2030, although there are no targets at the national level. The Czech Republic does not currently apply any carbon pricing in non-ETS sectors, though it has recently undertaken a detailed study about introducing it.

In 2018, around 310 facilities representing 52% of total GHG emissions in the Czech Republic were covered under the ETS. Emissions under the ETS fell by 3% between 2018 and 2019; they fell by 24% between 2005 and 2019. In December 2020, the number of installations under the ETS had fallen to 247.

Allowances are provided for free for some installations based on the risk of carbon leakage (mainly industrial companies and airline operators), though many free allocations will wind down by 2030; the electricity sector already no longer receives free allowances. Auctioning is the main allocation method for the electricity sector and will be increasingly used for industrial companies, transitioning away from free allocations. The development of ETS prices in the period to 2030 will be one of the most critical factors for the future of coal in the Czech electricity sector, but to a certain degree also for the future role of gas.

In 2019, the Czech Republic raised EUR 630 398 in ETS auction revenues. Of this, half was used to co-finance the national renewable energy support scheme (see Chapter 5) and another 28% was allocated to support energy savings measures in the building sector and the installation of low emissions and renewable heating sources in households. The remainder of the auction revenues was absorbed into the general budget.

This ETS regime is complementary to the EU Effort Sharing Regulation, which covers all emissions not affected by the EU ETS and under which country-specific emissions reduction targets are set (see above). In 2016, emissions in the non-ETS sector in the Czech Republic were 2% higher than in 2005 (EC, 2019). However, they have been falling again and in 2018 were 1.7% below the 2005 level. In absolute terms, non-ETS emissions reached 62.82 Mt CO_2-eq in 2016 before falling to 60.62 Mt CO_2-eq in 2018.

In late 2019, the MIT, the Ministry of Finance and the Ministry of the Environment completed a joint feasibility study about the introduction of a CO_2 tax, in line with a recommendation in the IEA's 2016 in-depth review. The study analysed the impacts of the introduction of a carbon price in non-ETS sectors, to match the EU ETS allowance price, on taxes, prices, the public budget and households. The analysis considered in particular a possible differentiation of CO_2 taxation rates between different fuels based not only on their emission intensity, but also including other characteristics, such as their emissions of sulphur dioxide, particulate matter, nitrogen oxide and volatile organic components.

The study found that a carbon price of EUR 10 per tonne of CO_2 would move the Czech Republic to the middle of the range of energy taxation among EU member countries and generate approximately CZK 3.2 billion in revenues, though it would also be associated with higher administrative costs. Not unexpectedly, the study also found a carbon tax to be regressive, as the impact would be greater on poorer households and poorer regions, raising issues of social justice.

Currently, taxation of heating fuels in the Czech Republic is low compared with other EU countries. Carbon pricing in the non-ETS sectors would help to create a level playing field, especially between district heating systems that fall under the ETS and individual carbon fuel-based heating systems that do not fall under the ETS (see Chapter 4). Moreover, the revenues generated through a CO_2 tax could be used to stimulate fuel switching to cleaner energy and incentivise energy efficiency investments or to cushion the social impact of the energy transition.

However, the government decided not to consider the analysis included in the study as it had a political commitment not to increase taxes. It has not excluded using the analysis in the future. The government could consider options to revise the overall taxation on an environmental basis without increasing overall fuel taxation in the short term.

Moreover, the government has indicated an openness to discuss the introduction of a carbon tax at the EU level. The revision of the EU's Energy Taxation Directive is expected for 2021.

Adaptation

In compliance with EU requirements, the Czech Republic prepared a Strategy on Adaptation to Climate Change in 2015 and a National Action Plan for Adaptation to Climate Change in 2017. Both are currently under review and will be updated in 2021.

The 2017 Adaption Action Plan does not include a detailed assessment of the possible impacts of climate change on the energy sector. This is instead discussed in the "Comprehensive Study on Impacts, Vulnerabilities and Risk Sources connected to Climate Change" (2015) that formed the basis of the Adaptation Action Plan. The comprehensive study was updated in 2019 to provide input for the ongoing revision of the National Action Plan.

This study identified three main threats for the energy sector: 1) reduced output of hydropower plants; 2) problems with the availability of water for cooling purposes; and 3) the increased risks to power supply and energy infrastructure due to extreme weather events. The study further noted that a significant increase in cooling demand is expected and that climate change could have a negative impact on the availability of biomass for energy purposes.

The adaptation measures aim to improve the systems for risk management and related security measures. The priority is to protect key energy infrastructure in the case of extreme weather events. Other proposed adaption measures include improved water management, including efficient use of wastewater and rainwater.

In 2018, water use in the energy sector accounted for almost 40% of total water abstraction (surface and ground water) in the Czech Republic and was almost entirely taken from surface water and mainly used for once-through cooling of steam turbines. However, water abstraction for the energy sector decreased by 7.5% between 2017 and 2018 due to the introduction of a new technology in the Elbe River basin that replaced once-through cooling with circular cooling.

The Adaptation Action Plan further recommends the development of smart grids, decentralised energy sources and the diversification of energy sources as key adaptation measures.

This is also reflected in the discussion of climate resilience in the Adaptation Action Plan, which includes three specific objectives and measures: 1) the creation of island energy systems; 2) ensuring a high resilience of the power distribution network and more diversification of energy sources; and 3) increasing the share of renewable energy sources that are resilient to climate change. The updated National Action Plan for Smart Grids (2019) in turn includes references to the climate resilience of energy infrastructure, in line with a recommendation in the IEA's last in-depth review in 2016, though the discussion is not very detailed.

Assessment

The Czech Republic experienced an 18% reduction of overall GHG emissions between 2000 and 2019. The largest reductions were achieved in the energy transformation sector, with a decrease of 23% since 2000, while the transport sector experienced an increase in GHG emissions. The LULUCF sectors have long acted as a carbon sink, but due to an unprecedented bark beetle problem, the sector started releasing emissions in 2018. This will need to be compensated for by enhanced emissions reductions in other sectors. While the Czech Republic is to be lauded for its success in decoupling emissions from economic growth, its CO_2 emissions per capita and the carbon intensity of the economy still rank among the highest of IEA member countries.

As a member of the EU, the Czech Republic's climate policy is steered by the EU climate framework. Under this framework, the Czech Republic is committed to reduce its GHG emissions by 14% by 2030 (compared to 2005) in sectors not covered by the EU ETS. In addition, the government has set itself a more ambitious national goal for 2030 and has set an indicative target to reduce GHG emissions by 80% compared to 1990.

To reach these goals, the Czech Republic has introduced comprehensive climate protection policies that are currently all under review to reflect the increased ambitions for 2030 and 2050 set at the European level. The Czech government submitted its NECP to the European Commission at the end of 2019, mapping out its current energy and climate targets and policies. As the NECP will be evaluated every two years to ensure the country is on track to meet its targets, it is a *de facto* compliance framework and will help the Czech Republic adapt its policies.

While the Czech Republic is likely to reach its 2030 EU target in the non-ETS sector with its current policies, projections show that it will likely miss its higher domestic 2030 climate goal. Therefore, enhanced efforts in all sectors are needed.

Coal still accounts for half of the domestic energy supply and the energy sector represents three-quarters of all GHG emissions. The replacement of coal in the energy mix with low-carbon and renewable energy sources will significantly contribute to emissions reductions and to reaching the government's climate goals. In this regard, the establishment of a Coal Commission to guide the coal exit is commendable and the government should act quickly to decide on the commission's recommendations.

In light of these developments, a coherent long-term strategic plan is needed, which also takes into account the EU's enhanced target of a 55% reduction by 2030 and the climate neutrality objective by 2050. The plan should focus on the future role of alternative energy sources, and specifically address the mid- and long-term role of the gas sector in the energy mix and the possible risk of stranded assets.

Second, a coherent approach with mitigation efforts from all sectors is needed in order to reach the domestic 2030 climate target. The Czech Republic has several strategic documents to guide its emissions reduction policies, for example in the transport and buildings sector, but they do not set sector-specific emissions reduction targets, making it challenging for the government to monitor if it is on track to meet the overall emissions reduction targets.

The government should introduce sector-specific emissions reductions targets for 2030, supported by sectoral plans to reach these targets. In doing so, the government should ensure adequate co-ordination across sectors and policy areas, to reach targets efficiently. In addition, the evaluation of policies and measures should be strengthened, and a framework elaborated which would allow for the timely readjustment of policies, if the country is not on track to meet its targets.

As in many IEA countries, transport sector emissions are rising continuously. Therefore, the government should further increase its support for decarbonisation, such as electrification, higher shares of biofuels, and the promotion of public transport and cycling. Considering measures to reduce the share of old vehicles on the road could also be considered.

Third, current policies do not give sufficient price incentives for decarbonisation. Low taxation and subsidies such as the provision of cheap coal for household use, which are countering decarbonisation efforts, pose a problem. The government should therefore consider reviewing its energy and climate taxation to make it an effective and efficient instrument to steer consumer behaviour and help implement the country's energy and climate policies. This would help increase emissions reductions, particularly in the transport and heating sectors, significantly improve air quality and better reflect the costs associated with climate change.

An important policy tool in this regard can be the introduction of a carbon pricing system for fossil fuels, which could be gradually phased in. For example, the composition of fuel taxes could be shifted towards carbon pricing so that the overall price of fuels better reflects their carbon content and impacts.

This should be considered for sectors that are not covered by the EU ETS, especially the building and transport sectors. In the case of district heating, the introduction of a carbon price could help to level the playing field and improve competition between ETS and non-ETS installations.

In order to make the carbon pricing system more acceptable to the public, revenues should be channelled back to consumers. This would address concerns about the regressive nature of increased fuel taxation and could be done through targeted measures, including social protection measures, earmarking of revenues for additional emissions reduction measures like housing renovation, and/or a broader tax relief, among other suggestions.

Moreover, with a view to address equity concerns, the government could provide targeted support to those that are most impacted by higher taxes instead of considering a general rechannelling of tax revenues to all consumers and/or citizens. A number of IEA and EU countries have already introduced carbon pricing or are in the process of doing so. Their experience can provide valuable lessons to help the government build and maintain support for carbon pricing.

Air pollution is a particular problem in the Czech Republic, mostly stemming from coal and wood boilers in the residential sector, and the relatively old car fleet, which is dominated by diesel cars. This greatly threatens the local population's health, as can be seen through current and expected health issues. In this regard, the government should further strive to reduce air pollution at the local level. Domestic coal and wood consumption and diesel cars should be targeted as a priority.

To accelerate emissions reductions in the building sector, the government has taken steps to subsidise the replacement of inefficient coal boilers with cleaner alternatives, aiming to replace 100 000 boilers by the end of 2020. In addition, the use of the two most inefficient emission classes of coal boilers will be banned from 2022. The Czech Republic is to be commended for this. To further accelerate this process and help improve air quality, the government should develop a phase-out plan for the three remaining emission classes of coal boilers still in use. Such a plan needs to ensure subsidies are only offered for boiler types that the government wishes to maintain in the market in the longer term.

Climate change can have significant consequences for the energy sector, which need to be anticipated with climate adaptation measures. First, there may be an impact on energy demand, as illustrated by increased electricity consumption to supply rising air conditioning demand, for example. On the supply side, rising water temperatures pose a threat to the effective functioning of thermal power plants, as they may lack sufficient cooling water. Hydropower may also be negatively impacted, should natural water inflows (such as rain or snow) become scarce. More severe storms could have an impact on electricity transmission and distribution. In this regard, climate adaptation measures to prepare for the impact of such changes should be given more thorough attention, and equal priority compared to climate mitigation strategies.

Recommendations

The government of the Czech Republic should:

- ☐ Develop a long-term strategic plan focused on the role of fossil fuels, including coal phase-out plans and the role of natural gas, in light of the EU's 2050 climate neutrality plans. The plan would help integrate climate and energy policies and create a stable and forward-looking framework for investors and consumers.
- ☐ Introduce specific GHG emissions reduction targets to 2030 for the transport and building sectors that complement other existing strategies targeting these two sectors. Set up a process for evaluation and timely readjustment of policy instruments if emissions reductions are not on track to meet the targets. Ensure adequate co-ordination across all sectors and policy areas, to reach targets efficiently.
- ☐ In the framework of a broader green tax reform and stronger price incentives for decarbonisation, introduce carbon pricing gradually in sectors not covered by the EU ETS to stimulate low-carbon investment and reduce fossil fuel consumption, while increasing public acceptance by channelling back revenues to consumers.
- ☐ Stimulate the shift from coal to more efficient heating systems, including renewable technologies, by setting up a phase-out plan for coal boilers for all emissions classes.
- ☐ Work together with the energy sector to adapt to changes required in the energy system stemming from climate change.

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4. Energy efficiency

Key data (2019)

Total final consumption (TFC): 27.0 Mtoe (oil 34.1%, natural gas 19.6%, electricity 18.6%, bioenergy and waste 12.3%, coal 7.8%, district heat 7.5%, solar 0.1%), +2.3% since 2009.

Consumption by sector: industry 37.3%, buildings 37.2%, transport 25.5%.

TFC per capita: 2.5 toe (IEA average:** 2.9 toe), +1% since 2009.

TFC per GDP:* 67 toe per million USD (IEA average:** 65 toe), -18% since 2009.

Exchange rates (2020):*** Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* GDP data are in billion USD 2015 prices and PPP (purchasing power parity).

** Weighted average of IEA member countries.

*** OFX (2021)

Overview

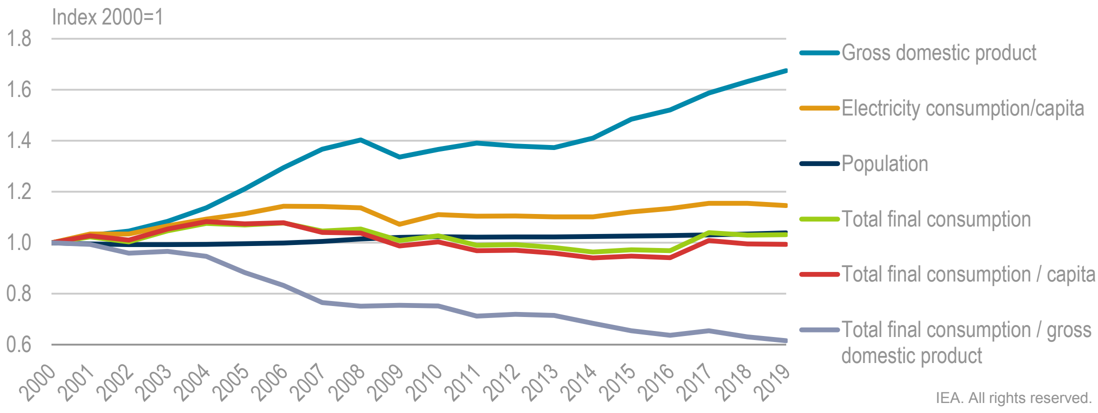
The Czech Republic has progressed notably in terms of energy efficiency measures since the last IEA in-depth review in 2016. The government has deployed an increasing number of public financing programmes, in particular in the building and industry sectors. Looking forward, addressing the lack of public awareness about the depth and extent of available support programmes is important to ensure uptake of the programmes. In this regard, the bundling of all energy efficiency measures targeting the residential sector under the Ministry of the Environment from 2021 onward is a welcome development.

Total final consumption (TFC) in the Czech Republic has been almost constant since 2000, increasing by 2% between 2009 and 2019. The population also increased by 2% in the decade, keeping the trend of TFC/capita very similar to that of TFC (Figure 4.1).

The Czech Republic's gross domestic product (GDP) increased by 25% between 2009 and 2019. The 2008 financial crisis caused GDP to stagnate, but the economy has been growing again since 2013 (OECD, 2021). The increase of GDP without a significant increase of TFC between 2013 and 2019 shows a decoupling between the country's economy and its energy consumption. Consequently, the TFC/GDP ratio decreased by 18% between 2009 and 2019.

The Covid-19 pandemic strongly affected the country's economy and energy consumption. For 2020, the OECD predicted GDP to decrease by 6.8% (OECD, 2020).

Figure 4.1 Energy consumption and drivers in the Czech Republic, 2000-19

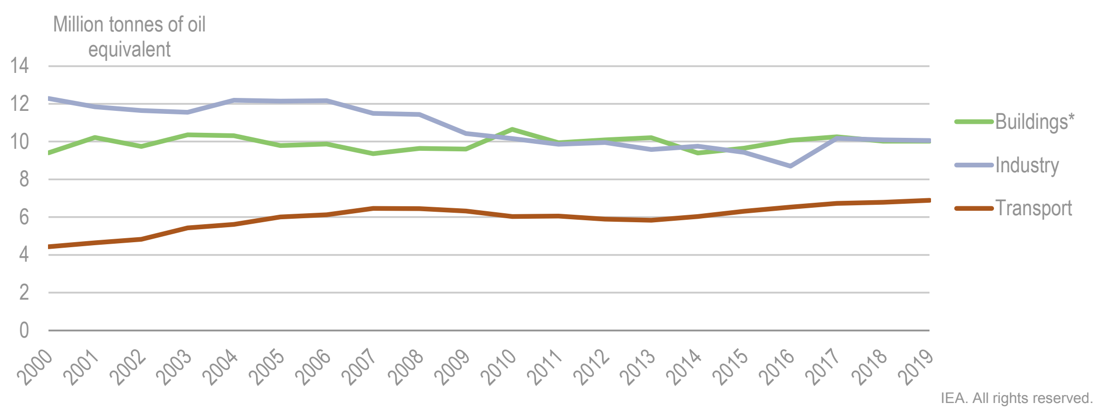


Increasing GDP with stable total final consumption shows a decoupling between economic activity and energy consumption, quantified by a decrease of the TFC/GDP ratio by 18% between 2009 and 2019.

Note: GDP data are in billion USD 2015 prices and PPP (purchasing power parity).
Source: IEA (2021a).

TFC was 27 million tonnes of oil equivalent (Mtoe) in 2019, up by 2% from 2009. Industry was the most energy-consuming sector in 2019, accounting for 37% of TFC (10.1 Mtoe), closely followed by buildings (10.0 Mtoe), while the transport sector accounted for slightly more than one-quarter of TFC (Figure 4.2). While energy consumption in industry decreased by 4% between 2009 and 2019, consumption by buildings and transport increased by 4% and 9%, respectively.

Figure 4.2 Total final consumption in the Czech Republic by sector, 2000-19



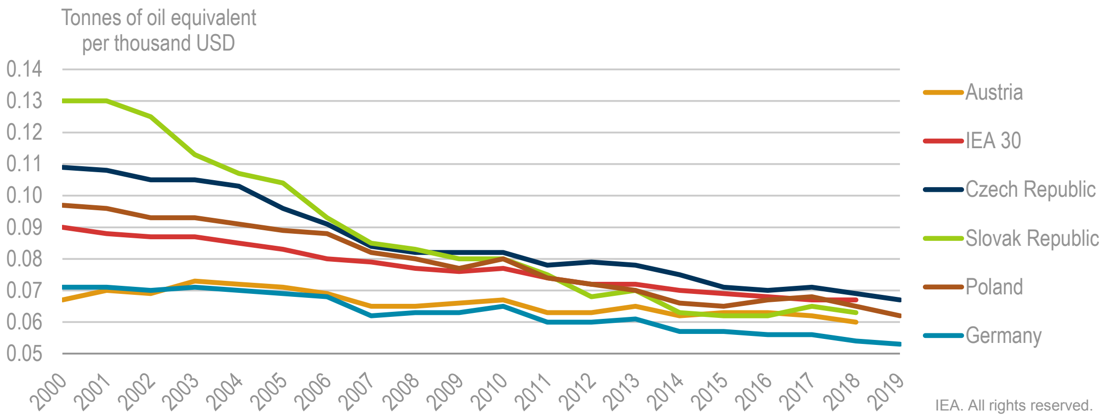
Buildings and industry account for about 10 Mtoe each, while energy consumption in transport has been increasing.

* *Buildings* includes residential and commercial and public services sector.
Source: IEA (2021a).

Energy intensity per capita and GDP

Energy intensity per GDP in the Czech Republic decreased quickly in the first years of the century, following the trend of neighbouring IEA countries (Figure 4.3). Energy consumption per GDP is 2% above the IEA average and the eighth-highest among IEA countries, an improvement compared to the last in-depth review in 2016 when the country ranked fifth-highest. In terms of TFC per capita, however, the Czech Republic has an energy intensity slightly lower than the IEA average (Figure 4.4).

Figure 4.3 Energy intensity per USD of gross domestic product in selected IEA countries, 2000-19

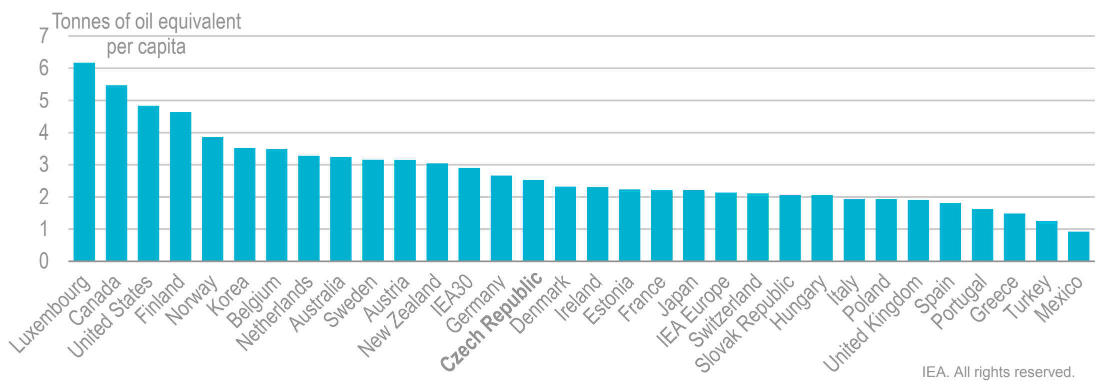


Total final consumption per GDP has decreased, but is still higher than in other IEA countries.

Notes: GDP data are in billion USD 2015 prices and PPP (purchasing power parity). IEA30 is the equivalent of a weighted average of 30 IEA member countries.

Source: IEA (2021a).

Figure 4.4 Energy intensity per capita in IEA countries, 2019



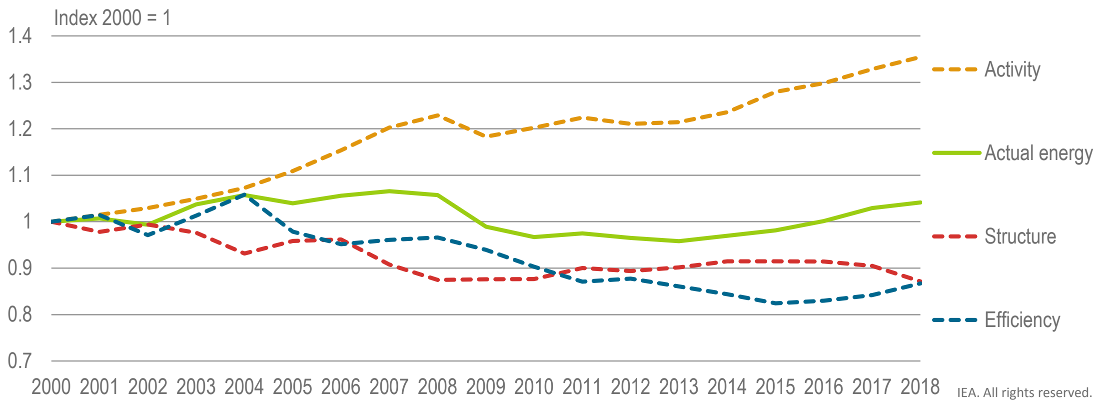
The Czech Republic's energy intensity per capita ranks in the middle of IEA countries.

Source: IEA (2021a).

Drivers of the Czech Republic's energy consumption

Three main factors determine a country's energy consumption level: 1) the level of activity; 2) the structure of activity; and 3) the level of energy efficiency. In the case of the Czech Republic, the level of activity has driven increasing final energy consumption (Figure 4.5). The level of activity reflects, among other things, rising levels of economic activity. This increase has, however, been balanced by a less energy-intensive economy (changing structure of activity) and efficiency improvements.

Figure 4.5 Drivers of final energy consumption in the Czech Republic, 2018

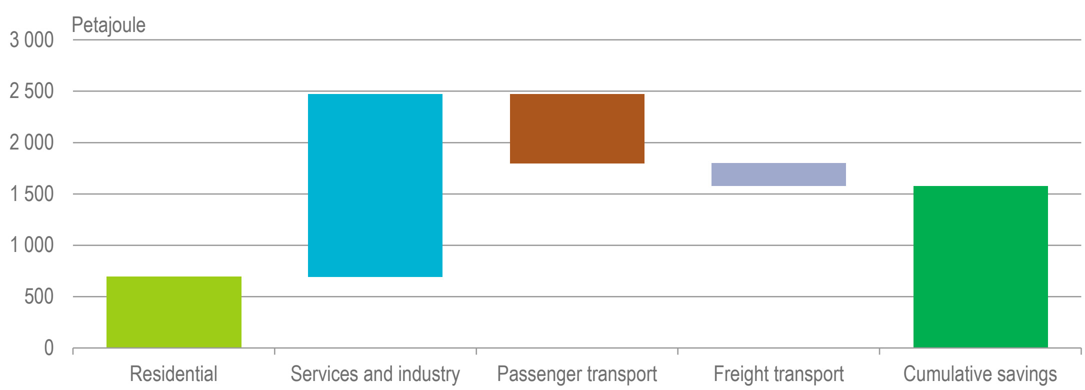


The increase in the level of activity between 2000 and 2018 has been balanced by changes in the structure of activity and efficiency gains.

Source: IEA (2021b).

Energy improvements have been achieved in all consumer categories. The largest energy efficiency gains have occurred in the services and industry sectors, resulting in accumulated energy savings of nearly 1 800 petajoules (PJ) in 2000-18 (Figure 4.6). Efficiency gains in the residential sector were also substantial, with savings amounting to 700 PJ in the same period. The transport sector has instead increased its energy consumption, both for passenger and freight transport. As a result, the Czech Republic achieved about 1 500 PJ of energy savings between 2000 and 2018.

Figure 4.6 Estimated cumulative energy savings in the Czech Republic by sector, 2000-18



Energy savings in the services, industry and residential sectors contributed to achieving cumulative savings of about 1 500 PJ between 2000 and 2018.

Source: IEA (2021b).

Policy targets and measures

As a member of the European Union (EU), the Czech Republic's energy efficiency policy up to 2020 was set in the national energy efficiency action plans that were superseded by the National Energy and Climate Plan (NECP) as of 2021 counting towards the 2030 targets (EC, 2019a).

The Czech Republic has to comply with energy savings obligations and contribute to the EU targets[1] on primary and final energy consumption for 2020 and 2030. For 2020, the Czech Republic is expected to meet the energy savings target of 98.7 terajoules (TJ) under Article 5 of the EU's Energy Efficiency Directive, but is not expected to meet its cumulative energy savings targets of 204 PJ under Article 7 of the Energy Efficiency Directive for the period 2014-20. Based on the pathway up to 2019, the Czech Republic would only achieve 69% of the cumulative energy savings target, as the additional measures put in place are insufficient (EC, 2020a).

The country met its indicative targets under Article 3 of the Energy Efficiency Directive for primary and final energy consumption in 2019 and is expected to also meet the targets in 2020, although the Covid-19 pandemic will have a strong influence on the 2020 consumption data (Table 4.1).

The cumulative energy savings target for 2021-30 is 462 PJ, or 8.4 PJ of new energy savings annually (EC, 2019a). The government already noted in the NECP that the measures set out in the document are likely to be insufficient to reach the 2030 targets and would result in cumulative savings of only 331.4 PJ, and that the country is considering putting in place additional measures beyond the ones under consideration (EC, 2020b; 2019a).

Table 4.1 shows the Czech Republic's 2020 and 2030 targets and the 2019 values for primary and final energy consumption. The Czech Republic is allowed to increase primary energy consumption up to 2020, but is required to reduce primary energy consumption towards 2030.

Table 4.1 Overview of the Czech Republic's energy efficiency targets to 2030 and status in 2019

	2019*	2020	2030
Primary energy consumption	1 689 PJ/ 40.1 Mtoe	1 855 PJ/ 44.3 Mtoe	1 735 PJ/ 41.4 Mtoe
Final energy consumption	1 055 PJ/ 25.2 Mtoe	1 060 PJ/ 25.3 Mtoe	990 PJ/ 23.6 Mtoe

* 2019 data are from the Eurostat database.

Sources: EC (2019a); Eurostat (2021).

[1] Under Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, as amended by its 2018 revision.

The NECP sets out the policy measures for the period 2021-30 and includes the estimated savings and cumulative savings per policy measure to reach the cumulative savings target of 462 PJ savings by 2030. The government proposes four different types of measures: 1) financial; 2) taxation; 3) regulatory; and 4) behavioural. In addition, the government will increase the use of voluntary agreements with the private sector to enhance the role of the sector in pursuing energy efficiency gains.

Notably, the new voluntary schemes would contribute 32% of the cumulative energy savings to 2030. Financial support schemes would contribute 44%, fiscal measures 4%, and the remaining 20% would be achieved through regulatory and behavioural measures (EC, 2020a; 2020b). Overall investment needs for the cumulative savings target are estimated at CZK 524.1 billion, of which CZK 156.6 billion would be public funds. Other sources would include the EU, private sector/industry investment and spending by households (EC, 2020b). The NECP breaks those investments down by sector and measure (EC, 2019a).

The government is operating a comprehensive set of financial support programmes for each sector, ranging from offering subsidies, preferential loans and technical advice and combinations thereof. Looking to 2030, the government is currently finalising the details of the new support programmes and is making particular efforts to tap into new EU-level funds, such as the Modernisation Fund, the Recovery and Resilience Facility, and the Just Transition Fund. However, the final design and approval of the support programmes is still outstanding and their deployment will consequently be delayed, raising concerns about reaching the energy efficiency targets to 2030.

Lack of public awareness is a barrier for the take-up of support programmes, some of which were underutilised in the period to 2020. The government has therefore designed a new information campaign to change energy consumers' behaviour. The campaign was launched in late 2020 and uses various information channels, including television, social media and online campaigns. The campaign reflects the recommendation of the IEA's 2016 in-depth review to ensure the regular dissemination of information about energy efficiency measures and the available incentive schemes.

The Ministry of Industry and Trade (MIT) is the co-ordinating authority with overall cross-sectoral responsibilities and the Ministry of the Environment (MoE), the Ministry of Transport (MoT) and the Ministry of Regional Development (MRD) share responsibilities over some energy efficiency measures and are implementing bodies.[2] The MRD is also involved in the development of policies, including housing and building regulations.

A major change in the Czech Republic's energy efficiency framework is the reallocation of competencies between the MRD and the MoE. The MRD handed over the administration of all measures for the residential building sector to the MoE for the period 2021-30 to facilitate co-ordination and simplify the support framework in the building sector and make it more accessible.

[2] See Annex A for more details about organisations and agencies with responsibility in the energy sector.

Industry

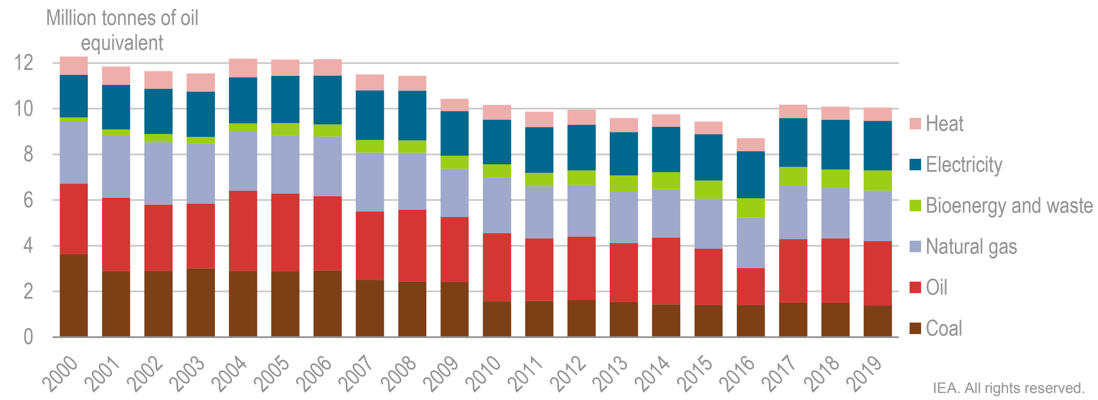
Consumption

Energy demand in the industry sector declined between 2004 and 2016 (Figure 4.7). In 2016, a failure of the fluid catalytic cracking unit of the Kralupy refinery caused its shutdown between May and September. The temporary shutdown led to a decrease in oil consumption in 2016, followed by a rebound in 2017 and stabilisation in 2018-19 at the same level as in 2010 (10 Mtoe). Between 2009 and 2019, total final consumption in industry decreased by 4%, from 10.4 Mtoe to 10.0 Mtoe.

Oil is the single largest fuel in industry (28% in 2019), followed by natural gas and electricity (22% each), and coal (14%). The use of coal more than halved between 2000 and 2010 and further decreased by 13% to 2019, when it reached its lowest level at 1.4 Mtoe.

In 2019, the chemical and petrochemical sector accounted for 38% of the total consumption by industry, when combining energy (11%) and non-energy use (27%) (Figure 4.8). Non-energy use consists of raw materials that are not consumed as a fuel or transformed into another fuel. Significant amounts of energy were also consumed by non-metallic minerals; paper, pulp and print; and iron and steel industries.

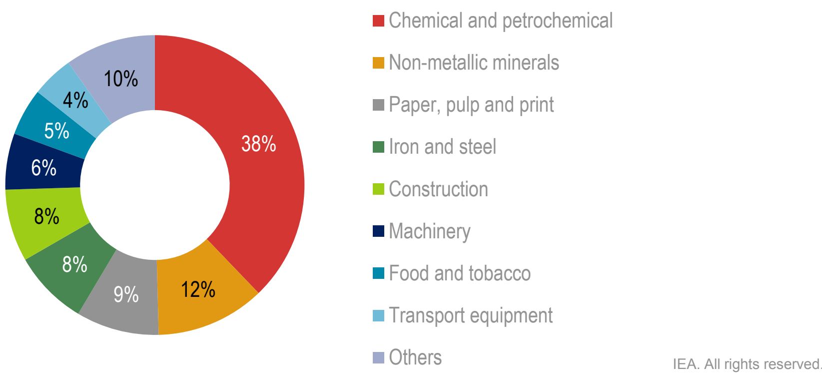
Figure 4.7 Total final consumption in industry in the Czech Republic by source, 2000-19



While coal consumption in industry decreased by 13%, the use of bioenergy and electricity increased between 2010 and 2019.

Source: IEA (2021a).

Figure 4.8 Subsector breakdown of total final consumption in industry in the Czech Republic, 2019



The chemical and petrochemical and non-metallic mineral sectors cover half of energy consumption in industry.

Source: IEA (2021a).

Policies and measures

An energy audit system is in place for both large and energy-intensive undertakings and several support schemes are available for investments to reduce the energy intensity of production processes and the reuse of waste energy. The State Energy Inspection monitors and verifies the energy audits.

Companies, including municipal and regional companies, with a number of employees or yearly revenue above a certain threshold or with an annual energy consumption higher than 5 000 megawatt hours (MWh) for two years in a row are legally obliged to apply energy management systems in accordance with the ISO 50001 or conduct energy audits every four years. The Czech requirements exceed those set by the European Commission and cover a higher number of companies, in particular energy-intensive small and medium-sized enterprises. There is no obligation to implement energy efficiency measures following an energy audit. And there is currently no systematic collection of the reasons why companies are choosing to move forward or not with energy efficiency investments following an audit. This information could help inform future policy design.

Minimum energy efficiency requirements ("eco-design") are required for a number of industrial appliances, such as electric motors, welding equipment and water pumps. Financial support for improving industrial equipment is provided under the new Operational Programme Competitiveness for the period to 2030.

The government regularly publishes calls to support energy management projects. In addition, technical assistance with the application documentation is provided through the State Programme for Support of Energy Savings and Use of Renewable Secondary Energy Sources (EFEKT).

The MIT is negotiating several voluntary agreements with energy-intensive industries and energy suppliers (both retail and distribution system operators), which are considered vital for fulfilling the 2030 targets. The first such voluntary agreements were signed with ČD CARGO a.s., the largest railway freight transport provider; APES, the Association of Energy Providers; ČEZ a.s., the state-owned dominant energy sector company; and E.ON

Energie a.s., E.GD a.s., innogy Czech Republic a.s. and GasNet s.r.o. as other significant energy sector companies. Negotiations are ongoing to sign an agreement with ŠKO-ENERGO, the energy supplier for the car manufacturer ŠKODA AUTO.

The government hopes that the industry sector will use the voluntary agreements not only to enhance their energy efficiency, but also to highlight their contribution to addressing societal concerns such as climate change and local environmental protection. The Czech civil society is increasingly interested about the private sector's contribution towards addressing climate change and environmental concerns and the schemes offer an opportunity to address these.

The expected savings under the voluntary agreements are calculated based on the information provided by the concerned entities and have not been verified independently by the government. There is therefore the possibility that not all of the savings will materialise. To address this concern, the government kept the option open to introduce energy efficiency obligation schemes, if needed (EC, 2019a; 2020b). Strict monitoring and verification that the measures are indeed implemented and produce savings needs to be ensured to achieve the desired outcomes. The government is in the process of preparing a monitoring, reporting and verification system.

Small and medium-sized enterprises, but also households and small municipalities, frequently lack the financial and technical competencies to undertake complex energy efficiency improvement projects and rely on external advice. For this, the government operates a network of energy consultation and information centres,[3] which provide free advice to support the uptake of energy-saving measures and renewable energy sources under the EFEKT programme. However, the potential beneficiaries are often not aware about the depth and breadth of the services offered and would benefit from a targeted awareness-raising campaign.

Transport

Consumption

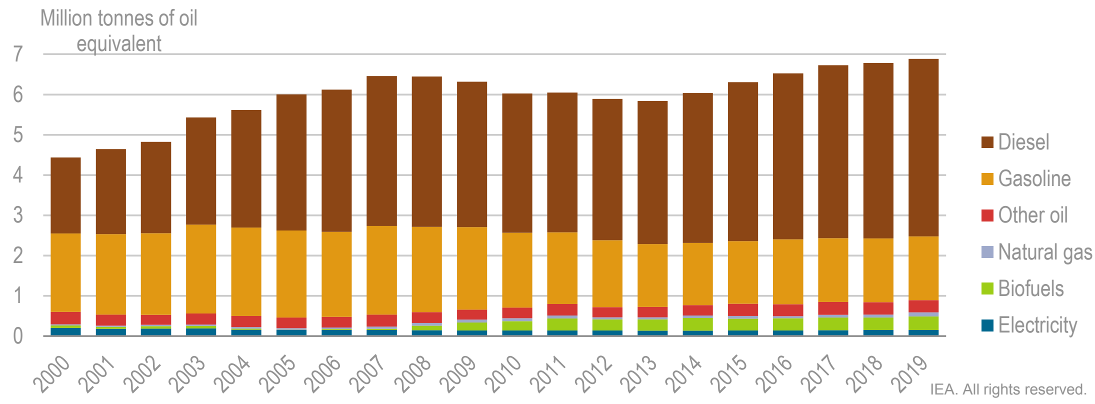
In 2019, oil accounted for 91% of energy demand in the transport sector, with a small share (5%) of biofuels and a low share (2%) of electricity. After a decline following the 2008 financial crisis, energy demand in the transport sector grew between 2013 and 2019, when it reached 6.9 Mtoe, 9% higher than in 2009 and the highest recorded energy consumption from the sector (Figure 4.9).

Road transportation accounted for 96% of domestic transport demand in 2018, with minor shares of rail and domestic aviation. The Czech Republic is a transit country for freight traffic and is itself a strong exporter of goods. Diesel is the most used fuel, covering two-thirds of the energy demand of the transport sector, followed by gasoline (23%). Alternative fuel vehicles in the Czech Republic are mainly fuelled by liquefied petroleum gas (LPG), which in 2020 accounted for around 115 000 out of the total 8.5 million

[3] For more information about the services offered, see: https://www.mpo-efekt.cz/cz/programy-podpory/efekt/strediska-EKIS.

passenger vehicles fleet, followed by compressed natural gas (CNG) (around 28 000) and electric vehicles (EVs; around 7 500) (MoT, 2020).[4]

Figure 4.9 Total final consumption in transport in the Czech Republic by source, 2000-19



Energy demand in the transport sector is predominantly met by oil, in the form of diesel and gasoline. The use of biofuels increased, but still accounts for only 5% of the total.

Source: IEA (2021a).

Policies and measures

The Czech transport sector has significant potential to reduce its energy consumption. Measures to achieve this include the substitution of the existing car fleet with more efficient vehicles, a stronger push for the introduction of low- and zero-emission vehicles and related infrastructure, shifting individual transport needs to public transport, and shifting freight transport from road to railway and waterways, supporting eco-driving initiatives, especially for truck drivers, and the accelerated use of advanced digital technologies for transport management.

Since 2011, the Czech Republic has been making slow but continuous progress in reducing the fuel consumption per passenger kilometre (pkm). In 2019, it reached 0.037 kilogramme of oil equivalent (koe) per pkm, down from 0.043 koe/pkm. For comparison, the EU average was 0.33 koe/pkm in 2011 and 0.032 koe/pkm in 2019 (Odyssee-mure, 2021).

The State Energy Policy of 2015 identified the need to reduce the consumption of liquid fuels in transport by simultaneously increasing the share of liquefied natural gas (LNG), CNG, and EVs and related infrastructure. The 2015 National Action Plan for Clean Mobility (NAPCM) covering the period to 2020 with an outlook to 2030 includes specific targets and support measures for the development of each type of alternative fuel vehicles and refuelling and charging infrastructure (MIT, 2015). The NAPCM was updated in 2020 to set out the development to 2030 with milestones for 2025 (Table 4.2).

[4] For more information on clean mobility in the Czech transport sector see: https://www.civinet.cz/cista-mobilita.

Table 4.2 Status and targets for alternative fuel vehicles and charging infrastructure in the Czech Republic

Type of vehicle	2020	2025	2030
Electric vehicles	17 000	101 000	250 000-500 000
Public charging stations	1 300		19 000-35 000
CNG vehicles	49 820	130 000	250 000
Refuelling stations	200	300	340-400
LNG vehicles	180	500	1 300
Refuelling stations	0	5	14/30
Hydrogen vehicles		95	40 000-50 000
Refuelling stations		15	80

Sources: MIT (2015); MIT (2019).

To reach these targets, the government is operating several subsidy schemes for the purchase of alternative fuel vehicles and the roll-out of infrastructure. In the period to 2020, subsidies for the purchase of EVs and related infrastructure were offered for businesses, municipalities, regional and other public legal entities through dedicated support programmes, but not for individual citizens for private vehicles. With grants provided by the MoT, about 2 000 recharging points and 9 hydrogen and 19 LNG refuelling stations were supported.

Electric vehicles also benefit from other support measures, such as an exemption from the road tax and reduced or free parking depending on the location. Since 2019, special vehicle registration plates are issued for EVs to allow the vehicles to benefit from dedicated lanes and exemption from tolls. The NAPCM targets that by the end of 2025, all cities with a population more than 10 000 should have charging stations installed.

The government considers CNG to be the most advanced (in terms of proven) alternative technology for mass-produced vehicles. In 2018, the government signed a memorandum of understanding with the Czech Gas Association for the period up to 2025 in this regard. Tax reliefs and subsidies were in place to support CNG vehicles until 2020. A key focus of the CNG programme was to replace old, diesel-powered city and inter-city buses with CNG fuelled buses. Subsidies were provided under the Integrated Regional Operational Programme financed by the EU. To benefit from the subsidies, scrapped diesel-powered buses must be at least 10 years old and have more than 500 000 km and conform to Euro 1-3 emission standards. For the period to 2030, the government is preparing a dedicated support scheme for the replacement of public transport vehicles with electric and hydrogen vehicles in Prague under the Modernisation Fund financed by the EU.

The roll-out of LNG vehicles is supported through a tax relief for purchases, and other benefits such as toll relief for trucks fuelled with LNG or bio-LNG. However, given that CNG and LNG are based on fossil fuels and do not provide carbon-free transport, the support from EU funds is likely to diminish.

The government is currently finalising new support programmes for the period 2021-30 to support the acquisition of more efficient alternative fuel vehicles in the public sector and electric vehicles by enterprises, including support for the development of electric infrastructure. As the uptake of EVs is lagging behind the target for 2020 with just a 35% achievement rate, the government should consider broadening the available subsidy schemes to include individual vehicle owners under the new schemes (EAFO, 2021).

New legislation regarding the procurement policy for public sector road vehicles is expected to become effective in August 2021.

As mentioned earlier, the Czech Republic has made progress in reducing the fuel consumption per passenger kilometre since 2011. Yet, the average age of the passenger car fleet in the Czech Republic was the third-oldest in Europe in 2019, with an average age of 14.9 years, compared to the EU average of 11.5. Almost 65% of the passenger vehicle fleet was more than ten years old (ACEA, 2021). The Czech Republic is an important market for the import of second-hand vehicles and in 2015, over 50% of imported vehicles were more than ten years old (Fraňková, 2016). The government does not offer specific incentives to scrap old cars and to replace them with newer, more efficient ones. Neither are there any legal or regulatory measures in place to take old inefficient vehicles off the road. It is worth noting also that the average age of the Czech fleet of buses and light, medium and heavy commercial vehicles is significantly above the European average (ACEA, 2021), and thus there is room for improving energy consumption.

The Czech Republic is implementing several initiatives to facilitate the shift away from road transport. A laudable initiative is the preparation of sustainable urban mobility plans or frameworks by all towns and cities with populations above 50 000 during 2019. The central government provides support for the implementation of these plans.

The Freight Transport Concept 2017-2023 aims to promote the modal change of freight transport away from road-based transport by ensuring that other forms of transport offer the same level of service. The Ministry of Transport signed a voluntary agreement in July 2020 with ČD CARGO a.s., the biggest Czech railway freight transport provider, to increase energy efficiency and lower the amount of energy used in transport. The agreement covers a wide range of measures, from supporting modal shift to increasing the electrification of the rails (see the section on industry).

To optimise the use of the transport sector's infrastructure capacity, the government has developed an Action Plan for the Development of Intelligent Transport Systems (ITS) in the Czech Republic up to 2020 (with an outlook to 2050) that also aims to improve the legislative conditions for the development and implementation of ITS in the country. About 100 projects are being implemented under the ITS to either develop basic ITS infrastructure or modernise traffic information centres (MIT, 2019). Implementation of the ITS will continue until 2030.

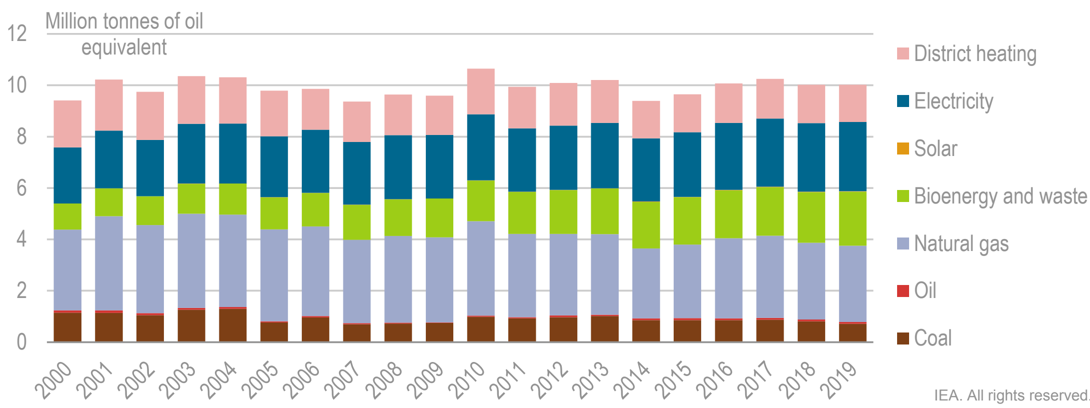
The Czech Republic does not levy a purchase tax on passenger vehicles and a road tax only applies for vehicles used for business purposes. The country uses an electronic toll scheme for heavy good vehicles, buses and coaches to pay road use taxes. The tolls for buses and coaches differ by the emission standards of the vehicles, with Euro 3 vehicles paying a higher toll rate than Euro 6 vehicles. A similar principle is applied to distance-based toll pricing for trucks that also differ by emission standards and type of truck (age and weight) (EC, 2019b). Since 2020, the tolls are now also applicable for trucks above 3.5 tonnes. However, other than through the differentiation of toll prices, vehicle emissions are not taxed in any other way in the Czech Republic. Since January 2021, toll prices also take into account external costs based on a vehicle's emissions and noise. As a result, total toll price (comprising payments for the use of infrastructure and for external costs) for CNG and LNG vehicles have decreased slightly.

Buildings

Consumption

Energy demand from buildings, in the residential (68%) and services (32%) sectors, accounted for 10 Mtoe in 2019, more than one-third of total final consumption. The energy consumption of the sector has been more or less constant since 2000. Since over two-thirds of residential energy demand is used for space heating, fluctuations in demand are mainly driven by variations in winter temperatures. In 2019, the energy demand in buildings was met by natural gas (30%), electricity (27%), bioenergy (21%) and district heating (14%), where 58% of the energy is produced from coal (Figure 4.10).

Figure 4.10 Total final consumption in the Czech buildings sector by source, 2000-19

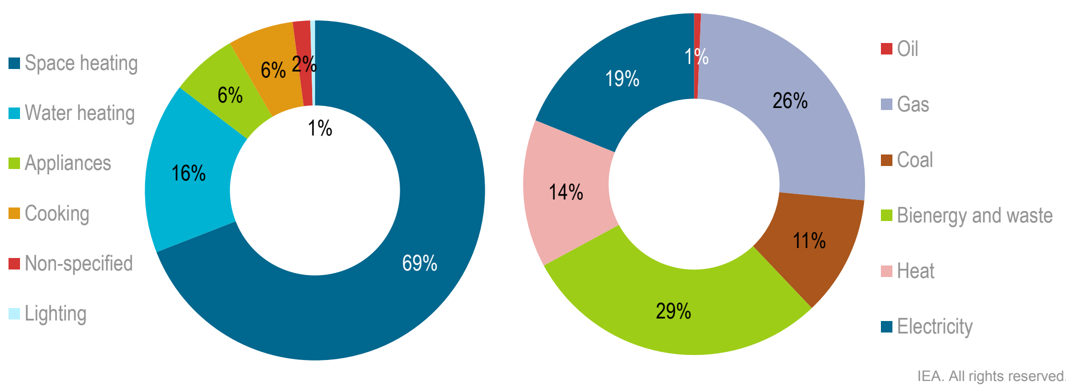


The buildings sector has slightly diversified its energy sources. Between 2009 and 2019, the use of coal and natural gas decreased, while bioenergy and electricity increased.

Source: IEA (2021a).

In the residential sector, more than two-thirds (69%) of energy is used for space heating, followed by water heating (16%), and appliances and cooking (6% each) (Figure 4.11). The residential sector is characterised by high use of bioenergy (29% of residential energy consumption in 2019), natural gas (26%) and electricity (19%). Coal is still used for residential heating and cooking, and accounted for 11% of total residential consumption in 2019.

Figure 4.11 Energy demand in the residential sector in the Czech Republic by end-use and source, 2019



Most of the energy in the residential sector is used for space heating. The main energy sources are bioenergy, natural gas and electricity.

Source: IEA (2021b).

Policies and measures

The Czech Republic is implementing a number of programmes to identify and finance energy efficiency improvements in public and residential buildings and those owned by enterprises.

The Energy Management Act, following the EU Energy Performance of Buildings Directive, sets the requirements for energy performance certifications, energy labelling and eco-design, energy audits, heating and cooling system controls, among others. Once the energy efficiency performance of buildings is identified with the energy performance certifications system, a number of subsidy programmes are available to provide financial support for energy efficiency improvements. For example, the New Green Savings Programme and its successor programmes provide subsidies for the energy efficiency upgrades of single-family and apartment buildings, for the improvement of the buildings envelope, the replacement and refurbishment of damaged insulation, change of heating, installation of renewable energy sources, and other construction measures.

The Czech Republic was among the first 12 EU countries to have prepared a Long-term Renovation Strategy by mid-2020 (BPIE, 2020) that will also help reach the targets of the NECP. The NECP has set an annual renovation rate of 1.4% in the business-as-usual case in the period to 2030 that could increase to 2% for non-residential buildings under the "real scenario", which foresees additional fiscal and legislative measures to promote more deep renovations (EC, 2019a).

The Long-term Renovation Strategy includes a comprehensive overview of the country's building stock and sets out specific policies and measures for each of three building segments (public, residential and business) further distinguished by their ownership and purpose of use. This followed from an evaluation of the specific barriers for energy efficiency upgrades in each of these three segments. This analysis was instigated to gain a better understanding of why the financial support schemes provided in the period to 2020 were not fully used and to identify the non-financial barriers that impede a higher rate of renovation (MIT, 2020).

For example, in the residential sector, the limited use of skilled professionals and expert supervisors is a key challenge for deep renovations. About 70% of the Czech population live in their own residence, either in direct or co-operative ownership. Residential building renovations of single-family houses are often undertaken in a piecemeal approach, e.g. replacing only the boiler or windows, and lack a comprehensive concept of how to effectively improve overall energy efficiency performance and reduce the carbon footprint of the building. Owners are wary of complex administrative procedures if they apply for subsidies and rely largely on their own financial means. Typically, they do not hire professional construction companies, which frequently impacts the quality of the renovations undertaken. In the case of multi-family residential buildings, including co-operatives, the need to agree on any efficiency investments among a large number of owners is an additional barrier (MIT, 2020). Nevertheless, the Czech Republic is doing rather well compared to other EU member states, as concerns the renovation of multiple family apartment buildings, and in particular of so-called panel houses,[5] as a large share of them have already been renovated. The typical renovations of the block houses largely

[5] Prefabricated panel housing estates are typically referred to as panel, or block, houses in the Czech Republic.

consisted of a simple polystyrene insulation of the walls and the roof and the installation of double glazed plastic windows. There is more energy savings potential in deeper renovations, including through the installation of more thorough insulation and ventilation systems.

Based on these findings, the government modified the existing support scheme for residential buildings to include non-subsidy financial mechanisms, such as concessional loans and guarantees, and is also contemplating simplifying the administrative and legal procedures for deep renovation. The government also specifically targets homeowners in its public awareness campaign to inform them about the multiple benefits of energy efficiency improvements, and plans to offer more targeted advice through the energy consultation and information centres financed from the EFEKT programme.

Small municipalities own 45% of the public building stock, which they usually manage themselves. An analysis of the barriers for accelerating energy efficiency improvements showed that small municipalities usually rely largely on subsidies for renovations. Consequently, renovations are frequently undertaken when funds become available and are not necessarily part of a Long-term Renovation Strategy. Small municipalities would benefit from technical assistance for the preparation of phased, comprehensive renovation projects and for the application of financial support and longer term certainty about the availability of financial support. In contrast to individual homeowners, the actual renovations are undertaken by professionals, which ensures project quality.

The government is therefore designing support schemes to meet the specific needs of municipalities that combine financial and technical assistance. The new support schemes also target a key motivational factor of municipalities – reducing energy consumption and therefore costs – to encourage them to implement energy management systems. The Operational Programme Environment targets non-residential public buildings and focuses on combining improvements of the building envelope and technical equipment with the use of renewable energy sources.

As the Czech Republic has a significant number of protected buildings and buildings in protected areas, particular attention should be given to developing good practices for energy efficiency renovations of traditional architecture. In addition, the government could consider focusing its support schemes even more on non-residential public sector buildings, such as town halls, schools, hospitals, homes for the elderly and sport centres.

Renovations in the business sector are also largely driven by the desire to reduce energy consumption and therefore costs. However, the complexity of government support schemes and the need to adapt renovation schemes to meet the criteria of the support schemes act as barriers to apply for financial support. In particular, small and medium-sized companies are interested in some form of financial incentive, but combined with technical assistance in the preparation and implementation phase of the project. Finally, for complex renovations that, for example, combine the installation of renewable heating sources with building envelope upgrades, the payback period is a critical barrier.

A key objective of the Czech Republic's energy efficiency policy in the building sector is the replacement of old, inefficient heat boilers that use solid fuels with more efficient boilers using alternative fuels. In 2020, a new minimum energy performance and emissions requirement for the sale of solid fuel boilers, the so-called eco-design, was introduced. The eco-design requirement for solid fuel local space heaters will apply from 1 January 2022.

To raise awareness about the new eco-design labelling, the government is launching a communication campaign focusing on changes in eco-design labelling in 2021.

Solid fuel boilers are classified in five classes depending on their efficiency and emissions. Since 2018, only boilers that are at least placed in Class 4 can be placed on the market in the Czech Republic and since 1 January 2020 only the fifth-highest emission class, in alignment with the eco-design regulation, can be placed on the market. Moreover, by 1 September 2022, solid fuel boilers in the first and second emissions classes will need to be replaced; around 100 000 of such boilers will hence be replaced with support from the boiler replacement programmes by the end of 2023. This will not only enhance energy efficiency, but also improve local air quality and reduce emissions.

Looking forward to 2030, at least another 80 000 boilers will be replaced and likely include the replacement of the third emission category boilers and solid fuel space heaters, where used as a main source of heat. It is also expected that this will help to improve air quality, which continues to be of particular concern in the Czech Republic (see Chapter 3).

The government also provides support for improving the efficiency of heat distribution systems, for example to implement forced ventilation systems with waste heat recovery or by replacing inefficient electric heating with heat pumps, and for the modernisation of lighting systems. Moreover, the State Energy Policy includes a target that 60% of supplies in heat supply systems should come from co-generation by 2040 (MIT, 2015).

District heating

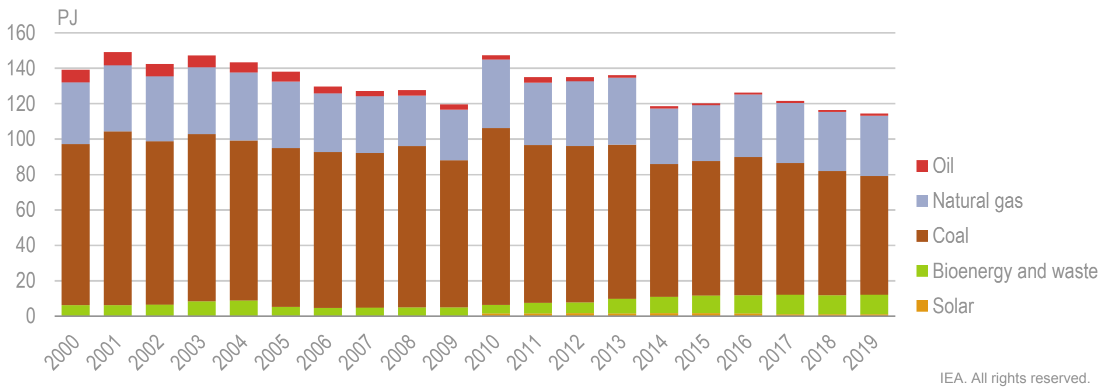
In 2019, around 116 TJ (2.8 Mtoe) of district heating (DH) thermal energy was supplied in the Czech Republic (Figure 4.12), or about 50% of total heat consumption. More than half of this heat was produced from coal in 2019, followed by natural gas and bioenergy. In recent years, the share of coal used in DH has decreased (from 68% in 2010 to 58% in 2019), and is expected to further decline to 20% after 2035 and be replaced by natural gas and renewables. A total of around 1 000 entities operate in the production and distribution of thermal energy, with three companies (EPH, ČEZ and MVV) accounting for about 25% of the market in terms of heat supplied. More than 1.5 million dwellings are supplied by DH, representing over 40% of all households in the Czech Republic in 2015.[6]

The 2012 Act on Supported Energy Sources defines an efficient heat supply system as supplying at least 50% of heat from renewable sources, or 50% from secondary sources, or 75% from co-generation, or a combination of these three sources. The latest evaluation of the heating supply system found that in 2018, only 207 of the DH companies were considered efficient. To accelerate the transformation of the DH system, the government is planning to introduce new support measures, primarily for operational support for renewable heat and electricity for co-generation. But the government plans to make DH eligible for investment support under the EU Modernisation Fund and the Recovery and Resilience Fund to accelerate the shift to efficient and sustainable heating systems.

[6] The latest survey on the number of dwellings supplied by district heating is dated 2011, while 2015 data are provided by the private company ENERGO.

The Energy Regulatory Office sets DH prices annually that differ for coal- and non-coal based producers. In 2018, the average price for coal-based producers was CZK 582/GJ (gigjoule) and for non-coal based producers CZK 567/GJ. Prices for coal-based producers have been increasing in recent years in line with emission allowance prices in the EU Emissions Trading System (ETS). Decentralised heating sources do not pay a carbon tax, and only large stationary plants fall under the ETS. There is, therefore, an incentive for consumers to opt out of the centralised DH systems and install individual heating sources.

Figure 4.12 District heating supply in the Czech Republic by source, 2000-19



Coal accounted for 58% of the heat supply in 2019, but this share has decreased by 10 percentage points in a decade.

Source: IEA (2021a).

Consumers supplied by DH are allowed to switch to individual or centralised heating. However, new individual heating sources with installed capacity above 200 kilowatts (kW) have to undergo an energy assessment regarding the technical and economical availability of DH in the given area. The upcoming amendment of the relevant legislation introduces a new obligation requiring that any change towards individual heating result in at least the same level of energy efficiency of a given building.

The share of DH systems in total heat supply has been shrinking in recent years, their revenues have dropped, and they have less funds to invest in the necessary efficiency improvements to accelerate the shift to sustainable heating sources. However, there are solid arguments to maintain and modernise the DH system in the Czech Republic. Many DH systems are based on co-generation plants, which ensure a high utilisation of primary energy sources. As most DH systems are located outside of city centres and are subject to stringent air pollution requirements, which have been further tightened in 2021, they have a lower impact on local air pollution in densely populated areas. DH also increasingly uses domestic biomass and renewables, which supports the shift to sustainable fuels. The shift towards the use of natural gas in DH systems also contributes to emissions reductions and an increase in efficiency. But there are questions about the longer term viability of this shift, as the government is also investigating options for the deep decarbonisation of the heating sector. However, the government is also initiating efforts to green gas, with the first supply of biomethane expected by 2030.

The Czech Republic currently does not have a strategic policy focusing specifically on DH and co-generation, however, the government is committed to cover over 60% of its heat supply from co-generation in 2040 (EC, 2019a). In 2020, the government published an assessment of the potential for high-efficiency co-generation and efficient district heating and cooling in the Czech Republic, which was an update of a similar report from 2015. A key finding of the assessment is that small sources with an output of up to 10 MW electric (MWe) have the greatest potential for the development of high-efficiency co-generation, while larger co-generation plants have only limited potential for efficiency improvements (EC, 2019a). However, the development of any new co-generation plants is subject to ensuring stable economic incentives for investors and heat suppliers.

The findings of this assessment will feed into the comprehensive heating strategy to accelerate the deep decarbonisation of the sector that is under preparation. The strategy will address emissions reductions, a shift to sustainable and renewable energies, and increasing the efficiency of existing installations (see Chapter 5).

Assessment

The energy intensity of the Czech economy is among the highest in the EU, mainly due to the presence of large energy-intensive industry sectors. Primary and final energy consumption decreased steadily until 2014, while the economy grew, with a significant decrease in industry sector demand, demonstrating the successful integration of more modern industrial machinery and technologies. Energy consumption grew again between 2015 and 2017 and stabilised in 2018-19.

The Czech Republic has progressed significantly in terms of energy efficiency measures since the last IEA in-depth review in 2016. It has deployed many public financing programmes, in particular in the building and industry sectors. Measures implemented for the industry underperformed, with certain allocated funds left unused. In particular, the New Green Savings and Operational Programme Environment delivered high energy savings, while other initiatives were less effective than expected. Consequently, the Czech Republic is expected to miss about 31% of its cumulative energy savings target from government measures, set following Article 7 of the EU Energy Efficiency Directive.

There are several reasons why the programmes did not produce the expected savings. First, it may take a long time to fine-tune a major energy efficiency programme so that it can generate large volumes of savings at an optimal cost. Some of the best energy efficiency programmes in Europe took up to 15 years to be optimised. It is therefore important that the major schemes continue without interruption and with sufficient long-term financing.

Second, public awareness of and attitudes towards energy efficiency are only slowly becoming more favourable. This growing interest is addressed through the new communication campaign that started in October 2020. The campaign targets households, municipalities and the business sector to raise awareness of the multiple benefits of energy efficiency and behavioural measures.

Third, the current programmes rely heavily on grants. Their effectiveeness would benefit from a greater share of other financial instruments, including the involvement of private and public banks, and so-called one-stop shops that support investors with the technical preparation and the administrative realisation of projects. The dialogue between the government and the banking sector to apply the “energy efficiency first” principle in their loans is a welcome move.

Fourth, in the Czech Republic, energy efficiency policy, legislation and implementation of programmes are the responsibility of the Ministry of Industry and Trade. In most IEA countries, specialised energy agencies prepare and execute energy efficiency programmes. Having dedicated and specialised teams responsible for the implementation and monitoring of energy efficiency policies can make these policies more effective. Such a dedicated agency would also be in charge of verifying the savings obtained through voluntary agreements.

Energy efficiency programmes can benefit from the EU’s expanding financing programmes, *inter alia* the Recovery and Resilience Fund, Cohesion Funds, the Modernisation Fund, and the Just Transition Fund. Overall, the Czech Republic aims to use the finances available for energy efficiency to the best advantage and is focusing on finishing document preparations for the period to 2030. The IEA encourages the government to finalise the documentation quickly to ensure the continuous availability of support and energy savings to 2030.

In this context, it is important that the Czech Republic develop a continuous pipeline of energy efficiency projects that can be financed from these sources. The ELENA facility under the European Investment Bank can be used for the preparation of large-scale industrial and public sector projects. The preparation of smaller projects by households, small businesses and public authorities could be better supported by the energy consultation and information centres (EKIS), which provide consultancy services for free for the implementation of energy efficiency projects.

Industry

To identify energy efficiency potential, the Czech Republic requires all large companies to undergo energy audits every four years or to implement an energy management system in line with ISO 50 001. While this stems from EU obligations, the government rightly went a step further by extending this requirement to small and medium-sized enterprises that have an energy consumption above 5 000 MWh/year for two years in a row. However, it is unclear how the outcomes of the energy audits are taken forward and there is no systematic information available as to why a company choses to move forward with the implementation of the audit findings or not. It is important to understand what kind of incentive structures and policy framework could change this. The IEA encourages the government to carry out a study in this regard.

The budget for the energy efficiency for small and medium-sized enterprises could not be spent entirely. These companies need particular support to identify, develop and implement their projects, as they often lack expertise and human resources to dedicate to energy efficiency. Lessons learnt from financing the construction and renovation of residential buildings can be applied for the renovation of buildings and other projects of small and medium-sized enterprises as well.

Large companies usually have dedicated resources for energy management and for preparing energy efficiency projects. Financial support for large companies might sometimes be needed to trigger the investment, but a good balance needs to be found to support only cost-effective projects that deliver a relatively high amount of energy savings per CZK of subsidy, while avoiding financing projects that would happen anyway without financial support.

A new main programme of voluntary agreements concentrates on very large and energy-intensive companies. The major challenge of voluntary agreements is their value added: are companies proposing energy efficiency measures they would not undertake without the agreement? In this regard, the IEA welcomes the government's decision to maintain the option of introducing an obligation scheme if the voluntary agreements do not achieve the indicated savings.

Transport

The transport sector has the fastest growing energy consumption. Most of the energy used in transport comes from imported fossil fuels. The Czech Republic is a large importer of second-hand cars, which is supported by a very low registration tax. The age of the vehicle fleet is consequently rather high. Reducing the average age of the vehicle fleet should be supported through an appropriate combination of scrapping schemes and taxation at the point of purchase or registration related to CO_2 emissions, beyond the current taxation of fossil fuels in transport.

Public transport policies, and in particular the multimodality of passenger transport, have contributed to an increase in the use of public transport and induced some energy savings. The Czech Republic also envisages creating low-emission zones by limiting the access of high-emission vehicles in certain cities. However, the current and planned transport policies will not halt, but merely slow down, the steep growth of energy consumption in transport. In order for the transport sector to contribute to the decarbonisation of the Czech economy, this trend will need to be halted and reversed.

An important measure could be the electrification of transport, and notably the take-up of electric vehicles. Even with the current high-carbon electricity mix, EVs would lead to higher overall energy efficiency and lower emissions. Moreover, with the coal phase-out looming, the energy efficiency of EVs will increase further.

The Czech Republic has adopted an updated National Action Plan for Clean Mobility, which foresees 30 measures to promote electric mobility and other alternative fuels. If quickly and fully implemented, and supported by well-prepared projects and appropriate budgets, it would significantly boost the move toward electric mobility and other zero-emission and alternative fuels.

Buildings

The Czech Republic's efforts to improve the building sector's energy efficiency are commendable, especially the introduction of financial instruments that combine grants with guarantees and preferential loans. The government is also introducing a communication campaign to increase awareness on the multiple benefits and the required behavioural measures.

The Czech Republic has a target for energy savings for its central government buildings. Until 2019, the government was not on track to reach this target. To boost energy efficiency, the government could consider including all types of public buildings in its renovation programmes, including town halls, schools, hospitals, sport centres, cultural buildings and other places that receive many visitors. The public sector should lead by example in deep renovation or staged renovation projects spread out over time. Municipalities, notably small ones, do not have the human resources or technical capacities to prepare and implement such complex renovations; therefore, technical support is crucial. Energy management systems should complement the investments and improve the actual functioning and the behavioural aspects of the use of the buildings.

The government's "New Green Savings" Programme integrates support for energy efficiency, renewable energy, and climate adaptation and mitigation measures for buildings. Typical renovations save up to 60% of energy, but miss out on opportunities for savings of up to 90% or more. To fully tap the decarbonisation potential, follow-up investments may be needed to renovate buildings to nearly zero energy standards. Therefore, current renovations shall be prepared and executed in a way that does not hinder possible deeper renovations in the future.

District heating

The Czech district heating systems face multiple challenges, including the increasing price of emissions allowances for large installations, versus low taxation and environmental standards for competing individual heating, uncertain long-term viability of natural gas solutions and uncertainties linked to the coal phase-out. Some 207 DH supply systems are considered efficient, out of some 662 heat production licences in 2018.

Given these challenges, the economic viability of the sector is at stake, which is a serious concern for the government, as nearly 50% of all households are connected to these systems, and many of them have no economic alternative, given the configuration of their house or apartment. Some households that do have access to an alternative heating solution may ask to be disconnected, making district heating more expensive for those that stay.

Apart from the social reason to continue district heating, there are also energy benefits. Well-designed DH systems can provide heat in a more efficient way, and with less local pollution, than individual systems. Simply maintaining inefficient DH systems should be avoided. The question is how to transform the mostly coal-based inefficient systems to efficient ones emitting less greenhouse gases.

There is probably no one-size-fits-all solution. The systems have different designs, some use steam, others high-temperature water; some have a single heat source, others have multiple sources; some have individual metering, others have collective metering; some have too big of a pipeline system (due to increased building efficiencies), others still have opportunities to expand their customer base.

As for the future of the heating sources for the systems, the government is looking primarily at gas heaters, including co-generation, waste incineration and biomass, to replace the still dominant coal-fired heating. The government is also researching and testing deep geothermal heat. Other alternatives could be waste heat and excess heat from industry and decarbonised gases. While heat pumps are generally still more expensive than some other forms of heating, the government has observed a fairly strong trend in the installation of heat pumps in new single-family houses that are typically owned by wealthier segments of the population. Also, generous subsidies for heat pumps are provided, which partially levelises their capital costs. For the future beyond 2030, small modular nuclear reactors are also considered as heat sources.

Generally, DH systems are more efficient if they use lower temperature water to reduce losses during transport. This would require better insulation of buildings and can only be implemented in an integrated approach. Individual metering could also help in this regard; when confronted with the actual costs of their heating, people tend to save energy better. Where municipalities themselves are active in district heating, renovation and individual metering could be more easily pursued.

When achieving carbon neutrality, heating, including district heating, is one of the easier sectors to decarbonise. Therefore, long-term plans for decarbonisation of DH systems should be developed and any public support for maintenance, or for investments in replacement or expansion, should be conditional on such plans.

Research, development and demonstration projects should concentrate on developing solutions for decarbonisation of district heating in Central European circumstances. The costs and resources of the relevant research and development projects could be shared in multinational teams.

Recommendations

The government of the Czech Republic should:

Industry

- ☐ Provide targeted technical and implementation support for energy efficiency projects in the small and medium-sized enterprise sector and implement an information campaign specifically focused on the sector to raise awareness of this support.

Transport

- ☐ Introduce measures to make the vehicle fleet younger and more energy efficient, speed up the introduction of electric vehicles, implement the measures identified in the updated National Action Plan for Clean Mobility in a timely fashion, effectively with a sufficient budget.

Buildings

- ☐ Support in particular deep energy efficient renovation of all public buildings, including schools, hospitals and sport facilities, through technical support and additional financial incentives.
- ☐ Ensure that building renovation measures that benefit from public support do not inadvertently prevent the decarbonisation of the building in the future.

District heating

- ☐ Develop solutions for the decarbonisation of district heating. Require a decarbonisation plan from district heating facilities that apply for public support.

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5. Renewable energy

Key data (2019/20)

Renewables in total final energy consumption (TFEC) (2019): 3.8 Mtoe/15.8% of TFEC (bioenergy* 3.5 Mtoe, solar 0.2 Mtoe, hydro 0.1 Mtoe, wind 0.04 Mtoe).

IEA median renewables share (2019): 15.5% of TFEC.

Renewables in electricity generation (2020): 10.3 TWh/12.8%* (biogas 2.6 TWh, solid biomass 2.5 TWh, solar 2.2 TWh, hydro 2.1 TWh, wind 0.7 TWh, renewable waste 0.1 TWh).

Renewable shares (2019):** gross final consumption 16.2%, electricity 14.0%, heating and cooling 22.7%, transport 7.8%.

Exchange rates (2020):*** Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* According to the IEA definition.

** Computed according to Eurostat definitions for consistency with EU targets. Eurostat definitions include normalisation of wind and hydro renewable electricity generation, and multiplication factors for advanced biofuels and renewable electricity in transport.

*** OFX (2021)

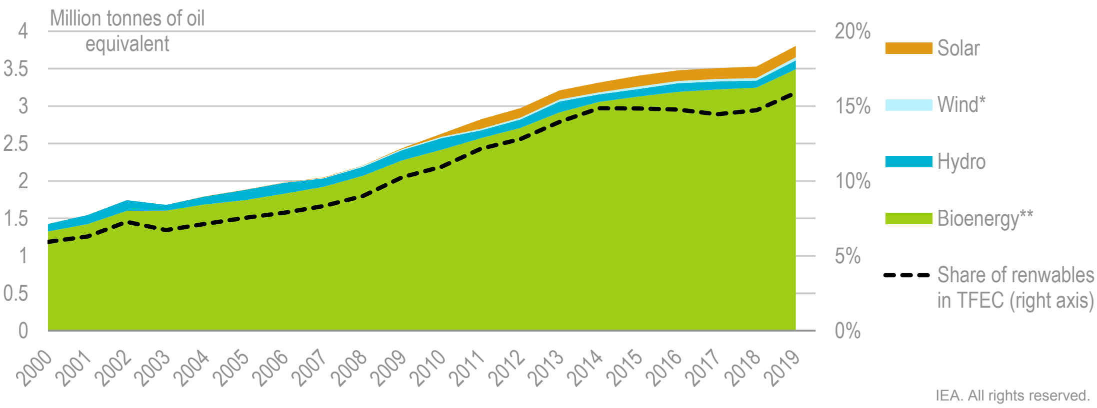
Overview

The Czech Republic is in the process of revising its legal and regulatory framework for the development of renewable energy sources. Pending the approval of the draft legislation, the sector is left without appropriate operational support programmes, while investment support continues to be available. This may impact the chances of achieving the country's energy and climate targets for 2030.

The share of renewables in total final energy consumption (TFEC) was 16% in 2019, a 71% increase since 2009 (Figure 5.1). Bioenergy was the key driver of this growth, accounting for 92% of renewables in TFEC. Energy consumption from solar power increased tenfold between 2009 and 2019, but still covers less than 1% of TFEC (4% of renewables in TFEC). Wind energy remained negligible (1% of TFEC), despite almost doubling in the decade 2009-19, while hydro slightly decreased, with annual fluctuations.

The National Energy and Climate Plan (NECP) defines 2030 targets for the shares of renewables in gross final energy consumption (22%), electricity (17%), transport (14%), and heating and cooling (an annual increase of 1 percentage point). These targets are defined using the European Commission's (EC) accounting rules, which include multiplying factors for advanced biofuels and electricity in transport.

Figure 5.1 Renewable energy in total final energy consumption in the Czech Republic, 2000-19



Bioenergy accounted for by far the largest share of renewable energy consumption.

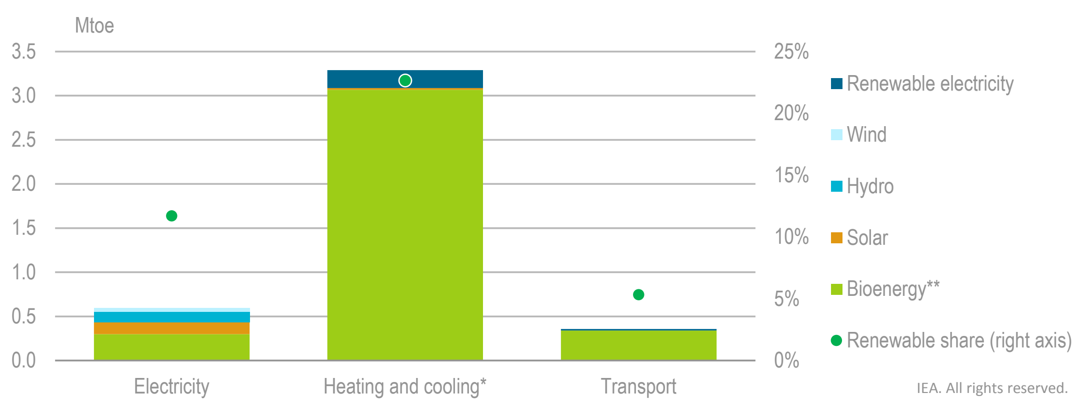
* *Wind* increased from 0 Mtoe in 2000 to 0.4 Mtoe in 2019.

** *Bioenergy*: primary solid biofuels, renewable waste, liquid biofuels and biogas. Excludes non-renewable waste.

Source: IEA (2021).

In 2019, renewable energy accounted for 16% of TFEC, 12% of electricity generation (according to the IEA definition), 23% of heating and cooling, and 5% of transport energy consumption (according to IEA definitions), without multiplying factors for advanced biofuels and renewable electricity (Figure 5.2). Bioenergy was the largest contributor to renewable energy, particularly dominating the heating and transport sector, with a small share of solar in renewable electricity, in heating and cooling, and in transport. Bioenergy covers more than half of renewable electricity, followed by solar (23%), hydro (20%) and wind (7%). The Czech Republic's renewable share in TFEC in 2018 was just below the IEA median of 16%.

Figure 5.2 Renewable energy in electricity, heating and cooling, and transport in the Czech Republic, 2019



Bioenergy was the main renewable source for heat and transport. Renewable electricity was mostly generated by bioenergy, followed by solar, hydro and wind.

* *Heating and cooling* from Eurostat data.

** *Bioenergy*: primary solid biofuels, renewable waste, liquid biofuels and biogas. Excludes non-renewable waste.

Notes: Electricity based on renewable shares of domestic electricity generation.

Source: IEA (2021); Eurostat (2021).

Renewable energy policy and targets

The Czech Republic's renewable energy targets are mainly driven by obligations under the European Union's (EU) Renewable Energy Directive (RED) for the period to 2020 and by RED II through the National Energy and Climate Plan (NECP) for the period to 2030. The government set a target for 2020 to reach a share of 13% of renewables in gross final consumption, which was already achieved in 2013. In 2019, the share was just above 16%. The sector targets for electricity and heating and cooling were also achieved well in advance. However, the country is not on track to reach the 2020 target in the transport sector (Table 5.1).

For 2030, the Czech Republic is committed to increase the share of renewables in gross final consumption to 22% as part of its contribution to the EU-wide target of 32%. Under the NECP, interim targets are set for 2022, 2025 and 2027 to allow the implementation of additional measures if the country is not on track towards the 2030 targets (EC, 2019).

For 2030, the Czech Republic has further adopted in its NECP the EU minimum target of a 14% share of renewables in the transport sector and also set an indicative target to increase the share of renewables in the cooling and heating sector by 1 percentage point annually in the period 2021-30. The government has set an ambition to reach 17% of renewables in total electricity generation by 2030 in the NECP (Table 5.1).

Table 5.1 The Czech Republic's 2020 and 2030 renewable energy targets and status in 2019

Renewable share by sector (% of gross final consumption)		Targets	
	2019	**2020**	**2030**
Gross final consumption	16.2%	13%	22%
Transport	7.8%	10.8%	14%
Electricity	14.1%	13.5%	17%
Heating and cooling	22.7%	15.5%	1 percentage point annually to 2030

Sources: MIT (2021); EC (2019).

The targets set for 2030 are not particularly ambitious compared with the targets of other IEA countries for the same year. The anticipated annual growth rate in the electricity sector is well below the country's achievement of the last decade, while the trajectory for transport is steep compared to historical trends. To reach the 2030 targets, the government needs to fundamentally reset the legal and regulatory framework and supporting measures in all three sub-sectors.

Act No 165/2012 is the main legislative basis to support sources of energy for the period to 2020. The act and the National Renewable Energy Action Plan of 2017 specified measures and tools regarding the development of renewables until 2020. Operational support schemes were the key measure for the promotion of renewable energy sources. However, the Czech Republic also operates other support schemes, including tax instruments, regulatory measures such as facilitating administrative processes, and indirect support measures such as providing guarantees of origin and raising consumer awareness.

From 2021 onward, the NECP outlines policies and measures for renewable energies until 2030. The preparation of the detailed support schemes and measures for the period from 2021 to 2030 is ongoing, with several investment support schemes already finalised. The government proposed an amendment to Act No 165/2012 Coll. (the Energy Act) in April 2020 that would substantially restructure the existing operational and investment support schemes and align the overall support measures with the new priorities set out in the NECP, such as a special focus on the transport sector and support for high-efficiency co-generation. The main features of the proposed amendment are the:

i) introduction of auctions for larger scale projects, typically above 1 megawatt (MW)
ii) continuation of the operational support for current sources
iii) prevention of overcompensation of supported energy sources
iv) reduction of administrative and regulatory barriers for renewable energy sources.

However, the legislature has not yet approved the amendment. Pending the enactment of the proposed act into legislation, the renewable sector in the Czech Republic is experiencing a large degree of uncertainty. Consequently, necessary investments may be delayed, which will make it more challenging to meet the interim and final renewable targets for 2030.

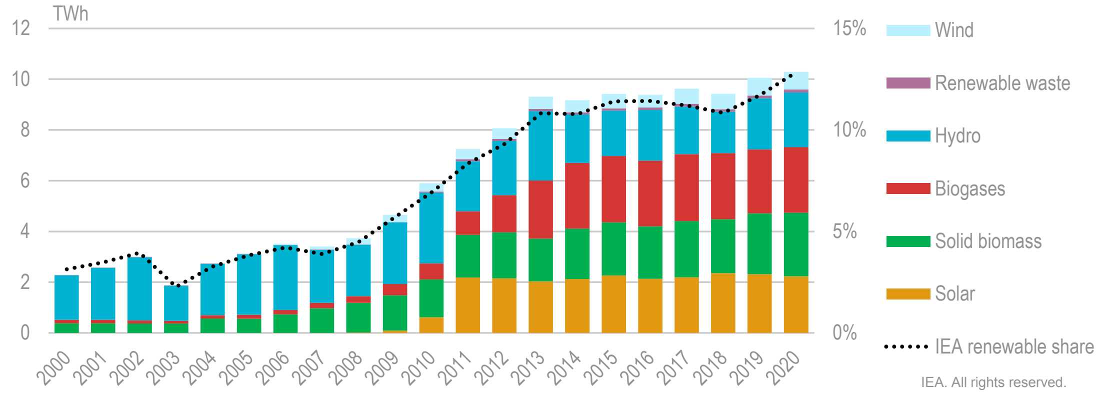
The EU's Modernisation Fund and the Recovery and Resilience Facility are the major sources for investment support for renewable energies towards 2030. The exact allocations under the funds for renewable energies have not yet been determined, but the Czech government expects that from a total of EUR 5.8 billion of revenues under the Modernisation Fund, 25% would be devoted to renewables over the period to 2030. In addition, EUR 250 million would become available from the Recovery and Resilience Facility, about half of which would be allocated for renewable electricity and the other half for the transformation of heating and cooling. Moreover, the government also expects that funds would become available under the EU's Just Transition Fund, but details are yet to be decided upon.

Renewables in electricity

Renewable electricity production more than doubled between 2009 and 2020, from 6% to 13% of total power generation due to the growth of generation from solar photovoltaics (PV), bioenergy and wind (Figure 5.3), while hydro had a constant share of about 20% of renewable electricity (2% of total power generation). Most of the increase in generation from solar PV and biogas occurred in the period to 2014; generation from renewables then stabilised until 2018, with a 9% increase to 2020. In 2020, 10.3 terawatt hours (TWh) of electricity was generated using renewable energy sources: 2.6 TWh from biogases, 2.5 TWh from solid biomass, 2.2 TWh from solar, 2.1 TWh from hydro and 0.7 TWh from wind.

The Czech Republic's progress against its 2020 target for the share of renewables in electricity generation is calculated using the EU methodology, which differs from the methodology used by the IEA. The EU methodology uses normalisation formulas for generation from hydro and wind generation. This normalisation has the effect of smoothing out the contribution of hydro and wind, as it averages the capacity factor of hydro generation over 15 years and wind generation over 5 years. The share of renewables in electricity generation according to the EU methodology was 14% in 2019.

Figure 5.3 Renewable energy in electricity generation in the Czech Republic, 2000-20



Renewable electricity has more than doubled in the last decade, driven by a notable expansion in solar power and bioenergy.

* *Bioenergy* includes primary solid biofuels, renewable municipal waste, liquid biofuels and biogas. Excludes non-renewable waste.

Source: IEA (2021).

Policies and measures for renewable electricity generation

The key operational support measures in the electricity sector to 2020 were purchase prices (feed-in tariffs) and green bonuses (feed-in premiums). The purchase price is the minimum guaranteed payment to the renewable energy producer regardless of the market price of electricity. A green bonus is paid either to the producer for self-consumption or as a supplementary payment when the produced electricity is directly sold to the market. The two schemes cannot be combined and the renewable electricity producer has to choose between them; however, the purchase price option is not available for all types of renewable electricity, as the government prioritises the green bonus scheme.

The Czech Energy Regulatory Office[1] sets the feed-in tariff and the green bonuses annually. The feed-in tariff is guaranteed over a 15-year period, with an annual increase of 2%, except for production from installations using biogas, biomass and bioliquid. The level of the feed-in tariff is based on the year in which the installation was put into operation (Janíček and Výmola, 2020). The electricity market operator is required to pay the obligated off-taker the difference between the guaranteed purchase price and the hourly market price of electricity.

To account for sharply increasing support payments for solar power plants put into operation in 2009 and 2010, the government introduced a levy for the years 2011-13 that plant owners needed to pay to compensate for the supposed disproportionate amount of support received. Since 2014, this levy is only paid by solar power plants put into operation in 2010. This retroactive change of compensation resulted in a strong decline in new solar

[1] See Annex A for more information about institutions and organisations of relevance to the energy sector.

capacity coming on-stream, as investor confidence was severely undermined and the overall growth of renewable electricity generation capacity has markedly stalled since, also reflecting the *de facto* absence of any support scheme for new installations since then.

In recent years, new small rooftop solar installations accounted for a capacity addition of about 20 MW annually. However, this is not sufficient to achieve the renewable electricity ambition for 2030 and does not reflect the estimated total potential of about 11.8 gigwatt (GW) of rooftop solar. Of the estimated total potential, about 40% could be installed on residential rooftops and 60% on commercial sector buildings, which would also allow shifting towards larger scale installations (ENACO, 2015).

In the case of the green bonus scheme, the renewable electricity producer receives the market price from the off-taker and the market operator pays the green bonus that is linked to the feed-in tariff of a comparable generation source to the producer. The green bonus scheme has several advantages compared to the guaranteed purchase price scheme. Producers can sell their electricity output to any customer or electricity trader at the market price and will obtain the green bonus in addition to the payment. Or they can self-consume the generated electricity and still obtain the green bonus.

The feed-in tariff and the green bonuses differ by type of renewable electricity source to reflect their different market values. The costs of the feed-in tariff and the green bonuses are covered by regulated parts of the overall price of electricity and are paid for by consumers up to a maximum level. The Energy Regulatory Office regularly publishes both in its price decision.

Looking forward to 2030, the government is keen to avoid a repeat of the situation experienced earlier and to regain investor confidence as well as that of the general public, who had become hostile to renewable electricity because a substantial share of the cost of the generous feed-in tariffs are passed on to them in the form of a special renewable levy; in 2019, this share was just over 42%. Therefore, the draft revision of the Energy Act proposes abolishing the feed-in tariff for new installations after 2021. Instead, installations of less than 1 MW capacity would continue to benefit from the green bonus scheme. Installations above 1 MW, or 6 MW in the case of wind power, will participate in an auction system where the bidder that demands the lowest subsidy will be selected (Janíček and Výmola, 2020). However, the current draft law excludes solar PV installations from the auction system, though the rational for this exclusion has not been clearly spelt out.

For the first time, support for the repowering of small hydro and wind installations is also included in the draft legislation and would be funded from the EU's Modernisation Fund. The details are currently being prepared. However, solar PV is excluded from the repowering provisions.

The introduction of auctions is expected to reinitiate the installation of larger renewable facilities that were not eligible for any support under the policy to 2020 and that do not have any significant project pipeline. However, it is uncertain if the proposed support schemes will be sufficient enough to incentivise those investments. The strategic aim of the new support mechanisms is to reduce the overall level of support for renewables in the electricity sector and instead augment support for renewables in the heating and transport sectors.

The proposed act also specifically addresses the issue of overcompensation of renewable electricity projects put into operation between 2006 and 2012, which account for the largest share of projects currently operating in the Czech Republic. This is in response to a decision by the European Commission that stated that although the support schemes did not violate the EU state rules provision, there were, however, projects that could be considered as being overcompensated based on their internal rates of return that differ for different types of installation, e.g. wind, biomass and photovoltaic (EC, 2016; Janíček and Výmola, 2020). Among the measures proposed in the draft act is a provision that would allow the government to change the terms of ongoing contracts with those renewable generators judged to be benefiting from an overcompensation and to recuperate those payments. For this, the draft act includes maximum limits of the internal rate of return by type of installation and a provision that would allow public inspections of installations to ascertain their internal rate of return (Janíček and Výmola, 2020). Some industry representatives have calculated that this could result in a further reduction of the originally agreed upon feed-in tariff by up to 50% for solar PV installations that are more than ten years old.

Any fundamental reset of the renewable electricity landscape in the Czech Republic will require an intensive stakeholder consultation to identify the most efficient, cost-effective and sustainable mechanism to increase the renewable share. Rebuilding investor confidence is indispensable with a view to the 2030 targets, but even more so with a view to the longer term energy transitions and the expected phase-out of coal-fired generation (see Chapters 2, 7 and 9). Similarly, the general public needs to be firmly brought on board and be reassured that the energy transition is possible without putting unduly financial stress on end-consumers, and that it will benefit more than just a small part of the population.

The government plans to rely on various sources of funding to reach the 2030 target for renewable electricity generation and is aiming for a shift towards more investment instead of operating support. However, as shown in the NECP, by far the largest part of the funding would be spent on operational support for existing installations and for those that will be installed in the period to 2030. In fact, spending on existing facilities is estimated to be almost ten times more than that for investments in new facilities (EC, 2019). Total payment needs to 2030 are estimated at CZK 511.2 billion. Of this, 89% is for continuous operational support for existing installations and the remainder is to support the installation of new renewable sources (EC, 2020).

The government is aware that financial support alone is not sufficient to encourage the uptake of new renewable electricity projects. Non-monetary support is also required and here, in particular, the creation of an enabling regulatory framework is warranted that facilitates the integration of renewable sources into the electricity system and allows for the timely creation of the necessary supporting infrastructure.

Reducing barriers for the development of renewable generation

To help to bring renewable electricity onto the grid, transmission and distribution operators are obliged to take into consideration the new and planned capacity additions in their system development plans.

A debate is ongoing in the Czech Republic about the proportion of variable renewable power generation that could be safely accommodated into the electricity grid. The transmission system operator is currently preparing a detailed assessment of the maximum capacity of solar PV and other variable renewables that can be integrated into the power grid and is also looking at future sources of flexibility. One preliminary number based on the current framework was 8-9 GW of solar PV as the maximum capacity in 2030 that could be accommodated without posing problems for grid stability under the existing framework. For comparison, in 2018, the Czech Republic had 2 GW of installed solar PV capacity, equivalent to 9% of total installed capacity; in 2019, solar accounted for 2.8% of generation.

Research undertaken by civil society shows that a substantially larger share of solar PV can safely be integrated, especially in light of the high interconnection rate of the Czech system with its European neighbours. This is also in line with experiences in other IEA countries. The Czech Republic is encouraged to study those in more detail. However, it will require a new approach to investment in system management and the creation of an enabling operational and regulatory framework.

The government is also working towards reducing the administrative requirements for renewable electricity generation. The 2015 amendment of the Energy Act abolished the need for an electricity generation licence for small generating sources up to 10 kilowatts (kW) that are primarily intended for self-consumption, even if the generating facility is connected to the transmission or distribution system. The distribution system operator cannot refuse to connect these small plants. While the owners of such facilities can export any surplus electricity to the system, they are not eligible to receive the market prices as compensation, as this would require an electricity business licence. There is currently no information available on how many self-producers are feeding surplus electricity into the grid or at what price.

The government has also included a provision into the draft act to ease the procedure for obtaining construction permits for facilities up to 20 kW or 30 kW; however, the details have not yet been finalised, as the act is still under negotiation. These types of installations also would not need a licence and would not be required to pay the distribution operator.

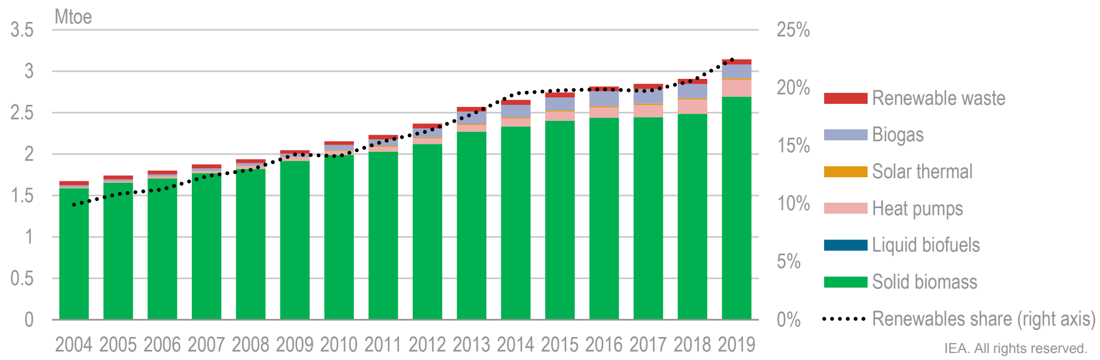
In another effort to reduce the administrative complexity for adding new renewable electricity capacity and required infrastructure, the government introduced a legal proposal at the end of 2019 to amend the Building Law to significantly accelerate and simplify the preparation and implementation of new construction projects, such as transmission lines.

The strategic aim of this revision is to establish a single decision-making process that would replace all partial decision making by several authorities, for example for land-use and building permits. The proposal would result in the creation of a new two-cell system consisting of a new supreme building authority at the central level and land-use planning authorities at the regional level and in municipalities with extended power. Anecdotal evidence shows that it can take up to seven years to obtain a permit for the installation of a wind power plant; as a result, several investors have abandoned their investment plans. The new law would come into effect gradually from 2021 until June 2023.

Renewables in heating and cooling

Direct use of solid biomass accounts for most of renewables in heating and cooling (82% in 2019), but in the last decade, heat pumps (6.4% of renewables in heating and cooling in 2019), biogas (5.3%) and renewable waste (2.0%) have also started to play an increasing role (Figure 5.4). Between 2009 and 2019, renewables in heating and cooling increased by 54%, led by a 40% increase of solid biomass, while heat pumps increased fivefold, biogas fourfold and solar thermal threefold.

Figure 5.4 Renewable energy in heating and cooling in the Czech Republic, 2004-19



Renewables in heating and cooling consist mainly of direct use of solid biomass.

Source: Eurostat (2021).

Since 2015, operational support in the form of either the guaranteed purchase price or the green bonus is available for renewable heat. The support applies to heat use from generating plants with an installed electricity capacity of up to 500 kW and using biogas generated by more than 70% from livestock manure and by-products of animal products or biodegradable waste. Renewable heating sources using biomass and geothermal energy combustion are eligible to participate in the green bonus scheme and are guaranteed a 2% annual increase in support.

In addition, the government offers investment support for the construction of new heating facilities using renewable fuels and for the refurbishment of existing heating facilities shifting towards using renewable fuels. Investment support is also available for the installation and refurbishment of heating sources in buildings if they are undertaken to comply with the energy performance requirements of buildings (see Chapters 3, and 4).

Looking forward to 2030, support schemes for renewable heat are included under the revision of Act 165 on supported energy sources that is currently pending in parliament. The government has identified biomass, municipal waste, natural gas and biogas to replace coal as the key fuel sources. However, waste heat has not been specifically recognised and the exploitation of its potential is not counted towards the annual capacity additions.

Biomass includes secondary sources of energy from, for example, the paper and pulp industry. Solid biomass will experience the largest increase to 2030 of all renewable heating sources and will account for about three-quarters of all renewable heating sources by then (EC, 2019). Given the already large share of solid biomass in the heating sector, its future role poses questions regarding sustainability issues and air pollution. New legislation on the use of waste is currently pending in the Czech parliament, aiming to establish a hierarchy of waste treatment and, once passed, will provide more certainly for the heat plant operators.

The Czech Republic currently does not have a dedicated heating and cooling strategy, but is in the process of preparing one with the view towards a deep decarbonisation of the heating sector. The strategy will look at the overall transformation of the heating and cooling sector, from reducing the sector's emissions, increasing the efficiency of existing installations, assessing the future of district heating (DH), and co-generation to encouraging the shift to sustainable and renewable energies (see Chapter 4).

DH is common in the Czech Republic and supplies about 40% of households. Over 56% of all district heat delivered in 2018 was coal-based. The government is committed to the rehabilitation and modernisation of the DH systems, to replace coal with low-carbon and renewable sources and to foster the use of co-generation. The new heating strategy will be announced in 2021 and assessed every two to three years to monitor if progress made is in line with the 2030 targets (EC, 2019).

A key challenge for the future of the DH system is the uneven taxation of heating installations that fall under the EU Emissions Trading System (ETS) and those that do not (see Chapters 3 and 4). Decentralised heating sources do not pay a carbon tax and only large stationary plants fall under the ETS. There is, therefore, an incentive to opt out of the centralised DH systems and install individual heating sources. As a result, the share of DH systems has been shrinking in recent years.

To accelerate the transformation of the DH system, the government is planning to introduce new support measures, primarily for operational support for renewable heat and electricity for co-generation. The government also plans to introduce investment support for the period to 2030 to accelerate the switch to sustainable fuels. Specifically, it plans to make DH eligible for investment support under the EU Modernisation Fund and the Recovery and Resilience Facility. Currently, the combination of operating and investment support for the conversion of existing heating plants is not allowed.

Co-generation installations are currently eligible for operational support in the form of green bonuses that are paid in addition to the regulated price of heat. However, the current support scheme expires at the end of 2021 and no replacement scheme has been announced yet. The proposed revision of Act 165 on supported energy sources that is pending in parliament includes a provision to continue the operational support for co-generation. However, this support would not be limited to the use of sustainable and renewable fuels, but would continue being available for all fuels that are less emission-intensive than coal. Co-generation plants with an installed capacity above 1 MW would need to participate in auctions, while small plants under 1 MW capacity will continue being eligible for the green bonus scheme. The operational support would be limited to a maximum of two years.

Any further delay in passing the revision of the Energy Act is likely to result in a continuous disconnection of customers from the DH system, as these systems are increasingly uncompetitive compared to systems that do not fall under the ETS. Moreover, pending the creation of a new policy framework and the approval of the new support scheme, it is also unlikely that any new large heating capacities will become operational due to the lack of clarity and long-term vision. The Czech government has asked the EC to grant an exemption to continue the existing support scheme at least until the end of 2023, when the impacts of ongoing transformation of the DH system will become apparent.

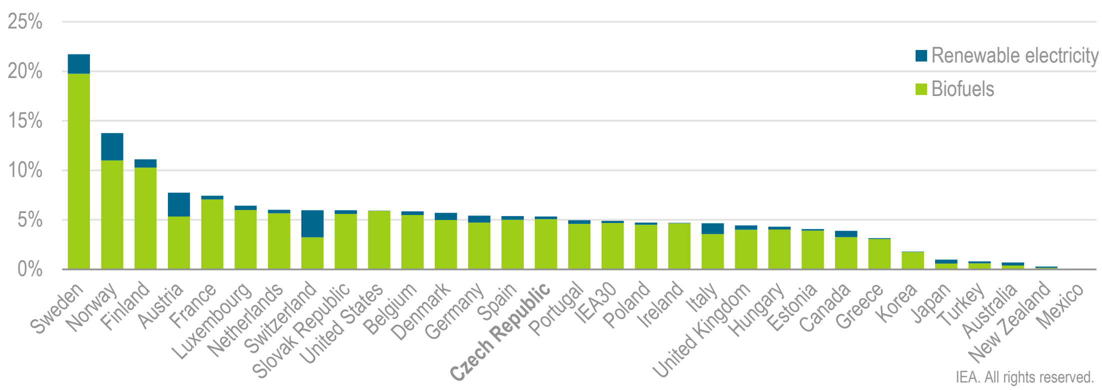
The NECP sees the development of renewable gases as an important contributor to the energy transition, including in the heating sector. The government is initiating efforts for greening gas, with the first supply of biomethane expected by 2030. Currently, the operation of biomethane production and infrastructure is unprofitable due to high operating costs.

Renewables in transport

In 2019, renewables accounted for 5.3% of the Czech Republic's transport demand, of which 95% consisted of biofuels blended with road transportation fuels and 5% of electricity, mostly from rail demand. In an IEA comparison, the Czech Republic's share of renewables in transport was slightly higher than the IEA average (Figure 5.5).

The Czech Republic's progress against its 2020 target for the share of renewables in transport is calculated using the EU methodology, which differs from the methodology used by the IEA. Starting in 2011, the EU introduced sustainability criteria mandating that only certain advanced biofuels could be counted as renewables. EU accounting rules were also updated so that multipliers are applied to the shares of advanced biofuels and renewable electricity. When applying the EU methodology, the Czech Republic's renewable energy share was 7.8% in 2019, not on track to reach the 2020 target.

Figure 5.5 Renewable energy in transport in IEA countries, 2019



In 2019, the share of renewables in the transport sector in the Czech Republic was close to the IEA median value.

Source: IEA (2021).

Looking forward, the NECP includes a breakdown of the contribution of different renewable transport fuels to reach the overall 14% target in 2030. Second-generation biofuels will contribute at least 6.2%, of which biomethane will contribute 4.5% and used cooking oils 1.7%. The Czech Republic targets a contribution of 7% from first-generation biofuels, the maximum allowed under EU legislation. The remainder (0.8%) will come from renewable electricity.

The Czech Republic has a mandatory biofuel blending requirement for automotive petrol and diesel fuels. Diesel needs to be blended with at least 6% biofuels and motor gasoline 4.1% by energy content. First-generation biofuels in the Czech Republic are mainly produced from food raw materials such as rapeseed, cereals and sugar beet. Biogas is produced from anaerobic fermentation, agricultural inputs, and landfill and sludge gas. All biofuels are produced locally, except for biodiesel, which is imported (EC, 2019).

Moreover, the government has set targets for electro mobility and the promotion of electric vehicles (EVs) in the 2019 update of the National Action Plan for Clean Mobility (NAPCM). By 2030, the government aims to have between 220 000 and 500 000 battery-only vehicles and plug-in hybrids in the country, compared to about 6 000 vehicles in 2020. If indeed 500 000 vehicles are on the road by 2030, this would be equivalent to about 7% of the total vehicle fleet and would require the availability of 35 000 charging points in 2030. This number would drop to 19 000 if only the lower end of the EV vehicle range is deployed by then. In 2020, there were about 1 000 charging points in the Czech Republic. The planned revision of the Building Law will also facilitate the acquisition of building permits for the charging infrastructure.

The government is, however, aware that this ambition will not make a major contribution towards meeting the overall target in the transport sector. The accounting rules at the EU level changed following Directive 2018/2001, which (among other changes) reduced the multipliers for the use of electricity in rail and road transport (EC, 2019). As a result, the share of electricity in transport in 2030 would be less than 1%, almost half that of today. The government could consider kick-starting its ambitious development of electricity mobility by mandating that any newly acquired public vehicles be electric.

In parallel, the 2019 update of the NAPCM promotes the further deployment of compressed natural gas (CNG) vehicles and related infrastructure. In 2019, there were around 23 000 CNG vehicles and 1 300 CNG buses operating in the Czech Republic that could avail of 190 public and 50 non-public CNG filling stations, in addition to 200 residential filling stations. The government also plans to develop infrastructure for the roll-out of liquefied natural gas (LNG) vehicles, which are currently used by the private sector to test LNG-fuelled trucks. By 2030, the government projects having between 29 500 and 61 900 gas-fuelled vehicles in the country (EC, 2019). However, it is aware that in the long term, the CNG and LNG fuelled vehicles will have to be replaced by greener alternatives, such as advanced biomethane, with a view to reducing greenhouse gas emissions.

The Czech Republic currently does not produce advanced biofuels. The government is preparing operational and investment support schemes to encourage the production of advanced biomethane and its supply to the transport sector. The operational support will be provided as an annual green bonus over the project's lifetime of 20 years. It will be financed from the state budget, primarily from the shift of operational support from electricity produced from those existing biogas facilities that will be converted to (advanced) biomethane plants. Priority is given to the conversion of those biogas stations that have a lower useful heat utilisation and that are located near high-pressure gas pipelines (EC, 2019).

The government plans to issue guarantees of origin for biomethane that would also be used for reporting purposes about the production and consumption volumes of biomethane in the country. Facilities wishing to apply for operational support must comply with the same requirements as those for electricity and heat production: they must be connected to the transmission or distribution system and be operated by a registered licence holder within the system run by the Electricity Market Operator (OTE) to ensure compliance with the mandated quality standards (EC, 2019). Other measures under discussion include the introduction of a legal obligation on fuel distributors to blend a certain minimum amount and the introduction of a monitoring and reporting scheme for advanced biomethane.

The updated NAPCM is also optimistic about the introduction of hydrogen-fuelled vehicles, but fails to explicitly mention that only low-carbon or carbon-free hydrogen would be used. The NAPCM aims to have over 118 200 hydrogen-fuelled vehicles in the country by 2030, which would result in 308 000 tonnes of avoided CO_2 emissions (EC, 2019). Hydrogen vehicles would benefit from the same measures as EVs, such as an exemption from parking fees and tolls on motorways and the use of preferential lanes. For this purpose, since April 2019, electric and hydrogen powered vehicles are issued with special registration plates.

Other measures to support renewables

The new Energy Act will establish a framework to support and facilitate the development of the renewable energy communities and to encourage energy self-consumption, through both legislative and non-legislative measures. Details have yet to be established, including a definition of energy and renewable energy communities. The transposition of the act is expected in 2021. This would be in response to the EU's Clean Energy Package, and especially the 2018 Renewable Energy Directive and the 2019 Internal Electricity Market Directive that the Czech Republic still needs to fully transpose into national law (Pappa and Vansintjan, 2021).

The government introduced dedicated investment support for renewable installations that serve more than one purpose into the draft act. For example, higher public funding will become available for small-scale rooftop solar PV installations that not only produce electricity, but also supply heat, as well as for solar PV systems that combine solar systems with battery energy storage, so-called hybrid systems.

The government is also contemplating the creation of an (unsubsidised) market for corporate renewable power purchase agreements to take advantage of the falling cost curves for certain renewable energy sources which bring them to parity with market prices (EC, 2019). This matter is being addressed in the revised Energy Act that is under consideration.

The policy focus is currently on exploring the potential of a relatively limited number of renewable energies, such as bioenergy and solar PV. In a welcome effort to broaden the renewable sources used in the country, the government has initiated measures for the economically efficient use of geothermal energy in the electricity and heating and cooling sectors. Geothermal electricity is currently not used in the Czech Republic. Several pilot projects are ongoing, but have not yet reached maturity.

Existing geothermal facilities used for heat generation receive operational support in the form of a fuel cost complement to maintain the plants' competitiveness and keep them in operation. Support for the creation of new geothermal plants will be available over a 20-year period under the green bonus scheme. Moreover, the government supports the creation of dedicated research infrastructure to strengthen the contribution of geothermal energy towards increasing the share of renewable heat (EC, 2019).

However, more could be done, and a good starting point would be for the government to undertake a comprehensive assessment of the full long-term potential of renewable energies in the country covering the technical, economic, social and public potential and their integration into the network infrastructure. Currently, such an assessment is undertaken by the Chapter of Renewables, a civil society group, and the Czech Academy of Science, while the government has not yet launched its own analysis. Having a clear view of the long-term potential and how to exploit this potential is also critical with a view to contribute to the EU's new climate ambitions (see Chapter 3).

Assessment

The Czech Republic has experienced significant growth in the renewable energy sector, with the share of renewables in TFEC increasing from 11% in 2010 to 16% in 2019. As the country's renewable energy targets are mainly driven by obligations under the EU's Renewable Energy Directive for the period to 2020, the country set itself a modest target rather than an ambitious one. The government set a target to achieve a renewables share in gross final consumption of 13% for 2020, which was already surpassed in 2013. As a result of this modest target, the country's shares of renewables in electricity and transport (12% and 5% respectively in 2019) rank among the lowest in the IEA.

The government expects a notable increase of renewable electricity production based on projections made for the NECP. In 2020, 10.3 TWh of electricity was generated using renewable energy sources. According to the government, up to 22 TWh of electricity from renewable sources can be integrated into the system without causing stability problems. By 2030, a total of 12.7 TWh of renewable electricity generation is expected to be fed into the electricity system. The IEA considers the 22 TWh limit to be a rather low projection, as the country is well interconnected with other countries and the interconnection rate is expected to further increase. The government should study examples of other IEA countries that have achieved a much higher penetration of variable renewables with considerably lower levels of interconnection capacity. The IEA also notes that the projections about the potential for growth of renewables included in the NECP and those made by the renewable industry are not in line with each other.

The Czech Republic operates several support schemes and measures to promote the development of renewable energy sources. Around CZK 43 billion has been paid annually for operational support of renewable energy sources since 2017, compared to the CZK 40 billion paid in 2016.

Preparation of support schemes for the period 2021-30 is ongoing. For this purpose, the government is proposing an amendment to Act No. 165/2012 that is designed to relaunch operational support for renewable energies except for solar PV, and other supported energy sources such as high-efficiency co-generation.

The legislative proposal has not yet been approved. There is hence a real danger that the delayed implementation of the new support scheme will leave the country exposed to the risk of low renewable energy investments over the next few years.

A key feature of the proposed legislation is to move away from feed-in-tariffs and to introduce competitive bidding and auctions for renewable power generators above 1 MW, and to offer green bonuses for units below 1 MW. The legislative amendment is also designed to broaden the focus to include renewables in heat generation.

With regards to providing investment support for renewable energies, the Czech Republic plans to tap into the various funds provided by the EU, such as the Modernisation Fund, the Just Transition Fund, and the Recovery and Resilience Facility.

In 2018, 92% of renewables in TFEC in the Czech Republic was produced from bioenergy, thanks to the wide availability of biomass. According to the government, the mid-term potential for renewables development also mainly relies on bioenergy. According to the NECP, bioenergy will account for two-thirds of the total renewable energies in 2030. The government should consider exploring the development of a wider variety of renewable sources and support related R&D programmes to identify their technical, economic and acceptance potential in order to reduce the reliance on any particular renewable source. The government should also consider that heavy investments in biomass-processing plants might affect the sustainability of wood production.

The Czech Republic had a 20.6% share of renewables in the heating and cooling sector in 2018. The governent expects the share to increase by 1 percentage point annually, to reach 30.7% by 2030, as the country has plans to phase out coal and convert heating plants to greener fuels in order to meet the EU emissions limits. The government should consider using the excess heat potential from industry to boost the share of renewables in heating and cooling.

The Czech Republic does not have a specific renewables target in the electricity sector, although there are projections in the NECP of 15.2% by 2025 and 17% by 2030. As end-use sectors such as transport, buildings and industry will likely electrify in the future, the government should consider setting a specific renewables target for the power sector to enlarge the emissions reduction benefits from such a shift.

The use of renewable and decarbonised gases in the Czech Republic is rather low. The government should prepare and initiate legislation for promoting higher shares of low-carbon fuels, renewable and decarbonised gases such as hydrogen, and synthetic methane and biomethane to achieve climate targets in a cost-effective way. A proper monitoring and reporting mechanism for bioenergy at large should be established so that the origin of these gases can be tracked.

The renewable energy target for the transport sector is 10.8% by 2020, up from a target of 6% in 2014. In 2019, according to the IEA definition, the share of renewables in transport was 5.3% (corresponding to 7.8% using the EU definition, because of multiplication factors for advanced biofuels and renewable electricity). The government has set a target of 14% of renewables in transport for 2030, with a minimum 3.5% of second-generation biofuels. However, considering that the country will likely not meet its 2020 target, it is necessary to prioritise and expedite the implementation of operational and investment support programmes focused on the transport sector, and the sector's transition toward electrification, in order to reach the target of 14% by 2030. The government plans to introduce a new support scheme for biomethane to ensure that it meets the renewable target in the transport sector.

Another challenge is the availability of second- and third-generation biofuels; a new support scheme can be either included in the amendment of Act 165/2012 or initiated as new legislation to be implemented after 2021.

Recommendations

The government of the Czech Republic should:

- Accelerate the approval procedure for the legislation to promote renewable energies (amendment to Act 165/2012) for the period after 2021, to avoid missing mid- and long-term decarbonisation goals.
- Prepare and initiate legislation for promoting renewable and low-carbon fuels that are not covered under Act 165/2012 to help achieve emissions reductions and climate targets in the most cost-effective way.
- Revisit the technical potential for the integration of variable renewable electricity into the system by studying best practice examples of countries that have already reached much higher shares of these renewables into their systems.
- Together with stakeholders, assess the full economic potential of all available forms of renewable energies and accordingly develop road maps to achieve those potentials to, in particular, prepare for the phase-out of coal power plants.

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6. Energy research, development and demonstration

Key data

Government energy RD&D budget (2019): CZK 2 953 million; USD 127 million

Energy RD&D of GDP (2019): 0.51 per 1 000 GDP units (IEA median:* 0.37).

Energy RD&D per capita (2019): 12.4 USD/capita (IEA median:* 17.0 USD/capita).

Exchange rates (2020):** Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* Median of 25 IEA member countries for which 2018 data are available.

** OFX (2021)

Overview

The Czech Republic aims to strengthen energy-related research, development and demonstration (RD&D) funding through the National Research, Development and Innovation Policy (NRDIP) and the State Energy Policy (SEP), though the country does not have a specific energy RD&D strategy. The main energy RD&D programme in the Czech Republic is the THÉTA Programme, which was approved in 2019 and is based on the SEP. The THÉTA Programme contributes to transforming the energy sector into a low-carbon economy (TACR, 2019). In particular, the Czech Republic places nuclear energy at the heart of its RD&D spending, ensuring the reliability and technological development of nuclear installations.

Public budget on energy RD&D

The Czech Republic has significantly increased public energy-related RD&D in the last decade. In 2019, its budget was CZK 2 953 million for public energy-related RD&D, a notable growth from CZK 1 100 million in 2009 (Figure 6.1).[1] The Czech Republic's energy-related RD&D funding fluctuated between CZK 1 100 million and CZK 1 500 million during the period 2009-14 and has increased since 2014 across all energy sectors. The steep increase in spending in 2019 relative to previous years was mostly driven by more significant spending in nuclear, energy systems analysis, power technologies including storage, and energy efficiency, and is largely related to the new THÉTA Programme (see

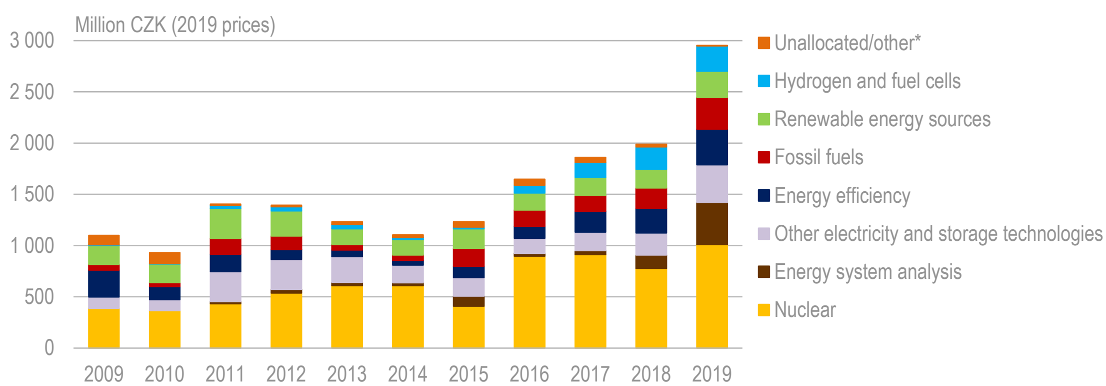
[1] More information on public spending on RD&D in the Czech Republic, including about the methodology applied, is provided on the Ministry of Industry and Trade's website at: https://www.mpo.cz/en.

below). This encouraging trend warrants further analysis and monitoring in the coming years to ensure the stability of available funds and avoid possible boom-and-bust cycles associated with volatile support for innovation. In terms of the allocation of energy RD&D funds, the share of public funds for energy efficiency and renewable energy remarkably decreased from 2009 to 2019, while the share for fossil fuels increased.

In 2019, nuclear energy received the largest share, at 34% of the total RD&D budget, consisting mostly of research in nuclear fusion (43% of nuclear research) and fission (41%). Energy system analysis received the second-largest share (14%), while electricity and storage technologies accounted for 12% of the total budget, mainly for electric power conversion and electricity transmission and distribution. Energy efficiency received only 12%, more than half of which was allocated to the industry sector. In particular, 28% of the RD&D budget in energy efficiency was spent on industrial equipment and systems, and 19% on industrial techniques and processes. IEA analysis shows that in order to achieve the climate targets, it is crucial to focus RD&D investments in hard-to-abate sectors, such as iron and steel and cement (IEA, 2020a).

Fossil fuels accounted for 10% of the total RD&D energy budget, and this was mainly used for the development of coal technologies. Only 10% of the fossil fuel budget (0.2% of the total energy RD&D budget) was allocated to carbon capture, and no funds are reported for research in CO_2 storage. Renewable energy RD&D received just 9% of the total public energy budget, of which 78% went to biofuels, mostly for solid biofuels production. The Czech Republic is also funding hydrogen by allocating 8% of the total energy-related RD&D budget.

Figure 6.1 Energy-related public RD&D budget in the Czech Republic by technology, 2009-19

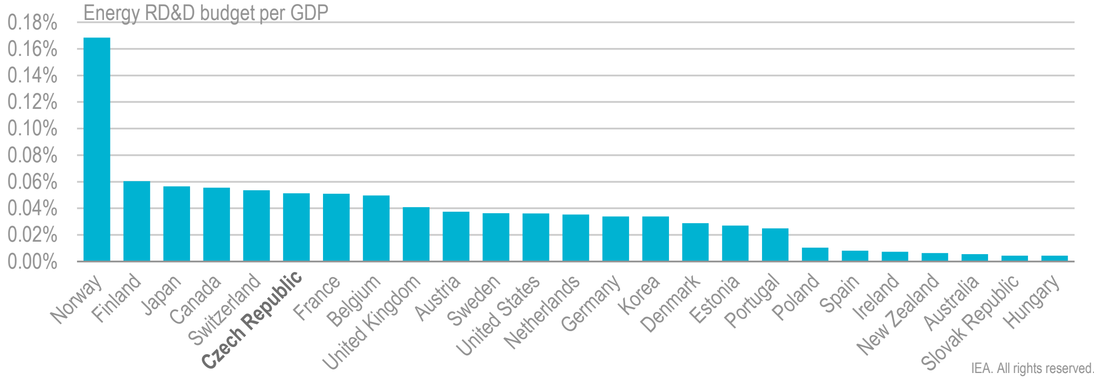


The Czech Republic has significantly increased its energy-related public RD&D budget during the last decade, with nuclear receiving the largest share.

* *Unallocated/other* includes basic energy research and unallocated energy RD&D budget.
Source: IEA (2021).

The Czech Republic spent 0.051% of its gross domestic product (GDP) in 2019 on energy-related RD&D, which was just above the IEA median of 0.037% (Figure 6.2). Expressed in absolute spending, the Czech Republic had the twelfth-lowest energy-related RD&D budget in an IEA comparison in 2019.

Figure 6.2 Energy-related public RD&D budget per GDP in IEA countries, 2019



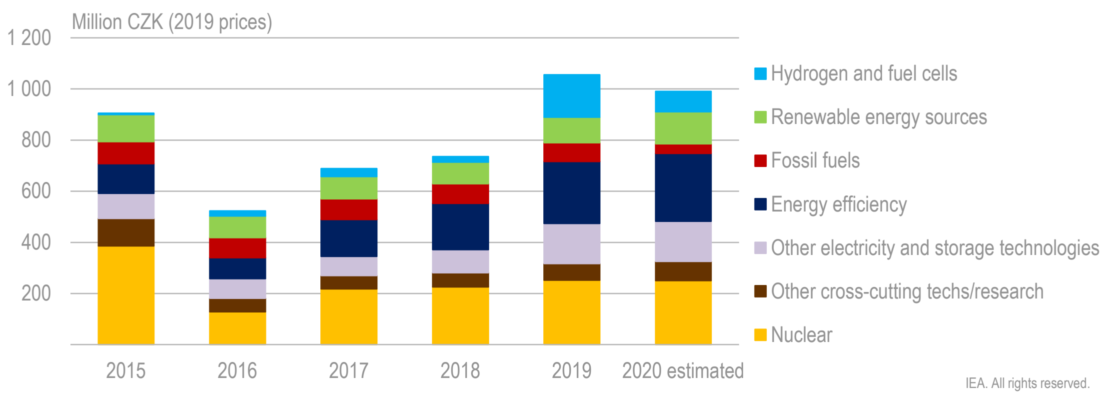
In 2019, the Czech Republic had the sixth-highest ranking in RD&D spending per unit of GDP, which was above the IEA median level.

Note: Data for Greece, Luxembourg, Italy and Turkey are not available.
Source: IEA (2021).

Private sector RD&D funding

The most recent data submission from the Ministry of Industry and Trade to the IEA for the first time also includes information on private energy-related RD&D spending that is connected to public spending through, for example, joint ventures or co-financing. According to these data, the private sector invested CZK 1 056 million in energy-related RD&D in 2019 and an estimated CZK 911 million in 2020. In 2020, about half of total investments were focused on energy efficiency (27%) and nuclear (25%, mainly nuclear fission), followed by other power and storage technologies (16%), and renewable energy sources (13%). Hydrogen and fuel cells received significant funding, especially in 2019 (CZK 166 million), when it accounted for 16% of total private spending in energy-related RD&D.

Figure 6.3 Energy-related private RD&D spending in the Czech Republic by technology, 2015-20



Private funding in energy RD&D was about CZK 1 billion in 2019 and 2020, with nuclear and energy efficiency covering half of the total.

Source: IEA (2021).

Research, development and innovation strategy and policy framework

The Czech Republic embeds energy research, development and innovation (RD&I) strategy guidelines and priorities in other strategic and policy documents, such as the SEP; the National Research Development and Innovation Policy (NRDIP) 2016-2020 and its update for 2019-20; the Innovation Strategy 2019-2030; and the National Priorities for Oriented Research, Experimental Development and Innovation of 2012, which laid out the overall National Priorities until 2030.

Energy RD&I is one of the SEP's five strategic priorities, aiming to ensure the competitiveness of the Czech energy industry. The government has established a new programme for applied research in the energy sector, the THÉTA Programme (see below) (MIT, 2015).

The NRDIP guides overall RD&I in the Czech Republic and provides the framework for the preparation of sector-specific RD&I policy developments. It pays special attention to applied research that supports the public administration and contributes to the overall economic development of the country.

The National Priorities for Oriented Research, Experimental Development and Innovation is the pendant to the NRDIP for experimental research. It sets out six priority areas with 24 sub-areas. Energy is the second priority, specifically the "sustainability of energetics and material base", which is further divided into three sub-areas: 1) sustainable energetics; 2) lowering the energetic demands of the economy; and 3) material base. Those 3 sub-areas are further divided into 35 targets that include, among others: nuclear energy, fossil fuels and renewables, but also enhancing energy efficiency, district heating and cooling, and strengthening of the power system. Moreover, energy-related RD&I is included in several of the other priority areas, for example for sustainable transport and strengthening the security of production processes. The National Priorities document also allocates the public RD&I budget to the priority areas.

The National Energy and Climate Plan of 2019 also includes a chapter on RD&I that links back to the other strategic documents discussed above and to the National Research and Innovation Strategy for Smart Specialisation (RIS3) of 2019. The preparation of an RIS3 is an obligation for EU member states and a precondition to be eligible for funding from the European Structural and Investment Funds (EC, 2019).

The two overarching objectives of the Czech Republic's energy RD&I are the promotion of sustainable energy and the reduction of the energy intensity of the economy. Projects listed under the priority of developing sustainable energy include the development of renewable energy sources, electricity networks including energy storage, heat generation, increasing the share of liquid biofuels, hydrogen and cleaner use of fossil fuels. Research in nuclear energy is also a core priority, with a focus on the nuclear fuel cycle, the radioactive cycle, and fourth-generation advanced systems and nuclear reactors. Under the objective "reducing the energy intensity of the economy", research focuses on maintaining the current rate of improvement of the energy intensity of the economy and fostering less resource-intensive means of production.

The Czech Republic's energy RD&I covers a rather broad range of topics and has notably diversified towards programmes that support the energy transition. However, the allocation of public funding is still heavily focused on nuclear research and fossil fuels. While the country clearly has a significant and accomplished research community in this area, it will be important to ensure that the new priorities identified in the THÉTA Programme and the RIS3 strategy, among others, are equally well-funded and supported. Only 18% of the total public RD&I budget is allocated to low-carbon energy and material resources.

Institutionally, research policy is covered by both the Ministry of Education, Youth and Sports, for overall RD&I, and the Ministry of Industry and Trade (MIT), for energy and industrial RD&I priorities. The Research and Development Council formulates the national RD&I policy and is responsible for the implementation of this policy. It also monitors and evaluates research organisations, prepares an annual analysis, and participates in the approval process of new support schemes and programmes. The findings of its evaluations feed back into updating national RD&I priorities.

Basic research is carried out by the Czech Academy of Sciences and the Grant Agency of the Czech Republic. The Technology Agency of the Czech Republic prepares and implements government-funded programmes for applied research and innovation in co-operation with central government bodies.

Selected policies and programmes

The Czech Republic is implementing a large number of research programmes in the energy sector. This section presents a selection of energy RD&I programmes that were launched since the IEA's last in-depth review in more detail.

The THÉTA Programme

An important development is the launch of the THÉTA Programme in December 2016 as the core programme for applied research in the energy sector. THÉTA represents one of the five strategic priorities of the SEP and is also designed as one of the national instruments for addressing the fifth pillar of the European Energy Union, namely RD&I. It also reflects a recommendation of the IEA's last in-depth review to define clear priorities for energy technology RD&I alongside a stable funding mechanism. The THÉTA Programme combines top-down and bottom-up approaches and focuses on projects that have a high potential for application in a number of different aspects of the country's public life. An innovative feature is the inclusion of energy policy research, social science and humanity in the range of projects that are eligible for funding, though their share remains small compared to other areas, such as nuclear research (TACR, 2019).

The THÉTA Programme is administered by the Technology Agency of the Czech Republic, while the MIT is in charge of the technical aspects of the programme. The THÉTA Programme is divided into three sub-programmes: 1) research in the public interest; 2) strategic energy technologies; and 3) long-term technological perspectives.

Research in the public interest

This sub-programme aims to improve the decision making and governance of public administrations in the energy sector, including MIT and the Energy Regulatory Office (ERU), through research that provides outcomes such as tools, methodologies, and strategic and conceptual documents. RD&I projects that target reliability and technological development of nuclear facilities, energy markets and regulation, and the transformation of the energy sector (smart grids and the use of flexibility for enhanced system control in the power sector) are eligible to apply. Fifteen per cent of the total programme budget is allocated for this sub-programme.

Strategic energy technologies

This sub-programme supports RD&I for technologies and systems with high potential for future commercialisation that could increase the competitiveness of the Czech economy and have strong export potential as well as contribute to environmental protection. The private sector plays a crucial role in this sub-programme, as supported projects should have potential for future commercialisation (implementation within three years from the completion of the project). RD&I projects that target, for example, new technologies for safe and reliable long-term operations of nuclear resources, more efficient use of biomass or electricity storage technologies are eligible to apply. Half of the total programme budget is allocated for this sub-programme.

Long-term technological perspectives

This sub-programme contributes to the long-term strategic objective of the transformation and modernisation of the Czech energy sector, with a special focus on system energy solutions. The programme targets research organisations and, ideally, the supported projects would combine basic and applied R&D activities. This sub-programme supports, among others, R&D activities in the field of reliability and technological development of nuclear facilities, accumulation of electricity and heat, renewables, and hydrogen and fuel cells. Just over a third (35%) of the total programme budget is allocated to this sub-programme.

The THÉTA Programme covers the period 2018-25 and has a total public budget of CZK 4 billion to provide a stable funding framework. In addition, the government expects private sector co-funding of CZK 1.8 billion, bringing the total budget to CZK 5.8 billion.

By the end of 2020, three tenders had been completed; one each in 2017, 2018 and 2019, that were open for applications from both research institutions and private enterprises. The co-funding share was 26% in the first tender, 24% in the second and 30% in the third. By November 2020, the government had committed a total of CZK 2.47 billion for over 140 projects from which 30 businesses and 47 research organisations benefited.

A total of five tenders will be called during the current programming period and the call for project proposals under the fourth tender closed on 12 May 2021. The assessment of the proposals will be completed before the end of 2021. The fifth tender will be announced in the first half of 2022. The government has initiated work on the design of THÉTA II. An initial meeting was held with high-level officials from the concerned institutions, including the Deputy Minister of the MIT and the Chairman of the Technology Agency of the Czech Republic. Options include linking the RI3 strategy with the THÉTA II Programme. The first public tender under THÉTA II would be in 2023.

National competence centres

The ongoing successful competence centre programme dates back to 2011 and aims to support the establishment and activities of centres for R&D and innovation in economic sectors with high innovative potential to improve the competiveness of the Czech Republic.

The programme covers the entire economy, including the energy sector. Five competence centres were established in the energy sector, two of which have a focus on nuclear.

However, the government noted that there was room to improve synergies between the different competence centres within a sector, by bringing them into one integrated system and linking them to operational programmes and other research units within one research area.

The government hopes to achieve this through the newly established National Competence Centre (NCC) programme that was approved in 2019. The aim of the NCC is to support the building of a stable and long-term base for applied research, to significantly strengthen those research organisations focused on applied research, and to concentrate existing capacities in the NCCs. One of the newly established NCCs is dedicated to energy, with the objective to leverage synergies and complement work under the EU programmes Horizon 2020 and its successor Horizon Europe, and other international RD&I co-operation in the energy sector.

Energy Regulatory Office's RD&I involvement

The ERU considers RD&I an important contribution for supporting an equitable and efficient energy transition. Outcomes of RD&I undertaken by the ERU are used to set new rules and regulations and price methodologies for the functioning of the fast-evolving power and gas sectors. In this regard, the ERU has identified five priorities for RD&I that address important aspects of energy system functioning and emerging issues. They are:

(i) regulatory framework: technological, financial and legislative analysis of power sector functioning and regulatory framework

(ii) tariff system innovation: addressing price setting, regulation and dynamic tariffication issues

(iii) smart metering/advanced metering management: effects on customers and prices, potential for the internal energy market, encouraging active customer engagement and cybersecurity effects of smart metering

(iv) local energy entities: approaches for local and community energy engineering at the levels of renewable energy sources communities, at the municipal and national levels, including legislative, technical, financial, development and data support

(v) developing software tools: technologies for supporting the activities of market regulation and monitoring, including statistical and regulatory reporting, price and market monitoring.

The ERU undertakes these research activities through ongoing RD&I programmes such as the THÉTA Programme and Horizon 2020. While the ERU is an observer to some projects, it is also taking the lead in research projects that focus on new regulatory methodologies in line with the demand for more decentralised power and gas sectors, solutions for processing, analyses and assessments of statistical data, and the evaluation of investments efficiency in regulated energy sectors.

Monitoring and evaluation

The Research and Development Council is responsible for the overall evaluation of RD&I projects funded by the public sector. The council has created a methodology for evaluating results obtained by the various research organisations and of completed programmes. The council applies a number of indicators to ensure that the funded projects and programmes are aligned with the national research priorities. The outcome of the monitoring and evaluation feeds back into updating the National Priorities of Oriented Research, Experimental Development and Innovation.

Monitoring and evaluation of outcomes currently takes mainly place at the level of individual programmes and, consequently, there are still different methodological approaches and processes in use. The government thus lacks a common basis on which to assess whether it is obtaining the expected outcomes of investment spending in a particular RD&I area, including for energy.

The ongoing debate about creating a new legal and institutional framework for RD&I is welcome, in particular the discussion about a comprehensive overhaul of the evaluation process. This would include the introduction of project efficiency measures as already used in other European countries, which are seen as best practice examples. In this respect, a white paper of a proposed new law was completed and opened for public discussion. It should be noted that this initiative goes beyond the energy sector and includes other RD&I sectors. The government is encouraged to bring this discussion to a swift conclusion as it predates the last IEA in-depth review of 2016.

A more streamlined RD&D evaluation process would also allow the government to link the outcomes of funded projects to future RD&D planning and design, which would further enhance value for money. The last IEA review in 2016 also recommended that the government develop a monitoring and evaluation mechanism based on the evaluation of international research infrastructures models.

International co-operation

Since the last IEA review, the Czech Republic has joined two more IEA Technology Collaboration Programmes (TCP): the Energy Storage TCP in March 2021 and the Gender in Energy Programme in August 2018. In addition, the country also participates in the Energy in Buildings and Communities TCP and the Fluidised Bed Conversion TCP.

On 2 October 2018, the Czech government organised a TCP National Coordination Day, in co-operation with the Technology Platform for Sustainable Energy. The objective of the event was to share practical information about the TCPs. Representatives of the IEA Secretariat and of seven TCPs participated.

The IEA’s TCPs cover a wide range of research areas, such as hydrogen; renewable energies; system integration; smart grids; district heating and cooling; carbon capture, utlisation and storage; and carbon recycling, which are priorities for the Czech energy research policy. Greater participation in the TCPs could support the country’s energy transition.

The 2018 event identified four key barriers to participation in the TCPs:

(i) Lack of general information about the TCPs, especially for potential non-government participants: the diversity of the TCPs in terms of structure, cost and task sharing requires an interested party to contact each TCP individually to obtain complete information.

(ii) Transaction costs: in particular, travel costs that are sometimes hard to justify.

(iii) Cost of participation: the joining fees of some TCPs are considered high, while interested parties face difficulties assessing if the value added of the outcomes justifies the costs.

(iv) Lack of visible results: potential members from the private sector are not motivated by the benefits of knowledge sharing only, but require visible results to justify membership. This could be overcome by enhanced information sharing.

It would be worthwhile for the Czech Republic to revisit the possibilities to join more TCPs; perhaps contacting the executive committees of the relevant TCPs directly. To facilitate the process, the government could make use of the dedicated staff at the IEA Secretariat and leverage its participation in the IEA's Committee on Energy Research and Technology to reach out to those TCPs that are of particular interest.

The transaction cost barrier is likely to be lower now than in 2018, as the TCPs have strengthened their online presence and interaction. Moreover, the government may wish to compare the relative costs and transaction costs of the IEA TCPs with the budgets allocated to, for example, bilateral co-operation.

The Czech Republic is more involved in co-operation at the European level and is actively engaged in the EU's Horizon 2020 programme, the European Strategic Energy Technology Plan and the European Energy Research Alliance. However, there is also room for further engagement at the European level, especially in emerging priority research areas such as geothermal energy.

A notable feature is the country's regional energy RD&I co-operation through the Visegrád group (V4).[2] In 2019, the Czech Republic and Hungary initiated the creation of a V4 platform for energy research. While the RD&I priorities have not yet been finally decided upon, they are likely to include smart grids, energy storage, energy efficiency and nuclear. The Czech Republic and Hungary are also planning to establish a special joint Innovation Platform to co-ordinate and eventually launch joint activities for energy innovation and technology development.

The Czech Republic is not a member in the Clean Energy Ministerial or of Mission Innovation.

[2] The Visegrád group (V4) includes the four Central European countries, namely the Czech Republic, Hungary, Poland and the Slovak Republic.

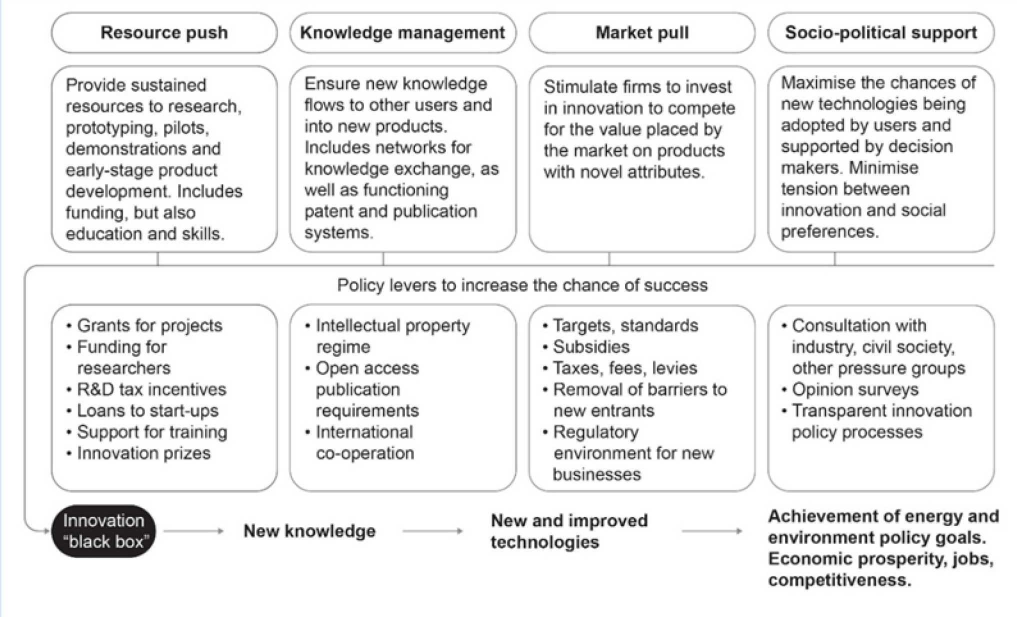
The IEA has undertaken analysis to identify the characteristics of successful innovation systems and has developed a four-pillar approach (Box 6.1). The four-pillar approach makes the important point that there are many things governments can potentially do beyond R&D funding for energy innovation. These include strengthening the academic system and promoting energy and scientific tracks; bringing academia, research institutes and private sector actors together and fostering collaboration; streamlining processes for creating start-ups and putting in place incentives for clean energy entrepreneurs; engaging in international collaboration to share the costs of energy R&D; and adapting infrastructure development plans so that they enable the diffusion of emerging technologies (IEA, 2020a).

Box 6.1 A four-pillar approach to successful energy innovation systems

Recent IEA work offers a four-pillar approach aimed to support government efforts in assessing the effectiveness of national innovation systems. Innovation processes are complex and may be influenced by a broad variety of factors, such as policy action, sectoral spill-overs, macroeconomic fundamentals, the domestic "ease of doing innovation" or regional specificities. Designing a successful technology innovation ecosystem requires several components, including, but not limited to, public funding for energy research, development and demonstration (RD&D). As new innovation strategies are being implemented, decision makers may benefit from taking a systemic approach to energy innovation policy making, and should ideally aim to cover all four of the following core functions of innovation systems (Figure 6.4):

- **Resource push:** A sustained flow of R&D funding, a skilled workforce (e.g. researchers and engineers) and research infrastructure (laboratories, research institutes and universities) is required. These resources can come from private, public or even charitable sources, and can be directed to specific problems or basic research.
- **Knowledge management:** Knowledge should flow smoothly between researchers, academia, companies, policy makers and international partners, among others.
- **Market pull:** The expected market value of new products or services must be big enough to make the R&D risks worthwhile, and this is often a function of market rules and incentives established by legislation. If the market incentives are high, then much of the risk of developing a new idea can be borne by the private sector.
- **Socio-political support:** There needs to be broad socio-political support for new products or services, despite potential opposition from those whose interests might be threatened.

Figure 6.4 The IEA's four functions of a successful innovation ecosystem for energy



Source: IEA (2020b).

Assessment

RD&D in the Czech Republic has advanced under the National Research, Development and Innovation Policy as well as the SEP, both of which enable increased support for RD&I across the energy sector.

Public spending in energy-related RD&D has significantly increased, from CZK 1 100 million in 2009 to CZK 2 953 million in 2019. With 0.036% of GDP dedicated to energy-related public RD&D investment in 2018, the Czech Republic had the tenth-highest spending in the IEA. Public investment in energy research has been focused on nuclear energy, with spending ranging from one-third to one-half of the total over the last decade.

Investments in RD&D for renewable technologies accounted for about 20% until 2012, but have since been around only 10% of total energy-related spending.

The MIT is to be praised for its recent work of assessing the information from across research project databases to track public energy technology RD&D budgets. The same holds for the data submission to the IEA in late 2020, with data covering public research and the share of private expenditure co-financed through public support. The government is encouraged to track all private funding for RD&D, continue assessing what metrics best support innovation policy and implement relevant tracking. The IEA encourages the government to make publicly available, perhaps in an annual report, how these data are collected, for example by surveying energy companies, which would be an IEA best practice example.

While the key strategic policies are developed at the national level, specifically those for RD&I, there is no dedicated ministry for RD&D. The main co-ordinating body is the Research and Development Council, while the Ministry of Education, Youth and Sports is responsible for international co-operation in RD&D, and the Ministry of Industry and Trade for energy-related RD&D. A government advisory body, the Research and Development Council, is responsible for the preparation and implementation of national RD&D policy. Given the dispersed responsibilities, it is important that the different ministries and public agencies mandated with energy R&D and innovation activities align strategic priorities, and share resources and outcomes of their respective activities.

Based on the long-term energy goals of the SEP, in particular the THÉTA Programme was established to promote applied research in the energy sector, and to help enshrine RD&D as a core part of the Czech Republic's energy policy. This is an effective way to align innovation activities with long-term energy goals, and codifies a vehicle to provide stable funding for continued research on topics relevant for the energy sector, and that can catalyse growth and competitiveness across the economy.

Moreover, the THÉTA's sub-programmes are good examples of how strengthening the engagement of private sector actors in energy innovation allows tapping into a greater pool of resources and talents, leveraging constrained public funds, and increasing the chances of bringing new ideas and concepts to markets. The government could consider using a similar approach for other programmes as well.

The ambitions of the SEP highlight the need to increase the level of funding available for RD&D in both the energy sector and in engineering and advanced manufacturing, including targeted RD&D funding to spur new industries. The main funding source for this would be the state budget. However, the budget has no specific byline dedicated to energy research.

Positively, the new THÉTA Programme has led to an overall increase of public funding for energy-related RD&D, and serves as the main instrument of support for applied research. A critical element of the programme is to preferably support projects that have significant "application" for the Czech business community, through dedicated schemes to support energy innovation by small and medium-sized enterprises and start-ups, which could help bring new ideas, concepts and technologies to markets to enable clean energy transitions.

Due to the wide range of actors in the RD&I field in the Czech Republic, there is a need to clearly allocate responsibility for co-ordinating policy in the field of technology RD&D. This should also ensure that the energy community plays an active role, including academia, non-governmental organisations, small and medium-sized enterprises, and innovative start-ups, bringing all pertinent actors into a collaborative "regulatory sandbox".

A multi-stakeholder process could allow the Czech Republic to set clear priorities for energy technology RD&D in emerging areas for the energy transition. The current RD&D funding track involves a high share of research related to nuclear technology. But there is a clear opportunity to have a national system of innovation predicated on RD&D in a range of other energy sources and types, especially low-carbon technologies, but also including advances in cleaner fossil fuel applications, which are still a significant building block of the energy mix in the Czech Republic.

The noteworthy projects under the THÉTA umbrella show the full range of these technologies, and demonstrate the relative state of development between low-carbon

RD&D topics (including nuclear) and fossil fuels. These projects could be better expressed to international audiences through more robust descriptions of their outputs to date and/or their expected outputs. More diversified RD&D would not only contribute to building up the technological capacity for greater diversity in domestic energy technology options, it would also enable taking account of advanced energy technologies in research for energy market design.

There is also an opportunity to increase collaboration at the international level on projects that can be critical for RD&D. The Czech Republic could participate in more EU R&D programmes beyond nuclear, and in more IEA TCPs than the current four. The Czech Republic could strengthen its engagement in TCPs to share best practices in additional areas of RD&D and benefit both from international knowledge and greater private sector awareness of potential regional and global supply chains. Taking part in the TCPs and other international partnerships for energy innovation could decrease the costs of technology development through knowledge sharing and collaborative R&D on priority technology areas. This could be particularly beneficial to lower the high transaction costs of international co-operation for innovative small and medium-sized enterprises and provide them with greater opportunities to cross the “valley of death” and reach commercial deployment and accelerate market uptake.

Finally, in order to ensure that policy decisions are delivering quantifiable results, the Czech Republic could consider strengthening the existing monitoring and evaluation framework by making it more uniform and bringing it in line with international best practices for independent evaluation of the pertinent research infrastructures models. Currently, monitoring and evaluation is not uniform nationally, and there can be differences in the framework, thus objective comparison and analysis between the programmes is lacking. An independent evaluation would streamline data collection, facilitate greater international collaboration and bring transparency, which could, in turn, attract increased private sector finance or project support.

Government-funded RD&D can spur new industries, drive innovation and provide the country with outputs that support the public good. However, to move from RD&D to the critical stage of technology deployment, it is imperative to help better position promising small and medium-sized enterprises in global supply chains and regional and global marketplaces. There are some international examples that the Czech Republic can follow to move from the laboratory to the market.

Recommendations

The government of the Czech Republic should:

- Develop a clear road map that would make RD&D a core pillar of its energy policy making and align it with long-term energy and climate goals.
- Clearly communicate firm and stable budget commitments and programme support to align innovation activities with long-term energy goals and to ensure smooth innovation processes.
- Pursue the harmonisation of a monitoring and evaluation framework across the range of RD&D projects, learning from international good practice approaches and with the view to feed back into priority setting.
- Expand the ecosystem for RD&D programmatic engagement for energy technologies beyond nuclear energy.
- Increase participation in international research collaboration fora such as the IEA Technology Collaboration Programmes and the EU R&D programmes, particularly in areas where the Czech Republic already has domestic RD&D activities, especially in renewable technologies, including geothermal.
- Integrate the energy technology RD&D data collection within the regular annual statistical activities and complete its coverage. Expand efforts to collect data related to private sector energy R&D and share methodologies and knowledge with international peers.

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7. Electricity

Key data (2019/20)

Electricity generation (2020): 80.1 TWh (coal 40.8%, nuclear 37.5%, natural gas 8.5%, bioenergy and waste 6.5%, solar 2.8%, hydro 2.7%, wind 0.9%, oil 0.1%), +5% in 2009-19, -7% in 2019-20.

Electricity net export (2019): 13.1 TWh (imports 11.0 TWh, exports 24.1 TWh).

Electricity consumption (2019): 60.1 TWh (industry 46%, service sector buildings 28%, residential buildings 26%, transport 3%).

Exchange rates (2020):* Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* OFX (2021)

Overview

According to generation adequacy modelling of the Czech transmission system operator (TSO) ČEPS, the Czech Republic will likely become a net importer of electricity by 2030 due to the continuous phase-out of coal-fired power generation and the absence of planned new large capacity additions. The government needs to accelerate the creation of a more enabling and supportive market framework for renewable generation capacity, distributed generation and storage options to ensure security of supply.

Coal and nuclear power generation dominate the electricity supply in the Czech Republic, accounting for 78% of total electricity generation in 2020. Variable electricity sources accounted for less than 5% of generation. The Czech Republic is a net exporter of electricity, trading with all of its neighbouring countries, namely Austria, Germany, Poland and the Slovak Republic.

Electricity supply and demand

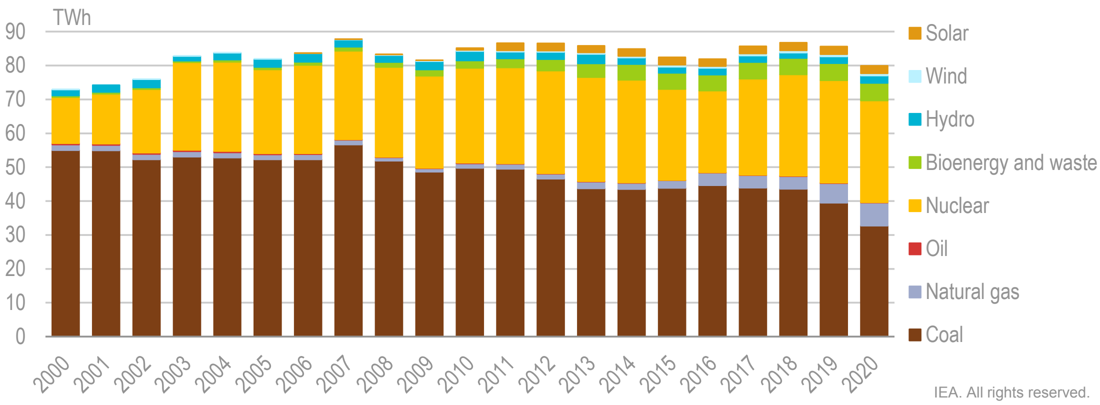
Electricity installed capacity

From 2009 to 2019, the installed generation capacity in the Czech Republic increased from 18.3 gigawatts (GW) to 22 GW, driven mainly by growth in the capacity of natural gas, solar photovoltaics (PV) and nuclear. Over the same period, the capacity of coal-fired generation remained stable. However, coal represents by far the largest share of installed capacity (49% in 2019), followed by nuclear (20%), natural gas (10%) and hydro (10%). Notably, since 2009, generation capacity of solar PV increased more than fourfold to 2019 (from 0.5 GW to 2.1 GW), and its share increased from 3% to 10% over the same period, which is the fastest growth rate of all types of generation (ERU, 2019). However, most of this growth took place from 2009 to 2011; since then, only a small capacity increase has been achieved.

Electricity generation

Between 2009 and 2019, the Czech Republic's electricity generation has only marginally increased, fluctuatating between 80 terawatt hours (TWh) and 90 TWh, with total generation at 85.8 TWh in 2019 (Figure 7.1). In 2020, Covid-19 led to a decrease of electricity generation to 80 TWh (-7% in one year). Coal and nuclear dominate the electricity generation mix in the Czech Republic. In 2020, coal-fired generation was 32.7 TWh; a 34% decrease compared to 2010. Coal-fired generation dropped by 6.8 TWh (-17%) from 2019, but had already decreased by 10 TWh between 2010 and 2019). Nuclear generation increased from 28 TWh in 2010 to 30 TWh in 2020. Renewables have increased by 74% between 2010 and 2020 (from 5.9 TWh in 2010 to 10.3 TWh in 2020), driven mainly by bioenergy, which grew from 2.2 TWh in 2010 to 5.2 TWh in 2020, and solar power, which grew from 0.6 TWh to 2.2 TWh in the same period.

Figure 7.1 Electricity generation in the Czech Republic by source, 2000-20



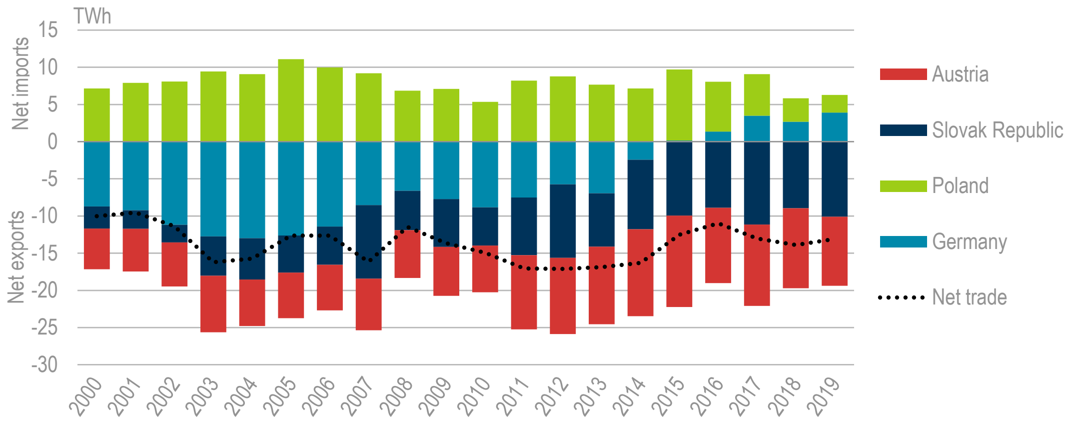
Total electricity generation increased slowly to 2019, with a significant decrease in coal-fired generation. In 2020, electricity generation dropped by 7% due to Covid-19.

* Wind and oil may not be visible on this scale.

Source: IEA (2021a).

The Czech Republic is a net exporter of electricity and trades with all of its neighbouring countries. Electricity exports reached 24.1 TWh in 2019 (Figure 7.2). Net exports were 13.1 TWh in 2019, down from their peak of 17.1 TWh in 2012. Net exports to the Slovak Republic were 10.1 TWh and to Austria 9.3 TWh in 2019. The Czech Republic is a net importer with Germany and Poland.

Figure 7.2 The Czech Republic's electricity imports and exports, 2000-19



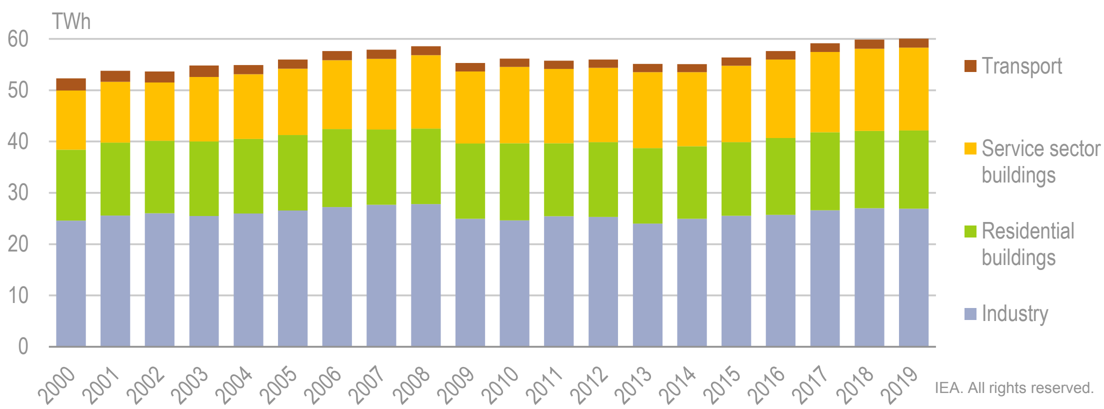
The Czech Republic is a net exporter of electricity and trades with all of its neighbouring countries.

Note: The graph only shows net trade, not overall imports and overall exports.
Source: IEA (2021a).

Electricity consumption

Electricity consumption reached 60.1 TWh in 2019, a 9% increase from 2009 (Figure 7.3). Electricity demand increased in all sectors between 2009 and 2019. In 2019, the industry sector was the largest consuming sector with 26.9 TWh (46%), followed by service sector buildings at 16.1 TWh (28%), residential buildings at 15.3 TWh (26%) and transport at 1.8 TWh (3%).

Figure 7.3 Electricity demand in the Czech Republic by sector, 2000-19



Shares of electricity consumption by sector have remained relatively stable.

Source: IEA (2021a).

Electricity outlook

Looking forward, the biggest challenge for the Czech electricity sector over the coming decades is to accommodate the phase-out of coal-fired generation while ensuring security of supply. The State Energy Policy (SEP) of 2015 has set target corridors for each generation source for 2040. According to the SEP the share of coal in gross electricity generation will more than halve, to 11-21% in 2040. In 2019, coal accounted for 46% of generation. Nuclear will largely replace coal and the share of nuclear electricity generation will reach 46-58% in 2040 (MIT, 2015). For this, the government plans to add 1 200 megawatts (MW) of nuclear capacity by 2036 (see Chapter 8).

The share of renewable electricity will not exceed a quarter of total generation by 2040, staying in the target corridor from 18% to 25%. This relatively low ambition for renewable generation is not in alignment with the new EU climate targets for 2030 and 2050 (see Chapter 3). Gas-fired generation would continue to be of only limited significance, not exceeding 15%, but could decline below its current share of just under 7%. The National Energy and Climate Plan (NECP) broadly confirms the target corridors for electricity generation by source of the SEP (EC, 2019). Under both scenarios, fossil fuels will still account for a significant share of electricity generation, between 16% and 36%.

The government established the national Coal Commission in July 2019 to assess the long-term role of coal in the electricity mix. The government set two constraints related to self-sufficiency and energy security: 1) to maintain 90% self-sufficiency of annual domestic electricity consumption; and 2) limiting electricity imports to a 10% maximum in any given year. This condition was set in accordance with the 2015 SEP that is currently under review (see Chapter 2). The loss of load expectation should not exceed the value of eight hours per year.

In December 2020, the Coal Commission recommended phasing out coal by 2038. In May 2021, the government asked the Coal Commission to reassess the possibility of an earlier exit as well as the impact on the Czech energy market. If the government confirms a phase-out date in 2038, in the conceptual scenario, coal would be replaced largely by natural gas, which would reach a share of 21% of total generation, and see its capacity increase by 1 500 MW.

The share of renewable sources would stay at around 25% of total generation, which is in line with the upper target corridor set in the SEP for 2040 and just marginally more than the 22% target in the NECP for 2030 (MIT, 2015; EC, 2019). Nuclear capacity would become the single largest generation source, after reaching 5 GW of installed capacity, which is consistent with current plans to build an additional 1.2 GW of capacity.

If the government were to decide to phase out coal by 2033, the earliest date discussed by the Coal Commission, the share of gas in total generation would reach almost 27% in the conceptual scenario and the share of renewables 28%.

However, external factors, mainly the CO_2 price under the European Union's (EU) Emissions Trading System (ETS) and the strict emissions limits set by the EU for power plants after 2021, may force an earlier exit of coal from the Czech Republic's electricity mix (see Chapters 3 and 9). ETS prices topped EUR 50/t CO_2 (tonnes of carbon dioxide) for the first time in May 2021 and the European Commission (EC) is finalising legislation to align the current ETS with the new climate goals for 2030, which will likely result in an additional sharp increase of ETS prices and rendering coal-fired generation less and less competitive (Watson, 2021). It should be noted that natural gas-fired capacity is also covered by the ETS, and its economic viability will also be impacted by the future trajectory of the ETS prices.

Generation adequacy

In its latest generation adequacy report, the ČEPS demonstrates that the Czech Republic will be dependent on electricity imports in 2030 in either of the three scenarios modelled. Moreover, under each of the three scenarios, the loss of load expectations would raise concerns for security of supply (ČEPS, 2019).

The major differences in the three scenarios modelled relate to the degree of reduced coal, natural gas and nuclear generation in the period to 2030, while the growth rate of solar PV, wind and other non-fossil fuel generation are the same across the three models. Moreover, the three scenarios reflect the absence of large capacity addition under preparation that could become operational before 2030 (ČEPS, 2019). In fact, the ČEPS specifically highlights that any new capacity addition to 2030 would most likely only come from decentralised facilities, or renewable sources that would be connected to the transmission system (ČEPS, 2019).

Coal-fired generation will continuously decline due to increasing ETS prices, as prices above EUR 30 per allowance will have a significant impact on the profitability of lignite power plants. Also, the new emissions limits for combustion power plants under EU regulations that become effective in 2021, and which will likely be further strengthened around 2028/29, will further reduce the economic rational and financial viability of coal-fired generation.

The ČEPS' base case scenario sees coal-fired generation declining from 39.5 gigawatt hours (GWh) in 2019 to 27.3 TWh in 2030, as about 4 GW of coal-fired generation will reach the end of its life cycle by 2026. Moreover, gas-fired generation would decline by more than half, from 5.7 TWh to 2.5 TWh. In the sensitivity I scenario, coal-fired generation will further drop to 24.4 TWh by 2030, as the new emissions regulations will render technological upgrading uneconomical for older plants. Gas-fired generation would be higher than in the base case scenario, but would still be substantially lower than in 2019. In the sensitivity II scenario, nuclear generation will decline between 2025 and 2030 due to possible simultaneous overhauls between 2025 and 2030. This could result in a possible 7.4 TWh reduction of generation (ČEPS, 2019). This sensitivity scenario sees coal-fired generation compensating for nuclear, as the shortage of electricity generation would be so significant that it could become economical for coal-fired generation to stay in operation.

Consequently, the country's role as a net exporter of electricity is slowly declining. By 2025, net electricity exports in the base case scenario would be 1.8 TWh, compared 13.1 TWh in 2019, and by 2030 the Czech Republic would become a net importer of electricity. Under the two sensitivity scenarios, the country would already become a net importer by 2025 (ČEPS, 2019).

For the analysis of required availability of reserve capacity, the ČEPS applied the N-1 criterion, i.e. the availability of reserve capacity to cover the outage of the largest generation unit in the system, and found that the loss of load expectation would be 42 hours on average in the base case scenario in 2025 and increase to 256 hours on average by 2030. The corresponding values for the energy not supplied are 11.7 GWh for 2025 and 122 GWh for 2030. Those values would increase considerably in both sensitivity scenarios (ČEPS, 2019). The values are significantly above the eight-hour target set by the government for the deliberations of the Coal Commission and require urgent measures to secure the country's power balance (ČEPS, 2019). Higher than already assumed imports are not considered feasible, based on the existing and expected generation situation in neighbouring countries, according to the TSO.

In May 2021, the government decided to update the 2015 SEP by the end of 2023. This offers an ideal opportunity to undertake a detailed technical and economic assessment of the roles the different sources of electricity can play in the future generation mix. Given the EU's enhanced climate ambitions, to which the Czech Republic needs to contribute, a thorough analysis of the decarbonisation options of the electricity sector is advisable. This would also provide certainty to investors who may be hesitant to invest in the absence of a clear road map for the power sector. Moreover, also in May 2021, ČEZ, the country's dominant operator of coal-based electricity generation, announced plans to generate only 25% of its total generation from coal in 2025 and to reduce the share of coal to 12.5% in 2030 (ČEZ Group, 2021).

Legal and regulatory framework

The key legal provisions governing the electricity sector are Act No. 458/2000 that provided for the creation of the Energy Regulatory Office (ERU)[1] and Act No. 165/2012 Coll. (the Energy Act). The Energy Act is currently under revision to, among other things, transpose the EU's Clean Energy Package into Czech law to institute new market design rules, in particular with regard to decentralised generation and energy communities.

The Energy Act sets out the rights and obligations of the ERU and the guidelines for the interaction between the ERU and the Ministry of Industry and Trade, the State Energy Inspectorate, and the Office for the Protection of Competition. The ERU's main responsibility is to regulate the activities of the natural monopolies in power transmission and distribution. It has significant competencies in the area of consumer protection as per the Energy Act and Act No. 634/1992 Coll. that is currently being revised to bring it into alignment with the 2013 EU Directive on Alternative Dispute Resolution for consumer disputes. The Market Operator, OTE, carries out its activities under a licence awarded by the ERU. It operates the Czech electricity and gas market (OTE, 2018).

Market structure

The Czech electricity market is fully liberalised. While there is complete legal separation between generation and transmission, large parts of electricity generation, distribution and supply are owned by ČEZ, the largest energy company in the Czech Republic. The state is the dominant shareholder of ČEZ, holding almost 70% of shares, while the remaining shares are held by a variety of institutional shareholders (ČEZ Group, 2019).

Wholesale electricity market

The Czech wholesale electricity market is fully liberalised. The short-term (spot) market is organised by OTE, the market operator, while long-term positions are traded on the European Energy Exchange. Bilateral over-the-counter agreements play an important role.

[1] See Annex A for more information on organisations and offices with relevancee to the energy sector.

In 2019, electricity traded on the European Energy Exchange was almost 50% lower than in 2018. Intraday market trading grew significantly in 2019 compared to 2018 due to the coupling of the Czech organised intraday market with other EU countries (ERU, 2019).

The government is currently redesigning the short-term power market. The trading period for the imbalance settlement period will be shortened from 1 hour to 15 minutes. This change will become effective on 1 January 2025.

The number of participants in the Czech electricity wholesale market has been continuously increasing since 2016 and reached 397 in 2019, with a total traded volume of 149 TWh (81% of which was traded on the spot electricity market). The number of participants in the spot market has also increased continuously since 2016, reaching 121 in 2019.

ČEZ owns and operates most of the major coal-fired plants and all nuclear plants in the Czech Republic, and accounted for 70% of total electricity generation in 2019 (ČEZ Group, 2020). The government expects that ČEZ’s market share will decrease with the gradual decline of coal-fired power plants and the increased renewable deployment. Overall, market shares are concentrated among a few suppliers.

Retail electricity market

In 2019, there were 83 suppliers active in the Czech liberalised retail electricity market, up from 61 in 2016. However, ČEZ Prodej is by far the dominant retail electricity supplier, accounting for 40% of the number of points of delivery. Just five companies (ČEZ Prodej, E.ON Energie, Pražská energetika, innogy Energie and Bohemia Energy) accounted for 83% of the entire retail market.

Since January 2006, all final consumers in the Czech Republic are entitled to freely switch supplier. In 2019, approximately 450 000, or 7.5% of total retail customers, changed their supplier. The annual switching rate was 6.1% for households and 13.2% for businesses, lower than in the record switching year of 2018, but higher than in 2016 and 2017 (ERU, 2019).

Prices and taxation

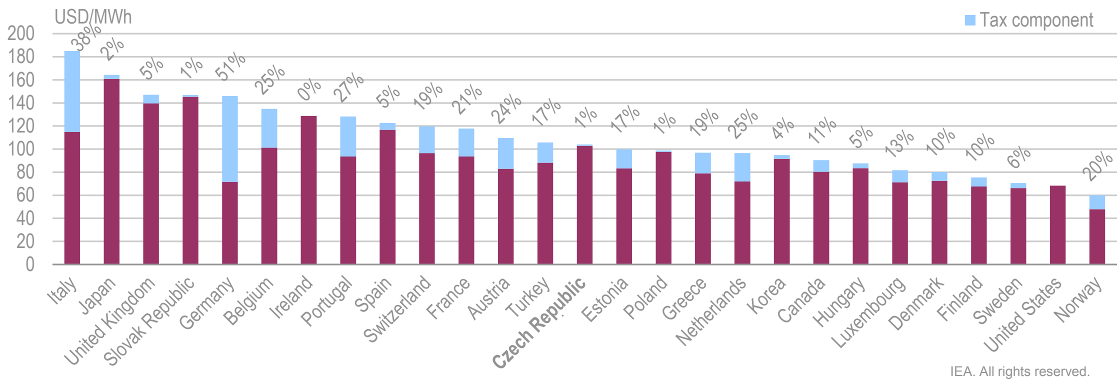
Final retail prices are composed of regulated and non-regulated parts. As the Czech electricity market is fully liberalised, the non-regulated price reflects the wholesale price of electricity and is set by the supplier selected by the customer. The regulated part of the final retail price includes a number of charges set by the ERU, such as support for renewable generation.

In 2019, the retail electricity price for industry was close to the median of IEA countries. Industrial consumers paid USD 104 per megawatt hour (USD/MWh), with a tax share of just 1%, the 14th lowest price and one of the lowest tax shares among IEA countries (Figure 7.4). The value-added tax of 21% is not included in the prices for industrial and electricity generators as it is refunded for purchases for commercial purposes (IEA, 2021b).

In 2019, the average household electricity price was composed of electrical energy costs (37.4%), network tariffs (31.1%), renewables charge (10.9%), system services costs (1.8%)

and market operator's services costs (0.7%), with taxes accounting for the remaining 18.1% (ERU, 2019). The household electricity price was 192 USD/MWh, the 12th lowest price, and with an average tax share, compared to other IEA countries (Figure 7.5).

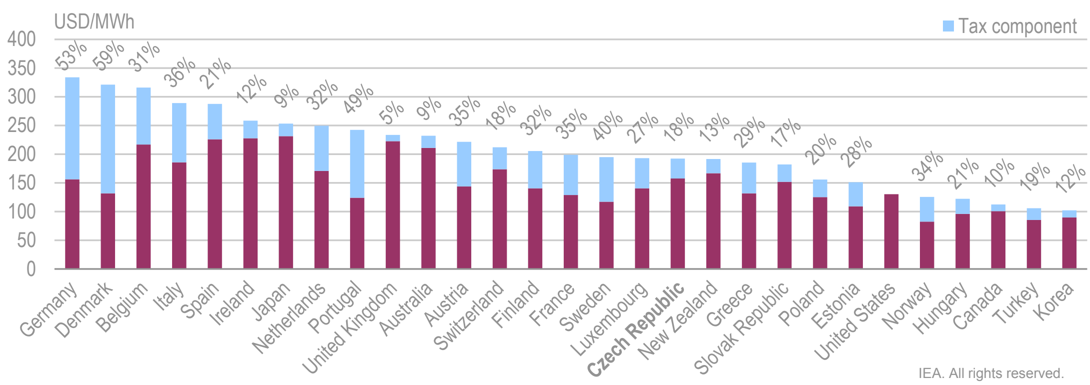
Figure 7.4 Electricity prices for industry in IEA member countries, 2019



Industry electricity prices in the Czech Republic were the 14th lowest among IEA countries in 2019.

Notes: Tax information is not available for the United States. Industry price data are not available for Australia, Mexico or New Zealand as the data had not been submitted at the time of publication.
Source: IEA (2021b).

Figure 7.5 Electricity price for households in IEA member countries, 2019



Household electricity prices in the Czech Republic were the 12th lowest among IEA countries in 2019.

Notes: Tax Information is not available for the United States. Household price data are not available for Mexico as the data had not been submitted at the time of publication.
Source: IEA (2021b).

Infrastructure

Due to its central position in Europe, the Czech Republic is well connected with all of its neighbouring countries, and plays a significant role for cross-border electricity flows and electricity trading.

Transmission

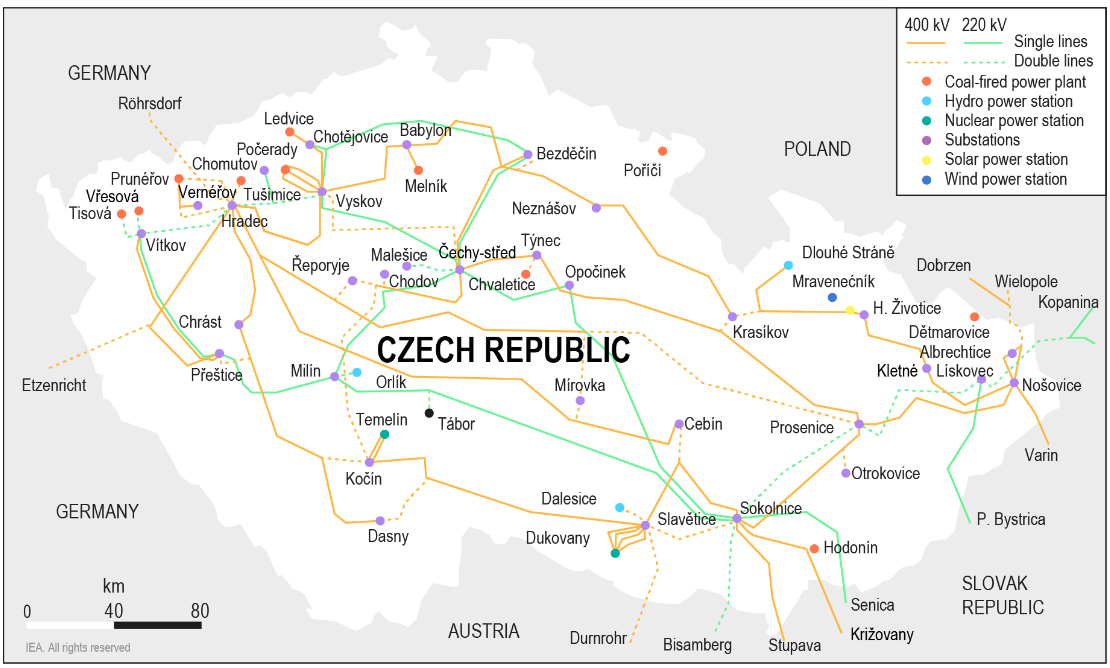
In 2020, the national transmission network comprised 3 867 kilometres (km) of 400 kilovolt (kV) lines, 1 824 km of 220 kV lines and 84 km of 110 kV lines. In addition, there were 11 km of international 400 kV lines and 6 km of 220 kV lines. The Czech transmission system also comprised a total of 44 substations and 79 transformers. The Czech transmission system co-operates synchronously with the electricity system of continental Europe.

The ČEPS holds the exclusive transmission system operator (TSO) licence for the Czech transmission system. It is responsible for operating, maintaining, upgrading and developing the transmission infrastructure, including interconnections. In undertaking its functions, the ČEPS co-operates closely with other European TSOs. In accordance with the Energy Act, the ČEPS prepares the rolling ten-year transmission system development plans of the Czech Republic, the latest of which covers the period 2021-30 (ČEPS, 2020). An important part of the ČEPS' Ten-Year Plan is to phase out the old 220 kV network and replace it with a 400 kV system and the conversion of 220 kV substations to 400 kV.

Interconnections

The Czech Republic has 17 cross-border electric interconnections that are used not only for electricity exchanges, but also for maintaining the stability of the entire interconnected system in Central Europe. The Czech electricity grid is directly connected with Austria (2x400 kV lines and 2x220 kV lines), Germany (4x400 kV lines), Poland (2x400 kV lines and 2x220 kV lines) and the Slovak Republic (3x400 kV lines and 2x220 kV lines).

Figure 7.6 Map of Czech transmission systems, 2019



The level of the interconnectivity of the Czech transmission system is regularly monitored and evaluated by the ČEPS. The EU has set a target for 2030 for member countries to have a 15% interconnection capacity compared to the installed generation capacity, which the Czech Republic already largely exceeded in 2019 (Table 7.1).

In the NECP, the government confirmed the target of the 2015 SEP to maintain the transmission system import and export capacity relative to the maximum load at a level of at least 30% and 35%, respectively, which corresponds to the 15% target in terms of installed capacity (EC, 2019). Table 7.1 shows the interconnectivity level in 2019 and the projected level for 2030 relative to the installed capacity and the maximum load. Accordingly, the Czech Republic will achieve the 2030 targets with a significant margin.

Table 7.1 The Czech Republic's current and expected interconnectivity level in 2019 and 2030

Years	Relative to installed capacity		Relative to maximum load	
	Export capacity (%)	Import capacity (%)	Export capacity (%)	Import capacity (%)
2019	29.6	28.0	55.6	52.6
2030	44.1	38.0	58.0-60.2	50.0-51.8

Source: EC (2019).

Distribution

The Czech electricity distribution network consists of 91 448 km of very high- and high-voltage lines and 151 737 km of low-voltage lines, and serves the residential, commercial, and small and medium-sized industrial sectors.

There were 258 distribution system operators (DSOs) in the Czech Republic at the end of 2019. However, the distribution network is owned and operated by three privately owned regional DSOs (ČEZ Distribuce, E-ON Distribuce and PREdistribuce). The geographical area of each regional DSO is clearly defined: ČEZ Distribuce serves mostly the northern part of the country, accounting for 65% of domestic electricity consumption; E-ON Distribuce serves mostly the southern part, accounting for 24%; and PREdistribuce serves exclusively the cities of Prague and Roztoky, accounting for 11% (ERU, 2018). All companies are exclusive licence holders for distribution services in their respective operating area. The other 255 DSOs are local distribution companies and mainly part of vertically integrated companies and legally and account-wise unbundled.

The future of the power system

Under the EU's Clean Energy Package, member states are obliged to enact market design rules that allow for and encourage a greater inclusion of new actors in the electricity market. The government has not yet updated the existing legal framework governing the electricity market in the Czech Republic. A revised law is under preparation within the wider framework of implementing smart grid infrastructure in the country. A wide portfolio of potential market participants and technologies, such as energy communities, aggregators, prosumers, and energy storage and electric vehicles (through vehicle-to-grid or vehicle-to-home mechanisms), is largely excluded from the Czech electricity market today. There is also a need to reduce the administrative burden for self-consumption of renewable sources and to facilitate the grid-access procedures for small renewable producers.

Although small solar PV operators are entitled to be connected to the grid, it is difficult to enforce this in all of the distribution regions. In light of an assessment by the ČEPS that new capacity additions to 2030 would likely come from decentralised and renewable facilities only, feeding of small-scale solar PV into the grid should be a priority.

As part of its larger strategic objective to encourage the installation of variable renewable electricity sources, the government should also consider revising the current structure of electricity charges to make the installation of small systems more attractive.

Smart grid and smart meters

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 and smart meters are important elements for the operation of a flexible power market capable of accommodating growing shares of variable renewable generation, and allowing for the application of new technologies and innovative business models.

The government developed the National Action Plan for Smart Grids (NAP SG) of 2015 to prepare for the implementation of advanced metering management (AMM) to increase the flexibility of the energy system. The period to 2019 was a preparatory phase during which the government undertook analysis to decide on the model for the implementation of a smart grid and to prepare the detailed implementation plan for the AMM. In 2019, the government approved an update of the NAP SG for the period 2019-30. The update includes a total of 20 measures across three main areas: 1) legislation, tariff system and regulation; 2) the use of new technologies in the operation of the electricity system; and 3) the integration of new technologies into the electricity system.

Specifically, the government will prepare the necessary legislation and network codes to transpose the provisions under the EU Winter Package into Czech law. Those legislative changes would enable the participation of aggregators to provide supply-side flexibility and to broaden the market for ancillary services. Other planned changes include allowing large consumers that connect to the 110 kV network to provide balance and other support services, and to use accumulation as part of the installations of solar PV power plants in low-voltage networks.

To facilitate the integration of new technologies into the electricity system, AMM meters will be installed for all customers that reach a specific level of consumption that is yet to be decided. Remote-controlled switching will be implemented at the medium voltage level and support will be offered for the automation of the low-voltage network. A pilot project will be implemented for the integration of electro mobility into the transport system.

In January 2019, the Czech distribution company E.ON Distribuce, a.s., together with a counterpart from the Slovak Republic, received approval from the European Commission for their ACON (Again COnnected Networks) international smart grid project for the modernisation of the distribution system to foster the integration of the Czech and Slovak electricity markets. The Commission will support the project with EUR 91.2 million. The Czech and Slovak TSOs are also supporting the project.

Under the project, intelligent technologies will be introduced into the distribution network to facilitate, among other objectives, the integration of variable renewable sources. Ultimately, the project is designed to improve the stability and security of the grid and improve remote network management with a view to connecting electric vehicles, batteries and other devices to the grid in the medium- and longer terms. Work on the modernisation of distribution networks began in 2020 and will continue until 2024.

Electricity security and emergency response

The Energy Act provides the legal framework for electricity emergency response policies in the Czech Republic. In addition, Decree No. 80/2010 on the state of electricity emergency and on the content of the Emergency Plan describes the key principles regarding the reduction of electricity consumption and management of changes in the supply of electricity during an emergency.

The ČEPS has a key role in responding to electricity supply disruptions; it is responsible for the dispatch control of the Czech electricity system, which involves the real-time balancing of supply and demand within the system. In order to maintain reliable transmission system operation and the provision of system services, the ČEPS Control Centre monitors, on a continuous basis, the expected load on the power system and scheduled cross-border exchanges.

Emergency response and management

In the event of an emergency situation within the Czech electricity system, the ČEPS Control Centre is entitled to declare a situation intended to avoid a state of emergency and, in the worst case scenario, declare a state of emergency in the Czech electricity system.

Depending on the severity of the electricity emergency, the ČEPS may implement the Consumption Restriction Schedule, which allows electricity consumption to be restricted for seven categories of customers; these categories correspond to the seven regulation stages set by the ČEPS. Although the electricity supply is not interrupted, consumers in certain specified categories are obliged to reduce their consumption.

At the time of the consumption restriction, the ČEPS continuously evaluates the development of the situation, uses the available resources needed to restore voltage and manages the gradual resumption of operation of the electricity system towards the end of a state of emergency. An instruction concerning the consumption restriction within a distribution system is issued by the dispatcher of the relevant DSO control centre. Once a crisis situation has been brought under control and a restriction is no longer necessary, the dispatcher sends a further instruction terminating the restriction.

Power system operation performance

The ČEPS and DSOs are responsible for ensuring the smooth operation of the transmission and distribution systems and minimising the number, duration and impact of system disruptions and level of losses. The system average interruption duration index (SAIDI), which indicates the average number of minutes of unplanned power system outages per year, and the system average interruption frequency index (SAIFI), which indicates the average number of unplanned power system outages per year, are standard parameters for the reliability of the grid.

For the Czech distribution network as a whole, the SAIDI and SAIFI increased in 2019 compared to 2018, but stayed under the five-year average (Table 7.2). While a comparison at DSO level is challenging, as local circumstances greatly influence SAIDI and SAIFI, it is worth noting that PREdistribuce, serving the cities of Prague and Roztoky, achieved historically low values of the SAIDI indicator (29.6 minutes/year) in 2019, while the SAIFI indicator was also below the 5-year average.

Since 2013, the DSOs are subject to a bonus/malus scheme regarding the SAIDI and SAIFI indicators. Revisions to the scheme will enter into force in the second half of 2021 and will, among other changes, introduce so-called automatically provided compensations.

Table 7.2 Change of values by supply indicators for distribution networks in the Czech Republic, 2015-19

Indicator	Company	2015	2016	2017	2018	2019	5-year average
SAIDI (minutes)	**Czech Republic**	**316.06**	**258.29**	**431.45**	**256.05**	**288.73**	**310.12**
	ČEZ Distribuce	361.72	309.64	501.47	307.09	348.52	365.69
	E-ON Distribuce	352.90	252.14	466.68	249.70	281.20	320.52
	PREdistribuce	30.93	32.52	40.34	34.06	29.61	33.49
SAIFI (interruptions)	**Czech Republic**	**2.64**	**2.21**	**2.76**	**2.24**	**2.32**	**2.43**
	ČEZ Distribuce	3.29	2.87	3.41	2.74	2.90	3.04
	E-ON Distribuce	2.27	1.60	2.34	2.01	1.97	2.04
	PREdistribuce	0.36	0.33	0.57	0.40	0.36	0.40

Source: ERU (2019).

In the transmission network, the average duration of interruption and non-delivered energy declined from 2018 to 2019, but was higher than the five-year average (Table 7.3). The number of interruptions in 2019 was the highest of the past five years.

Table 7.3 Change of values by supply indicators for transmission networks in the Czech Republic, 2015-19

	2015	2016	2017	2018	2019	5-year average
Average duration of interruption (minutes)	16	12	9	16	13	13.2
Number of interruptions	7	3	4	8	11	6.6
Non-delivered energy (megawatt hours)	140	45	50	113	102	90.0

Source: ERU (2019).

Assessment

In 2020, coal and nuclear generation dominated the Czech Republic's electricity supply, with shares of 41% and 37%, respectively. The remainder consisted of renewables, at almost 13%, and natural gas at 8.5%, while oil-fired power generation accounted for a marginal share. Total generation stood at 85.5 TWh in 2019 and decreased to 80.2 TWh in 2020 due to the Covid-19 pandemic.

In 2019, total electricity consumption was 60.1 TWh. Industry was the largest electricity consuming sector at 46%, followed by the service sector buildings at 28%, and the residential buildings at 26%. Electricity demand in the transport sector accounted for 3% of total demand. The Czech Republic is a net exporter of electricity.

The carbon intensity of the electricity mix has declined in the last decade, as coal-fired generation decreased by 19% between 2009 and 2019, and by 17% in 2020 alone.

According to the SEP and the NECP, this trend will amplify in the coming decades, as low-carbon technologies will continue to replace coal-fired generation. The share of nuclear power and renewable energies is expected to increase significantly while the Czech Republic plans to use natural gas as a transition fuel.

However, the planned energy mix for 2040, in both the SEP and the NECP, still foresees a significant share of carbon fuels in the electricity mix, estimated between 16% and 36%. This would make it challenging for the Czech Republic to significantly contribute to achieving the EU climate targets.

Several strategic documents lay out the future of the Czech electricity sector, yet the precise road map remains unclear. Setting out more specific and detailed targets would create investor confidence and help mobilise investments to ensure sufficient generation capacity.

The government established the Coal Commission in 2019 to develop different scenarios for the coal phase-out from the energy sector and the impact on the future electricity mix. Some of the scenarios analysed go beyond the climate and renewable energy targets in both the NECP and the SEP. Under the so-called "conceptual" scenario, fossil fuel generation would account for 35% in 2030, while under the so-called "progressive" scenario the share would be only 7%, which appears rather ambitious. The current SEP is expected to be updated by the end of 2023 and the work of the Coal Commission will be an important input for the development of the new SEP. However, external factors, mainly the EU's new energy and climate targets, may result in an earlier exit of coal from the Czech Republic's electricity mix than discussed by the Coal Commission and such a development should also be included in the deliberations for the new SEP.

The transmission grid of the Czech Republic is well interconnected with its neighbouring countries; interconnection capacity is 30%, and more interconnections are in the pipeline. The country has been a net exporter of electricity, and a stated goal for any of the future scenarios is that the country should produce at least 90% of its electricity needs. Such a high level of interconnectivity will facilitate the integration of high shares of variable generation. Already countries with interconnectivity lower than 10% are able to integrate variable renewable shares of up to 50%.

The Czech electricity market is fully liberalised and exchange trading is well established. The intraday market has a gate closure time of one hour ahead of generation, which is rather long in an international comparison. The government anticipates a gate closure time of 15 minutes to be implemented in 2024. This is rather late, and may hamper active market participation from variable renewables, short-term storage and aggregators.

The number of players in the wholesale market has increased over the past years. Nevertheless, the state-owned utility ČEZ owns and operates most of the coal-fired plants and all nuclear plants in the Czech Republic, with an approximate share of 50-60% of the market. The government should keep a close eye on this high level of market concentration.

Electricity prices for industry and households are at a median value compared to IEA countries. However, in the case of household prices, fixed components such as the distribution and renewables charges amount to over 50% of the final price. This price structure limits price dynamics, and does not provide incentives for consumers to adapt their consumption towards greater electrification (e.g. heat pumps), nor is it an effective demand response in the electricity sector. Generally speaking, to incentivise cleaner electricity production, it is better to tax input fossil fuels than the electricity itself.

The current structure of electricity charges does not support the development of small solar PVs. The IEA learnt that in some regions, distribution companies are reluctant to connect small PV installations, and if a connection is granted, there is no or very low remuneration for electricity supplied to the grid. As the penetration of small-scale solar is still low, the government could consider implementing a net-metering system to make these small systems more attractive.

Retail prices are unregulated and determined by the market. Since January 2006, all customers can freely switch electricity suppliers. Moreover, the switching rate has continuously increased. Nevertheless, the three largest companies still account for almost 70% of the supply in the retail market.

The current legal framework governing the electricity market has not yet been updated to reflect the new market design rules included in the EU Clean Energy Package that aims to encourage a greater inclusion of new actors, such as aggregators and prosumers. A revised law is under preparation.

As a consequence, the inclusion of a wide portfolio of potential market participants and technologies, such as energy communities, prosumers, and energy storage and electric vehicles (through vehicle-to-grid or vehicle-to-home mechanisms), lacks the necessary legal framework. This deprives the electricity market of the flexibility needed to accommodate a growing share of variable generation and to foster innovation and increase the number of participants in the market.

In 2019, the government approved the update of the National Action Plan for Smart Grids for the period 2019-30. The deployment of smart meters would start in mid-2024 and is expected to be completed by the end of 2028. The absence of advanced metering infrastructure hampers the use of efficient demand response mechanisms.

Recommendations

The government of the Czech Republic should:

- ☐ Assess and monitor the development of variable renewable electricity generation, the projected phase-out of coal-fired generation, and the feasibility of the planned nuclear expansion, to proactively ensure that generation adequacy is maintained in the medium and long term.
- ☐ Align the national electricity policy with the EU's Clean Energy Package and swiftly advance the completion of a comprehensive framework and remove barriers for the participation of energy communities, prosumers, storage, aggregators, self-consumption and individual participants in the electricity market. Investigate whether incentives for such participation are needed.
- ☐ Swiftly implement smart metering. A delayed development of smart metering would hamper the effective participation of consumers and aggregators in the electricity market.
- ☐ Develop a coherent and comprehensive road map for the decarbonisation of the electricity sector, with clear assumptions and targets, to promote clarity for investors.
- ☐ Review the structure of electricity charges to support electrification of energy demand and the development of small solar PVs.

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8. Nuclear

Key data (2019/20)

Number of power reactors: 6 reactors.

Installed capacity: 3 921 MW (net) 4 290 MW (Temelín NPP 2 250 MW, Dukovany NPP 2 040 MW).

Electricity generation (2020): 30.04 TWh, +7.3% since 2010.

Share of nuclear (2020): 19.5% of TES, 37.5% of electricity generation.

Exchange rates (2020):* Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* OFX (2021)

Overview

Nuclear plays an important role in the Czech Republic, accounting for 19.5% of the total energy supply (TES) and 37.5% of electricity generation in 2020. Electricity generation from nuclear has more than doubled since 2000, following the commissioning of the Temelín Nuclear Power Plant (Figure 8.1). In 2019, the Czech Republic had the seventh-highest share of nuclear power in total electricity generation among IEA countries.

In addition, the Temelín Nuclear Power Plant provides district heating to its local communities. Expanding this activity is under construction and in general of further consideration.

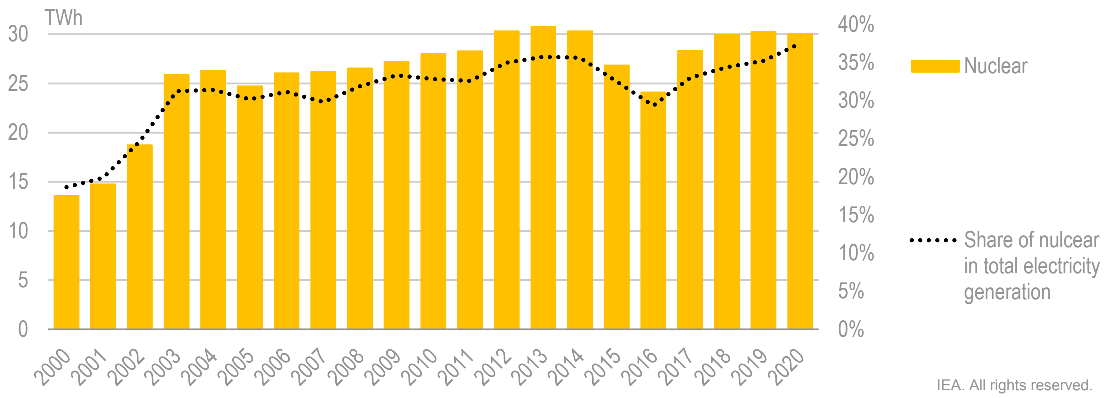
The Czech Republic has six nuclear power reactors at two sites in operation (four units at the Dukovany plant and two units at the Temelín plant). The State Energy Policy (SEP) published in 2015 underlines that nuclear energy will constitute 46-58% of total electricity production in the long term to replace the share of coal that is expected to decline continuously (see Chapter 9). Under the SEP, the government has announced the construction of new nuclear units at an existing nuclear power plant site with a total capacity of up to 2 500 megawatts (MW) by 2030-35 (MIT, 2015).

Recent findings from the Coal Commission, which recommends that the country phase out coal for electricity and heating at the latest by 2038, further strengthens the policy objectives for nuclear (see Chapters 2 and 7). In the 2015 SEP, the government sees only limited expansion of renewable sources in the electricity sector and new nuclear capacity is therefore increasingly seen as a key solution to fill the expected capacity gap in the mid-2030s (see Chapters 2, 5 and 7).

The Czech public supports the expansion of nuclear capacity. A survey undertaken in June 2020 found that about two-thirds of the population would like the share of nuclear energy to remain stable or increase (CVVM, 2020). This public support is especially strong in the local communities near the nuclear power plants.

In a speech in December 2019, the Czech prime minister stated that construction of the country's next nuclear unit – at Dukovany – was expected to begin in 2029, with the reactor in operation by 2036, bringing the share of nuclear electricity to 40% by 2040 (World Nuclear News, 2019). On 28 July 2020, the Czech government signed an agreement with domestic power utility group ČEZ for installing one new unit at Dukovany (Reuters, 2020).

Figure 8.1 Nuclear power generation in the Czech Republic, 2000-20



Source: IEA (2021).

Existing nuclear fleet

As part of then-Czechoslovakia, the Czech Republic has been developing nuclear power since the late 1950s and has over the years developed extensive operational experience and supply chain capabilities in this field. In particular, national companies such as Škoda continue to be heavily involved in the construction and maintenance of nuclear power plants. In the 1970s, several nuclear reactors were built by Škoda in Bohunice (now part of the Slovak Republic) using the Soviet Union water-water energetic reactor (VVER) technology.

The construction of the first VVER in the Czech Republic started in 1978 at Dukovany, based – like all the nuclear reactors in operation in the country today – on the VVER light water reactor technology. The four-unit VVER-440 model V-213 reactors were designed by Russian organisations and built by Škoda. These entered into commercial operation in 1985-87 and have since been modernised.

In 1982, work started on the Temelín Nuclear Power Plant, also designed by Russian organisations and with engineering support from Škoda. Temelín was initially planned as a 4-unit VVER-1000 V-320 plant, with the construction of Units 1 and 2 starting in 1987. Following the 1989 Velvet Revolution, the new government decided in 1990 to suspend the construction of Units 3 and 4. In 1993, Westinghouse was selected to upgrade the instrumentation and control systems, as well as the radiation monitoring and diagnostic systems. This project was financed by ČEZ with a loan from the World Bank. In addition, Westinghouse supplied the reactor fuel (initial core and four reloads). Temelín Units 1 and 2 were put into operation in 2002 and 2003, respectively.

Temelín is also used to provide district heat to the town of Týn nad Vltavou (8 000 inhabitants) 5 kilometres (km) away. A connection to the city of České Budějovice (about 100 000 inhabitants) 26 km away is currently under construction. A district heat project for Dukovany to the city of Brno (380 000 inhabitants, 40 km away) is supported by local communities.

Both the Dukovany and Temelín Nuclea Power Plants are owned and operated by ČEZ, the largest power utility in the Czech Republic. Over the last decade, ČEZ has made significant investments to modernise and increase the rated capacity of its nuclear fleet. As part of increasing the efficiency and utilisation of power reserves, the output of the four-unit Dukovany power plant increased to 2040 MW. Similar upgrades for the two-unit Temelín power plant have also taken place.

In March 2020, ČEZ submitted an application to extend the licence of Unit 1 of Temelín, which was issued by the State Office for Nuclear Safety (SONS) in September 2020. In June 2020, ČEZ stated that it expects to invest about USD 2.3 billion of capital expendure over the next 27 years to extend the operating lifetime of Dukovany by 20 more years to 60 years, i.e. until 2045-47.

Despite significant maintenance and uprating of programmes over the last few years, the nuclear fleet load factor remained above 80% on average between 2010 and 2020, with about 30 terawatt hours (TWh) of electricity generated per year. In 2020, production was slightly reduced by 0.5%, down 0.15 TWh from the 30.2 TWh produced in 2019. This was caused by measures in response to the Covid-19 pandemic during planned outages at Dukovany.

Table 8.1 Nuclear power plants in operation in the Czech Republic on 1 January 2021

Reactor name	Model	Net capacity (MW_e)	Construction start	First grid connection	Commissioning
Dukovany 1	VVER V-213	468	1979	1985	1985
Dukovany 2	VVER V-213	471	1979	1986	1986
Dukovany 3	VVER V-213	468	1979	1986	1986
Dukovany 4	VVER V-213	471	1979	1987	1987
Temelín 1	VVER V-320	1 027	1987	2000	2002
Temelín 2	VVER V-320	1 027	1987	2002	2003

Note: MW_e = megawatt electrical.
Source: IAEA (2021).

Nuclear new build programme

The construction of new nuclear units has been actively considered in the Czech Republic over the last two decades. In 2009, a first tender was launched for the construction of two new reactors at Temelín as per the initial construction plans for the site in the late 1980s. Three consortiums expressed their interest: Westinghouse (AP1000), Škoda JS/Rosatom (VVER AES-2006) and Areva (EPR). Bids were formally submitted in July 2012, and the contract was to be signed late in 2013. However, this was deferred for 18 months to mid-2015, awaiting the completion of a new energy strategy by the new government. At the time, financing conditions were a key consideration, with both Rosatom and Westinghouse offering long-term financial support for about 50% of the investment. In parallel, the government planned to legislate contract options for a cost-difference guarantee for electricity that would cover the expected gap between the wholesale electricity prices and the construction costs.

In April 2014, the government confirmed that it would not provide future price guarantees amid concerns from the Ministry of Finance regarding the impacts on retail electricity prices. Consequently, ČEZ decided to cancel the procurement process in accordance with the Public Procurement Act.

In June 2015, the Cabinet approved the Ministry of Industry and Trade's long-term plan for the nuclear industry, involving one new unit at Dukovany and possibly three more at the two sites. It recommended that ČEZ create a subsidiary joint-stock company (Elektrárna Dukovany II) to prepare construction plans and explore options for financing the new reactors, even though the first might not be approved until 2025. SONS issued a permit for the siting of two nuclear units at the Dukovany locality on 8 March 2021 (SÚJB, 2021). The government's National Action Plan for Nuclear Energy also stated that the Dukovany II Unit 1[1] has priority over Temelín, in order to maintain production at the site after the existing reactors will be retired by about 2045 (assuming 60 years of operation) (MIT/MoF, 2015).

The Czech prime minister confirmed the timeline for the Dukovany project in December 2019, with construction starting in 2029 and commissioning in 2036. Only proven light water reactor designs would be considered, with the People's Republic of China (Hualong One), France (EPR), Korea (APR1400) and the United States (AP1000) being the main technology providers expected to participate in the tender.

However, in December 2020, the publication of the tender was delayed with a view to the parliamentary elections planned for mid-2021 and suggestions that some potential bidders should be excluded from the tender process. A decision from the Czech Cabinet is expected in 2021 (World Nuclear News, 2020a).

Nuclear new build financing proposal for Dukovany II Unit 1

In July 2019, the Czech government published a resolution highlighting its commitment to provide loan guarantees to ČEZ to allow it to secure cheaper financing. However, the resolution confirmed that the government would not provide a return on investment guarantee. In November 2019, the Czech prime minister announced that a supplier would be selected for the new reactor at Dukovany by 2022 (World Nuclear News, 2019). In May 2020, the Czech government agreed to a state loan covering 70% of the costs of building the new reactor. The loan would be interest free during the construction, followed by a rate of 2% once the plant begins operation. The Czech government has estimated that the development and construction phases will costs CZK 140-160 billion (USD 6-7 billion) (Reuters, 2020). This would represent an overnight construction cost of 5 000-5 833 USD/kW$_e$, consistent with the latest projected costs for proven nuclear reactor designs in western OECD countries (NEA/IEA, 2020).

In parallel, in July 2020, the Czech Cabinet approved a proposed new law, which would allow the government and ČEZ to agree on a minimum 30-year power purchase

[1] The Dukovany II Unit 1 is also known under the name Dukovany 5.

agreement (PPA) for the Dukovany II Unit 1. The PPA is framed for projects of more than 100 MW_e that would be commissioned after 2030. The price should allow ČEZ to make a return on investment. However, the PPA does not offer a guaranteed return, notably in the event of construction costs overruns that may have to be borne by ČEZ depending on the contractual arrangements with the reactor vendor. The electricity will be resold by the state-owned company on the wholesale market. The difference between the off-take and wholesale electricity prices will be passed on to final consumers either as a surcharge or a rebate. This financial support is intended to significantly reduce the cost of capital and ensure competitive costs for consumers. It will also alleviate potential concerns related to ČEZ's dominant position in the electricity market, as the company will not be responsible for marketing the output of the new plant.

This financing framework for nuclear new build is supposed to address specific market failures of electricity and financial markets related to unpriced societal benefits and long construction times. Such issues will be reviewed by the European Commission in accordance with its state-aid rules.

First, investments in long-lived, highly capital-intensive, low-carbon technologies such as nuclear energy are related to long-term societal objectives such as climate change mitigation. Hence, they have characteristics similar to strategic infrastructure investments with large positive externalities at the system level that require specific linkages between the public and private objectives. In the absence of specific policy support mechanisms, the cost of capital of such (private) investments would therefore be significantly higher than the (public) costs of capital recommended for climate action (NEA, 2020). This market failure is not specific to nuclear power, and in fact applies to all low-carbon technologies. For instance, IEA (2020) shows that without price guarantee schemes external to markets, the weighted average costs of capital of solar PV and wind power would more than double in Europe and China.

Second, one specificity of nuclear over variable renewables (wind, solar PV) relates to the construction lead-time. Today, in OECD countries, the construction duration of a proven nuclear reactor can be assumed to last seven to ten years, with several additional years required for project development. The risk of construction delay can also be perceived as high based on recent experiences with first-of-a-kind projects. As highlighted by Newbery et al. (2019), private financing would require considerable reassurance to undertake investments with such a time horizon, considering the rapidly growing policy uncertainty beyond this horizon. Additional policy support is therefore warranted to overcome this uncertainty. Direct financing support, especially during the construction phase as envisaged by the Czech Republic, would therefore be an effective way to align nuclear new build financial conditions with the country's long-term energy policy objectives.

Plans for additional nuclear new build by 2040

In parallel, the 2015 SEP also identified that at least one additional reactor could be built at Dukovany and two at Temelín and these two options remain open (MIT, 2015). Those additional nuclear capacities would amount to at least 3 600 MW_e and could come online by 2040, further compensating for the phase-out of coal power plants. In November 2020, SONS granted revised permits that were initially issued in 2014 for ČEZ to build two reactors at Temelín. However, those new units currently do not have a specific decision timeline and are not covered by the first implementing contract between the government and ČEZ. This means that the forthcoming new build tender for the Dukovany II Unit 1 will not benefit from a programmatic approach and the associated series effect that could foster a reduction of the construction costs (NEA, 2020).

Small modular reactors

Over the last few years, the Czech Republic has expressed interest in investigating the potential to deploy small modular reactors (SMRs), in parallel with large nuclear reactors. SMRs are generally defined as nuclear reactors with power outputs up to 300 MW_e. They present several technical features that enhance construction predictability and lead to potential reductions in construction costs and delivery times. SMRs are also well suited to provide non-electric applications, such as industrial and district heating, and could therefore support the decarbonisation of both the Czech electricity and heat sectors.

To explore the potential benefits of SMRs in the Czech Republic, ČEZ has recently signed a number of memoranda of understanding with several SMR vendors:

- GE Hitachi, which is developing the BWRX-300, a 300 MW_e, single-module, boiling water reactor. The design is currently under review by the US Nuclear Regulatory Commission for design certification.
- NuScale Power, which is developing a 12-module light water reactor with a rate capacity of 60-77 MW_e per module. A demonstration reactor is planned at the Idaho National Laboratory in the United States and the company has secured a design licence from the Nuclear Regulatory Commission.
- Rolls-Royce, which is developing the UK-SMR, a 477 MW_e, single-module, light water reactor. The company expects to build a demonstration unit in the United Kingdom by the early 2030s.

Efforts in the area of SMR are led by ČEZ with support from research centre Řež, the nuclear research and development (R&D) organisation. These efforts also profit from participation in Euratom research programmes that specifically address the technical and safety features of SMR in the European context. These activities would benefit from the development of an integrated road map to assess how SMR could contribute to the decarbonisation of the Czech energy mix, as well as the potential role of nuclear stakeholders and industry players in supporting the development of these new reactor designs.

Regulatory and legal framework

The regulation of nuclear power is framed under the 2016 Atomic Act. This act translates requirements from relevant EU directives and international treaties.

In line with international standards, a core principle of the Atomic Act is that the primary responsibility for nuclear safety and radiation protection of nuclear facilities resides with the operator, under the supervision of SONS. In that respect, ČEZ is accountable for the safe construction, operation and decommissioning of nuclear power plants, as well as for radioactive waste management under SONS regulation.

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 adhere to the licence conditions and the act's provisions. In case of non-compliance, SONS can enforce remedial actions, amend or revoke a licence. Inspectors are permanently present at the Dukovany and Temelín plants. Facilities such as the three research reactors, the spent nuclear fuel interim storage facility and the low-level radioactive waste repository are also supervised by SONS.

In addition, SONS is in charge of nuclear security matters. Since joining the EU in 2004, the Czech Republic observes provisions of the Euratom Treaty in the field of nuclear safeguards. The country is also party of the International Atomic Energy Agency's (IAEA) non-proliferation regime. Its safeguards agreement under the IAEA Nuclear Non-Proliferation Treaty that came into force in 1997. The Additional Protocol in relation to its safeguards agreements with the IAEA came into force in 2002. Last but not least, it is member of the Nuclear Suppliers Group.

Regarding nuclear liabilities, the 1997 Atomic Act incorporated 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 each single nuclear event in the case of nuclear installations used for power generation purposes, storage facilities and repositories of spent nuclear fuel assigned to these installations, or nuclear materials generated by processing of this fuel, and CZK 2 billion (EUR 80 million) for other facilities and transport. The nuclear operators must be insured for liability. To cover these possible liability claims, a nuclear insurance pool was established in 1995. The government is obliged to compensate for amounts exceeding insurance coverage.

As in other EU nuclear countries, "stress tests" for the safety of nuclear power plants were conducted after the 2011 Fukushima Daiichi nuclear accident under the oversight of the European Nuclear Safety Regulators' Group. In 2012, the peer review concluded that the safety of nuclear installations in the Czech Republic was satisfactory and recommended several specific measures drawing on the lessons learnt from Fukushima. In particular, as part of their long-term operations, the Dukovany and Temelín units have since been equipped with additional diesel generators, as well as additional hydrogen recombiners to prevent hydrogen from accumulating.

Nuclear fuel cycle

Historically, the Czech Republic produced up to 2 500 million tonnes (Mt) of uranium during the 1970s and 1980s, but production has steadily declined since the early 1990s. Czech production fell to 600 tU/year in 1994, and only limited production continued at the Rožná mine before its closure in 2017. This mine was the last one in operation in Central Europe, and while new mining projects have been considered in recent years, none have moved forward due to the low international uranium prices. Today, all the uranium is therefore imported from international suppliers.

Regarding the front-end of the nuclear fuel cycle, all conversion, enrichment and fuel fabrication were initially undertaken in the Russian Federation by TVEL, the fuel division of Rosatom. In line with diversification objectives of the Czech government, Westinghouse (United States) is co-operating on fuel activities for Temelín Nuclear Power Plant.

Radioactive waste management and decommissioning

The Radioactive Waste Repository Authority (RAWRA/SÚRAO) was established in 1997 and is responsible for the disposal of all radioactive waste in the Czech Republic. All producers of radioactive waste bear the full costs of management and disposal.

There is no state policy on reprocessing and the decision is left to ČEZ, which does not perceive it as being economic for the time being.

Used fuel is stored at each power plant. Originally, used fuel from Dukovany was sent to the interim storage facility at the Jaslovské Bohunice plant (now in the Slovak Republic). The dissolution of Czechoslovakia in 1993 meant that the used fuel originating from Dukovany would be stored in another country, and therefore required repatriation. Interim dry storage facilities have since been built at both Dukovany and Temelín. ČEZ is also considering the construction of a central used fuel interim storage facility at Skalka (southern Moravia).

In December 2020, the Czech Cabinet announced that it had approved a shortlist of four potential sites for a deep geological repository for used nuclear fuel and high-level radioactive nuclear waste. The government also approved a new schedule, calling for the site to be selected by 2030, five years later than originally planned. The repository is expected to be operational by 2065 (World Nuclear News, 2020b). However, building long-term public confidence remains a long-term endeavour, as several municipalities near the shortlisted sites have reported that they do not support such a proposal (NEI, 2021).

Nuclear research and development and competencies

The Czech Republic has been a key player in nuclear research for over 60 years. The Nuclear Research Institute ÚJV Řež plc was set up in 1955, at the time through a collaboration agreement with the then-Soviet Union. Since 1992, this research centre has been privatised and is owned jointly by the ČEZ Group (52.4%), together with Slovenské elektrárne (SE, 27.8%), Škoda JS (17.4%) and the municipality of Husinec (2.4%).

The research centre Řež (subsidiary of ÚJV Řež) operates two research reactors: the LVR-15 (10 megawatts thermal, built in 1957) and the LR-0 (5 kilowatts thermal (kWt), built in 1982). A third research reactor is operated by the Czech Technical University in Prague (VR-1 Sparrow, 5 kWt, built in 1990). These reactors initially operated with highly enriched uranium from Russia and have since been converted to low enriched uranium fuel. Used highly enrichted uranium fuel has also been returned to Russia as part of the co-operation agreement between the two countries.

Řež has developed a diverse portfolio of R&D activities that includes support to the existing nuclear reactors' operations, nuclear safety, the supply of radioisotopes for industrial and medical applications, nuclear waste management, the development of Gen-IV reactors, and fusion technologies. These projects are funded through industry contracts and state support. Řež is an active member in the Euratom Horizon 2020 research programme.

In recent years, a key Euratom project led by ÚJV řEŽ has been the ALLEGRO project, a 75 MWth helium-cooled high-temperature fast demonstration reactor (GFR – gas fast reactor). The project is structured as part of the V4G4 Centre of Excellence that brings together Central European countries (Hungary, Poland and the Slovak Republic) as well as France.

In addition, nuclear education and training programmes rely on a strong network of universities that provides scientific and technical training required for the nuclear sector.

Assessment

Nuclear energy plays a vital role in the Czech electricity mix, with 30.0 TWh produced in 2020, accounting for about 37% of total power generation and 74% of its low-carbon electricity. Both, the long-term operation of the existing nuclear fleet and nuclear new build are priorities in the SEP to support competitive electricity prices, security of supply, energy independence and decarbonisation strategy objectives.

Nuclear energy benefits from a high level of multi-partisan political consensus and public acceptance at the national and local levels. The nuclear sector provides significant socio-economic benefits to the country, in particular considering that it benefits from a well-integrated domestic supply chain and developed R&D infrastructure.

The Czech nuclear fleet also provides nuclear district heating for its local communities. Heat from the Temelín Nuclear Power Plant is supplied to two local towns and a connection to the city of České Budějovice 26 km away from the plant is under construction, with 11 km still to be built. Additional district heating supplies from the Dukovany Nuclear Power Plant are also considered.

ČEZ is implementing a robust programme to modernise its competitive nuclear fleet and implement long-term operation. The capacity of the four-unit Dukovany Nuclear Power Plant was increased by 12%, to 2 040 MW_e (IAEA, 2021). Similar uprates for the two-unit Temelín Nuclear Power Plant have taken place. In June 2020, ČEZ stated that it expects to invest about USD 2.3 billion over the next 27 years to extend the operating lifetime of the Dukovany Nuclear Power Plant by 20 more years, for a total of 60 years.

According to the SEP, by 2040, nuclear power should increase its share to between 46% and 58% of electricity generation. The Czech government has recently renewed its commitments towards nuclear new build and has completed a detailed review of its new build strategy. In July 2020, the Cabinet approved a bill on measures to transition the Czech Republic to low-carbon energy. The bill is currently under discussion in the parliament. Under this bill, the state will commission ČEZ for the construction of one nuclear reactor and provide a dedicated financing support package. This new 1 200 MW reactor will be built at the Dukovany site (Dukovany II Unit 1). Construction should start in 2029 and commissioning would take place by 2036 in order to support the expected coal phase-out. This timeline means that the Czech Republic has the opportunity to learn lessons from recent first-of-a-kind Gen-III nuclear projects, several of which have experienced significant construction delays and cost overruns in western OECD countries.

In parallel, the government signed a framework agreement and the first implementing agreement with ČEZ for the preparation of construction. These agreements set out the responsibilities of both parties for the preparatory, construction and operational stages. During the first stage, which will run from 2020 to 2024-25, ČEZ will be in charge of conducting a competitive tender to select an engineering procurement construction contractor and to manage the required licensing and permitting processes. The overall framework is yet to be approved by the European Commission under state-aid rules.

The new build proposal also includes a financial support package in order to address market failures and reduce the risk to investors and the cost of the electricity. This package will include two key pillars. First, a direct contribution to financing through a state loan covering about 70% of the investment costs. The loan would be interest free during construction, followed by a 2% interest rate during operation. The remaining 30% investment will be covered by ČEZ equity. Second, an off-take agreement for the sale of electricity will be introduced with a PPA, for which the government will act as the counterparty. The off-take price has not yet been fixed and the criteria on which it will be decided have also not yet been finalised. It will be important to ensure that consumers are protected from cost overruns by, for example, only considering proven designs and to avoid a repeat of the situation experienced in other European countries with first-of-a-kind new builds.

The electricity will be resold by the state-owned company on the wholesale market. The difference between the off-take and wholesale electricity prices will be passed on to final consumers either as a surcharge or a rebate. This is expected to alleviate potential concerns related to ČEZ's dominant position in the electricity market; the company will not be responsible for marketing the output of the new plant.

The government's plans for nuclear new builds have also identified that at least one additional reactor could be built at Dukovany and two at Temelín. Those additional nuclear capacities would amount to at least 3 600 MW_e and could come online by 2040, further compensating for the phase-out of coal power plants. In November 2020, SONS granted revised permits that were initially issued in 2014 for ČEZ to build two reactors at Temelín. However, those new units currently do not have a clear timeline and are not covered by the first implementing contract between the government and ČEZ. This means that the forthcoming new build tender for the Dukovany II, Unit 1will not benefit from a programmatic approach and the associated series effect that could foster a reduction in the construction costs.

Since 2015, the Czech Republic has also expressed interest in SMRs. ČEZ is currently reviewing the technical and economic feasibility of several reactor concepts. To this end, memoranda of understanding have been signed with three vendors: Rolls-Royce (UK-SMR), GE Hitachi (BWRX-300) and NuScale. SMRs could be especially well suited to support the need to decarbonise industrial and district heating in the country.

The Czech Republic is making progress with the management of high-level radioactive waste. ČEZ is in charge of spent fuel management, with interim storage at both nuclear sites. The Radioactive Waste Repository Authority (SÚRAO) has shortlisted four candidate sites to host a deep geological repository, several of which are located near existing nuclear power plants. The government aims to further evaluate the overall suitability of those potential locations in order to decide by 2030 on a reference site as well as a back-up site. After 2025, it is expected that the Policy of Radioactive Waste Management and Spent Fuel Management will be updated (with a minor update in 2022 regarding a new potential site among four candidate sites) and that a dedicated bill will be drafted to frame the involvement of local municipalities. The deep geological repository should be operational by 2065, in line with the expected retirement of the existing nuclear fleet.

Recommendations

The government of the Czech Republic should:

- Ensure that lessons are learnt by all relevant stakeholders from recent Gen-III nuclear new build projects in OECD countries to limit the risk of cost overruns and construction delays.
- Support ČEZ to conduct a robust tendering process for the Dukovany II Unit 1 new build project with clear technological and economic selection criteria, while ensuring the essential security interests of the state.
- Building on the forthcoming conclusions of the Coal Commission, clarify the long-term prospect and decision timeline for nuclear new build to ensure that industry policy and energy policy agendas remain well aligned.
- Establish a road map to identify the potential role of small modular reactors in the Czech energy system, in particular in relation to the decarbonisation of the industrial and district heating sectors.
- Ensure the timely update of the Policy of Radioactive Waste Management and Spent Fuel Management and maintain the engagement of local municipalities near potential deep geological repository sites to ensure long-term public acceptance.

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9. Coal

Key data (2019/20)

Production (2020): 31.6 Mt/10.2 Mtoe, -27% in 2009-19, -24% in 2019-20.

Net imports (2020): 2.3 Mt/1.7 Mtoe (3.6 Mt imports, 1.3 Mt exports).

Total energy supply (TES) (2020): 34.6 Mt/12.2 Mtoe (production + net imports + 0.7 Mt stock changes).

Share of coal (2020): 43% of energy production, 30% of TES, 41% of electricity generation and 8% (in 2019) of total final consumption.

Consumption by sector (2019): 14.3 Mtoe (heat and electricity generation 73.6%, industry 32.6%, residential 4.9%, services 0.2%).

Exchange rates (2020):* Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* OFX (2021)

Overview

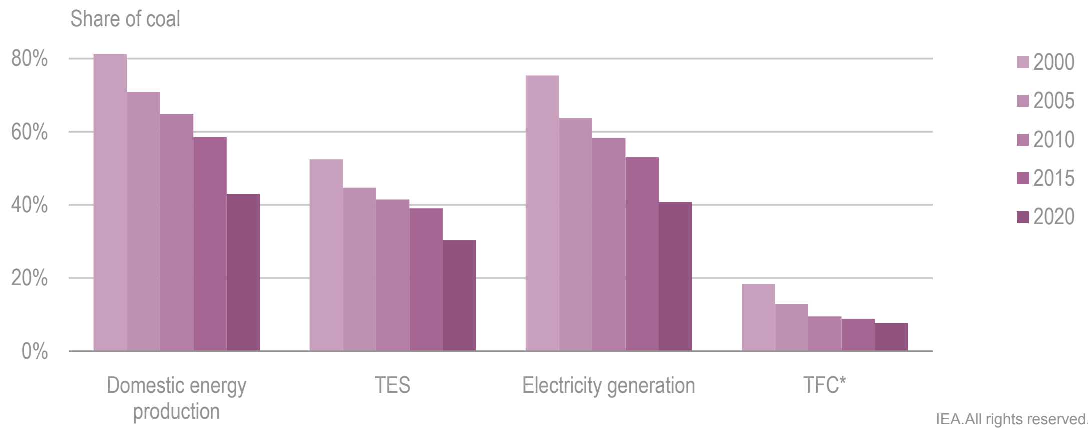
In December 2020, the Coal Commission recommended phasing out coal from the electricity and heat sectors of the Czech Republic by 2038. In May 2021, the government requested the Coal Commission assess the possibilities of an earlier coal exit. The phase-out of coal has significant implications for the energy sector, as coal is the main energy source in the Czech Republic, accounting for almost one-third of total energy supply (TES)[1] and 41% of electricity generation in 2020 (Figure 9.1). The government needs to take a decision on the recommendations of the Coal Commission.

The share of coal in the energy mix of the Czech Republic has declined since 2010: the share of coal in TES dropped significantly, from 41% in 2010 to 30% in 2020. The decrease in coal production, especially of thermal coal (used in power generation) and metallurgical coal (used in the blast furnaces and coke ovens by the steel industry), caused total coal imports to surpass coal exports from 2016 onwards.

The share of coal in electricity generation declined from 58% in 2010 to 41% in 2020, while the share of coal in total final consumption (TFC) fell from 12% in 2009 to 8% in 2019.

[1] Total energy supply (TES) comprises production + imports – exports – international marine and aviation bunkers ± stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (e.g. power generation and refining) or in final use.

Figure 9.1 Share of coal in different energy supplies in the Czech Republic, 2000-20



The share of coal in the Czech Republic has continuously decreased, especially as a share of total energy production and of electricity generation.

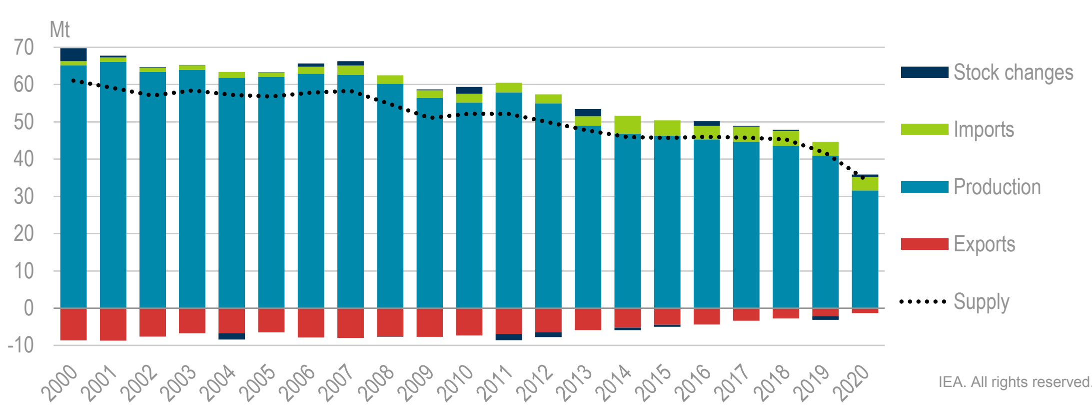
*Most recent TFC data are from 2019

Source: IEA (2021a).

Supply and demand

The Czech Republic's coal supply was 42 million tonnes (Mt) in 2019, a decrease of 18% since 2009 (Figure 9.2). In 2020, coal supply further dropped, due to the Covid-19 pandemic, to 35 Mt. Domestic coal production accounted for 91% of the total coal supply in 2020 and consisted of 93% lignite, 4% thermal coal, and 3% metallurgical coal. Coal supply consisted for 85% of lignite, 9% metallurgical coal, and 6% thermal coal in 2020. In the same year, domestic production covered all of the country's lignite needs, but only 33% and 53% of metallurgical and thermal coal supply respectively, for which the Czech Republic relies on imports.

Figure 9.2 Coal supply in the Czech Republic by source, 2000-20



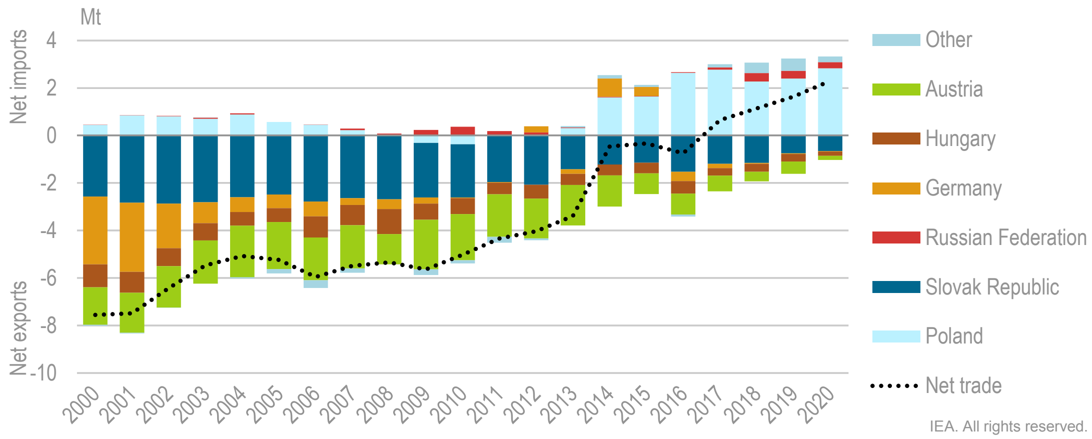
The majority of the coal used in the Czech Republic is produced domestically. However, domestic production has decreased, and in 2016 imports of mainly metallurgical coal exceeded exports.

Source: IEA (2021a).

The continuing decline in production has been mainly driven by the reduced production of thermal and metallurgical coal, which dropped respectively by 79% and 83% in the 2010-20 decade, while lignite production decreased by 33%. In 2016, the Czech Republic became a net importer of coal, as imports of mainly metallurgical coal surpassed coal exports. In 2020, net coal imports were 2.3 Mt, while in 2010 net exports were 5.0 Mt.

The country imported 3.6 Mt (64% metallurgical coal, 34% thermal coal and 2% lignite) in 2020, largely from Poland (3.0 Mt) and the Russian Federation (0.3 Mt) (Figure 9.3). Exports were mostly to neighbouring countries, including Austria, Hungary and the Slovak Republic, and totalled 1.3 Mt in 2020. Of the exported coal, 37% was metallurgical coal, 37% thermal coal, and 26% lignite.

Figure 9.3 The Czech Republic's coal trade by country, 2000-20

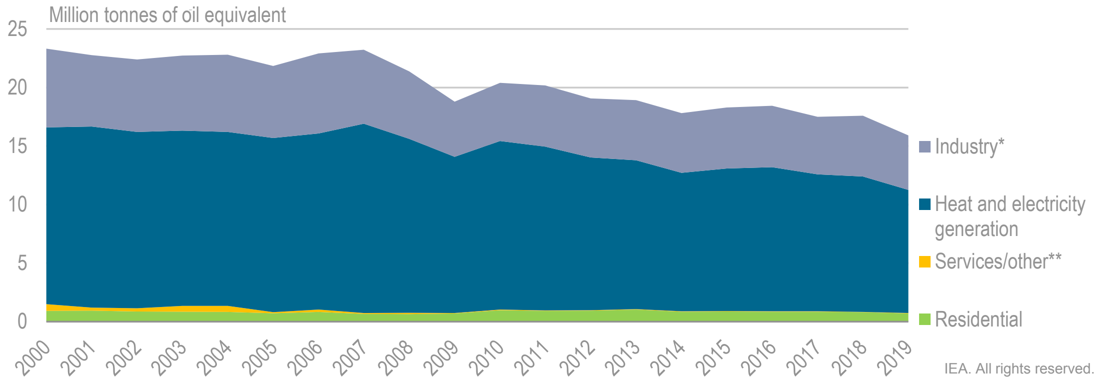


The Czech Republic has been a net coal importer since 2016, mainly from Poland and Russia, as the imports of metallurgical coal increased to 64% of total coal imports in 2020.

Source: IEA (2021b).

Coal demand in the Czech Republic was 14 million tonnes of oil equivalent (Mtoe) in 2019, a decrease of 19% from 18 Mtoe in 2009 (Figure 9.4). The largest part of the Czech Republic's coal consumption was used for heat and electricity generation, which accounted for 74% of total coal consumption (in energy terms) in 2019. Coal demand for heat and electricity generation fell by 21% between 2009 and 2019, as coal was replaced by nuclear energy for electricity generation and natural gas for heating. The second-largest share of coal was consumed in the industry sector, accounting for 33% in 2019. The amount of coal used for the industrial sector has remained relatively stable in the last decade. In 2019, most of the remaining coal was used in the residential sector (5%), with a marginal share in services/other (0.2%).

Figure 9.4 Coal demand in the Czech Republic by sector, 2000-19



Coal consumption in the Czech Republic has declined in line with a drop in coal demand for heat and electricity generation, which still accounted for over 70% of total coal consumption in 2019.

* *Industry* includes energy use in industry sectors and transformation in coke ovens and blast furnaces.

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

Source: IEA (2021a).

Industry structure and coal-mining policy

The Czech Republic has extensive recoverable coal reserves estimated at about 1.5 billion tonnes. Lignite accounts for about 80% of these reserves, and is mainly produced in northwestern Bohemia, while hard coal is mined in northern Moravia (EURACOAL, 2020; Cablik et al., 2019).

The government has set geographical limits for coal mining based on ecological and political parameters. The actual extractable coal reserves are therefore substantially smaller than proven reserves. Four private companies are active in lignite mining while only one, a state-owned company, undertakes the extraction of hard coal.

Hard coal

In 2018, the Czech Republic had 78 Mt of economically recoverable hard coal (including thermal and metallurgical coal) reserves. Hard coal is mined in the Karviná region of the Ostrava-Karviná coal basin, with approximately 23 Mt of recoverable reserves that is part of the Upper Silesian basin in North Moravia, near the Polish border. The exploitation of the substantial hard-coal reserves located in the Beskydy Mountains of the Ostrava-Karviná coal basin is banned. All hard coal is mined deep underground. About half of the hard-coal production is used for coke in the iron and steel industry; some hard coal is also used in co-generation plants and for district heating in the eastern parts of the country where it is mined.

Ostravsko-Karvinské Doly (OKD) is the only company extracting hard coal in the Czech Republic and its recoverable reserves accounted for 3 Mt on 1 January 2021.

In 2020, OKD operated three deep mining complexes:

(i) the ČSA mine in Karviná
(ii) the Darkov mine
(iii) the ČSM mine in the eastern part of the Karvina coal basis where coal is mined at two interconnecting sites: north and south.

In September 2020, OKD announced that it will permanently close the Darkov and the ČSA mines at the end of February 2021, following a decision by the Czech government to gradually transfer the mines to the state-owned company Diamo for decommissioning (Eurometal, 2020). As of 1 March 2021, only the ČSM mine was left in operation.

The Covid-19 pandemic forced OKD to temporarily hold operations. The ČSM mines and the ČSA mine in Karviná were closed in July 2020 for six weeks, while operations at the Darkov mine were already temporarily shut down in May 2020 (Guthrie, 2020).

In 2020, OKD produced 2.2 Mt compared to around 3.6 Mt in 2019 and over 8 Mt in 2015 (OKD, 2021).

A major change in the Czech coal industry since the IEA's last in-depth review is the renationalisation and subsequent restructuring of OKD, which filed for insolvency on 4 May 2016. Low international metallurgical/coking prices made OKD's operations increasingly unprofitable. The financially healthy part of OKD was first transferred to a subsidiary, OKD Nástupnická, which was then bought by the state-owned financial holding company Prisko under the Czech Ministry of Finance in 2018. OKD submitted a comprehensive restructuring strategy to the regional court in Ostrava in 2017, announcing plans to cease all mining operations by 2023 (Svobodova, 2017).

As a first step, mining operations at the Paskov mine ended on 31 March 2017. The Paskov mine was the only active mine in the Ostrava mining district and produced high-quality metallurgical coal/coking coal. Next, operations in the Darkov and Lazy mines ceased by the end of 2018 and in the ČSA mine by 2021. Finally, the last active mine, ČSM will be closed in 2023. The Lazy mine, part of the Karvina complex, was eventually closed in 2020, while the Darkov mine was still producing in 2020.

Lignite

Lignite is the only fossil fuel in which the Czech Republic is self-sufficient. On 1 January 2021, the Czech Republic had about 586 Mt of lignite reserves in the active open pit mines. In 2020, total lignite production was 31 Mt. Lignite is mined in the Karlovy Vary and Ústí region in North Bohemia and is used across a range of uses due to its large range of heating values, from less than 10 gigjoules per tonne (GJ/t) up to 18 GJ/t. Beyond its use in the power sector, lignite is an important input for the country's district heating systems, especially in the larger Czech cities. Between 2 Mt and 3 Mt of lignite is used in district heating stations and by households in the vicinity of the mining areas. A minor share of lignite is exported, for example to heating plants in the neighbouring Slovak Republic.

Four private companies mine lignite and all mining is open pit:

(i) Severočeské doly, a.s is the country's biggest producer of lignite, and part of the ČEZ Group. It operates two mines, in Bílina and Doly Nástup Tušimice/Libouš.

(ii) Vršanská uhelná a.s, part of the international Sev.en Energy group, operates the Vršany open pit with reserves said to last until about 2055.

(iii) Severní energetická a.s. is also part of Sev.en, and operates the largest lignite mine in the country: the ČSA open pit mine. Mining will cease in 2023 due to the regional ecological limits (see below).

(iv) Sokolovská uhelná, a.s. is the smallest lignite mining company and mines on Družba open pit. The company is considering potential future mining on the Jiří open pit.

Extractable lignite reserves were estimated at almost 4.4 billion tonnes in 2018, including the reserves in the active mines (Czech Geological Survey, 2019). However, most of these reserves are non-accessible as they are located in the ČSA and Bílina coal-mining areas in the Ústí region for which the Czech government established regional ecological mining limits in 1991 to protect the environment and avert the resettlement of the local population. In 2015, the government revoked the mining limit for the Bílina mine. It later also extended the Bílina mining licence to 2055, while the licences for all other lignite mines are set to expire in 2040. The decision was explained by the lack of resettlements needed for the mining extension. However, the local population voiced concern about the possible environmental impact on their living conditions and also expressed apprehensions that this decision would be followed by additional revocations of mining limits.

On the basis of an environmental impact assessment, in 2019 the Ministry of the Environment confirmed the extension of the Bílina mining limit from 2030 to 2055, but set conditions to limit the impact on the local population. The government did not revoke the mining limit for the ČSA mine, as it would have necessitated the resettlement of local communities. However, discussions about a possible revocation of the mining limit for the ČSA mine were ongoing until recently.

The Bílina mine has between 100 Mt to 150 Mt of additional lignite reserves that can be exploited following the revocation of the mining limit. The majority of the coal mined at the Bílina mine is used by the ČEZ Group. Beyond its use for power generation, coal from Bílina is also used by households for heating and co-generation.

Taxes and subsidies

Coal-mining companies are required to pay royalties on mining leases and extracted minerals. Royalties are paid per hectare of land leased and the rate varies for different locations, taking into account, for example, the type of activity conducted and the environmental impact of the activity. Royalties from mining leases therefore vary between CZK 100 and CZK 1 000 per hectare. Royalties on the extracted minerals cannot exceed 10% of the sales price of the extracted minerals.

Since 2000, the central state collects 25% of the revenues from royalties, while the remaining 75% is given to the municipalities affected by the mining activity. Forty per cent of state budget revenues (10% of total) are spent on remediation of environmental damages caused by the mining activities.

The Czech government earmarked EUR 1.58 billion to deal with ecological damage caused by mining before the privatisation of the mining companies, and for mitigating the impact caused by the termination of coal mining in the Kladno region. Those funds are drawn from the Privatisation Fund established in 1992 into which an earmarked portion of the receipts from the mine privatisation was paid into.

The Czech Republic provides subsidies related to the use of coal. Among those are subsidies for the retrofitting of existing coal-fired power (though those are no longer available) and co-generation plants to make them more efficient and extend their life cycle. However, funding for retrofitting that substitutes coal with coal is not permitted. The introduction of new co-generation capacity using coal with renewable sources is also subsidised. Subsidies are provided both as investment and as operational aid. The government has no plans to phase out coal-related subsidies as it considers those necessary to meet the climate and air pollution targets and to improve energy efficiency, as co-generation of power and heat reduces primary energy consumption (EC, 2019a). Until recently, the government also provided subsidies for the replacement of old coal-fired heating for new ones that combine biomass with coal. However, the ongoing third phase of the boiler replacement programme excludes this support (see Chapter 4).

The role of coal in the energy transition

As the country's only domestic fossil fuel, coal has been, and still is, a key energy source in the Czech Republic. Yet, the share of coal in the energy mix and, in particular in power generation, continues to decline. This is due to a combination of several factors: the ecological mining limits resulted in a gradual output reduction; the increasing EU Emissions Trading System (ETS) prices make coal less and less competitive compared to other energy sources, such as natural gas and renewables in the power sector; the strict emissions limits set by the European Union (EU) for power plants as of 2021; and the climate ambitions of the EU for 2030 and 2050. There are no new coal-fired generation plants under construction.

The use of coal in the Czech Republic significantly contributes to local air pollution, notably sulphur oxides (SO_2) and nitrogen oxides (NOx) emissions and particles. Although these emissions are steadily decreasing, they are still high in international comparison, causing health issues in larger cities. EU-level regulations for air pollution limits for power plants require power plant operators to either complete retrofitting by 2021 or to cease operations.

Operators in the Czech Republic plan to decommission at least five lignite power plants, with a total capacity of 1.56 gigawatts (GW) by 2023. This is about 14% of the total installed coal capacity in 2019. The total amount of installed coal-fired capacity that fails to meet the new EU guidelines is not known, though some studies have estimated that a considerable share of 40-60% of the country's coal-fired plants could be affected by the new directive (Alves Dias et al., 2018) (see Chapter 7). In May 2021, ČEZ, the country's dominant operator of coal-based electricity generation, announced plans to generate only 25% of its total generation from coal in 2025 and to reduce the share of coal to 12.5% in 2030 (ČEZ Group, 2021).

The question is therefore no longer if, but when, coal will be phased out from the electricity and heating mix of the Czech Republic and which fuels will replace coal in which sectors. There is already a solid base of international experience on how to move towards the decarbonisation of the power sector that can inform decision making in the Czech Republic. The decarbonisation of certain industries such as steel production is more complex and will require substantial investments in research and innovation as well as in energy efficiency (see Chapters 4 and 6). The Czech Republic could consider joining international efforts in this regard.

The Coal Commission

In 2019, the Czech government established a Coal Commission and tasked it to clarify the long-term role of coal in the Czech energy mix, while taking into account all the related impacts of a potential coal phase-out, such as the necessary maintaining of grid stability, regulatory steps and setting a detailed timeline. In December 2020, the Coal Commission recommended a phase-out of coal by 2038 (Reuters, 2020). In May 2021, the government asked the Coal Commission to reassess the possibility of an earlier exit as well as the impact on the Czech energy market (Reuters, 2021).

The Coal Commission was co-chaired by the Minister of Industry and Trade and the Minister of the Environment and included members from other government units, parliament, the chambers of commerce and industry, the three affected regions, labour unions, academia and environmental groups. It created three working groups for the:

- (i) identification of a schedule for the coal phase-out and its impact on the energy mix
- (ii) analysis of the main parameters of the phase-out and supporting legislation
- (iii) identification of the social and economic impacts.

The government set two constraints for the deliberations of the Coal Commission related to self-sufficiency and energy security. The first is to maintain 90% self-sufficiency of annual domestic electricity consumption and limiting electricity imports to 10% maximum in any given year. This condition was set in accordance with the current State Energy Policy (SEP) that is in the process of being revised (see Chapter 2). Regarding the energy security dimension, the loss of load expectation should not exceed the value of eight hours per year.

With these conditions in mind, the Coal Commission deliberated four scenarios:

- (i) reference: business-as-usual; maintaining the share of renewable energy sources as set in the SEP
- (ii) conceptual: coal phase-out in the electricity sector by 2038 and identifying options for the further decarbonisation of the heating industry
- (iii) progressive: coal phase-out by 2033, enhanced development of renewable energy sources and accelerated development of battery storage options
- (iv) ambitious: builds on the progressive scenario and maximises the development of photovoltaic power and even more accelerated storage options, including a significant development of seasonal storage.

While the mandate of the Coal Commission did not specifically require setting a deadline for the coal phase-out, the commission recommended a phase-out by 2038, in line with the conceptual scenario. However, this recommendation was not unanimous. Representatives of environmental organisations and the Minister of the Environment supported an earlier coal exit by 2033 (progressive scenario), while the representative of the Ministry of Labour did not support the 2038 phase-out, expressing concerns about an insufficient analysis of the social and employment impacts (Zachová, 2020).

In the conceptual scenario, total installed power capacity would reach approximately 22.4 GW in 2038, slightly lower than in the reference scenario, and generation would be just under 77.1 terawatt hours (TWh), slightly higher than in the reference scenario. This compares to 22 GW and 85.8 TWh in 2019.

In the preliminary modelling results for 2038, coal would be replaced entirely by natural gas, with a share of 21% of total generation, while the share of renewable sources would stay more or less equal to the reference scenario, at 25% of total generation, which is in line with the upper target set in the SEP for 2040 and just marginally more than the 22% target in the National Energy and Climate Plan (NECP) (MIT, 2015; EC, 2019a). Nuclear capacity would become the single largest generation source after reaching 5 GW of installed capacity, which is consistent with current plans to build an additional 1.2 GW capacity.

It is important to note that the Coal Commission worked on the assumption that in the reference scenario for 2038, installed capacity of coal and coal-fired generation would already be substantially lower than in the reference scenario for 2033. In the reference scenario for 2038, coal capacity would be just under 3 GW and generation just under 9.4 TWh, compared to 4.9 GW and 19.4 TWh in 2033. This compares to 10.7 GW installed capacity and 39.4 TWh generation in 2019.

Table 9.1 Installed electricity capacity in reference and conceptual scenarios in the Czech Republic, gigawatts (GW)

Product	Scenario	2019	2033	2038
Coal	Reference Conceptual	10.7	4.89 2.90	2.96 0
Gas	Reference Conceptual	2.30	1.32 2.22	1.32 3.72
Nuclear	Reference Conceptual	4.29	4.06 4.06	5.20 5.20
Renewables	Reference Conceptual	4.69	9.08 9.08	10.55 10.60
Batteries	Reference Conceptual		0.97 0.97	1.18 1.18
Heat producers	Reference Conceptual		1.58 1.58	1.66 1.66
Total	**Reference** **Conceptual**	**21.98**	**21.90** **20.81**	**22.87** **22.36**

Sources: ERU (2021); and information provided by the government from the "Intermediate outputs and recommendations of the Coal Commission (version for interministerial consultation in February 2021)".

Independent analyses undertaken by Bloomberg NEF and EMBER, an international climate and energy think tank, shows that an earlier phase-out of coal, by 2030, would be possible under certain assumptions.

Bloomberg NEF modelled how the EU ETS price would develop for two different cases – if the EU adopts a 50% or a 55% EU-wide emissions reduction target for 2030 (compared to 1990 levels) – the existing target for 2030 is a 40% reduction. In the 50% reduction scenario, ETS prices would reach over 50 euros per tonne of carbon dioxide (EUR/t CO_2) in 2030; in the 55% reduction scenario, they would reach almost EUR 80/t CO_2. In either case, the Czech Republic's coal-fired generation fleet is expected to become uncompetitive by 2030 taking only economic factors into consideration for plant dispatch (Poseidon, 2020). In other words, the Bloomberg NEF model was not limited by the current government policy to remain preferably a net electricity exporting country, and in any case not to exceed 10% of imports to meet annual demand.

The report specifically notes the lack of a pipeline of renewable projects in the Czech Republic, which implies that most of the gap from an earlier coal exit would be filled by gas, at least initially. Gas-fired power plants would provide the dispatchable capacity needs that are currently met by coal (Poseidon, 2020).

The second study, by EMBER, also showed how coal can be phased out from the electricity and heat mix already in 2030. This analysis took a different approach, by setting the coal phase-out in 2030 as the condition then modelling the various pathways to get there, instead of showing how coal would be phased out due to loss of economic competitiveness (Rosslowe et al., 2020).

The EMBER study also identified the need for additional gas-fired capacity, which would be supplemented by the introduction of grid-scale battery storage to replace the need for additional dispatchable thermal capacity. Renewable capacity would expand faster in the second half of the 2020s, which would result in a declining competitiveness of gas-fired generation. In this model, the Czech Republic would become a net importer of electricity in 2030, albeit at a marginal level (Rosslowe et al., 2020). An interesting difference between the two studies is the role played by wind and solar PV in replacing coal. While the Bloomberg model sees wind accounting for 25% of total generation in 2030 and solar PV for 10%, the EMBER model has shares of 15% of PV and 14% of wind power in 2030.

Gas-based generation can play an important role in the transition to a carbon-free power sector, especially in countries where the dependence on coal today is substantial. At the moment, there are no additional gas-fired plants in the pipeline in the Czech Republic, and they are not likely in the future. There is a need to ambitiously expand the share of renewables and storage capacity starting today to achieve the new ambitions for 2030 and the 2050 carbon-neutrality target. Gas-fired capacity is also subject to the EU ETS and likely to be suffering from a similar fate as coal by becoming increasingly uncompetitive against renewables.

However, the long-term process and timeline for the coal phase-out and the contribution of individual alternative fuels (except for nuclear) is yet to be decided. This will be elaborated during the process of revising the SEP, which should be completed by late 2023 and also in light of the eventual new climate reduction target agreed upon at the European level for 2030. Moreover, the coal phase-out path would be reviewed every five years. Nevertheless, it is important to provide planning certainty to investors to ensure that the necessary capacity is built, and perhaps even earlier than currently envisaged. The government should ensure that its industry and energy policy agenda remain well articulated. In addition, it will be important to identify if, and if so what type of support mechanisms are needed to ensure investment materialises.

Coal phase-out in heating

Coal is the dominant fuel for district heating (DH) at 58% and around 40% of households are connected to DH systems in the Czech Republic. Large coal-fired DH systems fall under the EU ETS and are also subject to the stringent EU legislation for pollutants such as NO_X and SO_X that became effective in 2021. They have hence become less competitive compared to decentralised heating systems. However, DH systems are frequently more energy efficient than individual heating systems as they usually rely on co-generation. The government is therefore committed to maintaining the efficient heating networks by converting co-generation to gas, at least initially until other alternatives to coal and gas have proven their suitability. For smaller local heating networks, the possibility to use heat pumps is also being considered (see Chapter 4). The government is in the process of preparing a dedicated heating and cooling strategy that will reflect the coal phase-out and the overall transformation of the energy sector.

The EMBER model also examined the impact of the coal phase-out on the heating sector. Its results show that about two-thirds of heat from coal co-generation plants could be replaced by large heat pumps, waste heat recovery and higher building energy efficiency. The remaining third would be replaced by gas co-generation and gas boilers. The study affirms that there is sufficient potential for this in the country to make it the most economic replacement of coal (Rosslowe et al., 2020).

About 5% of annual coal demand is still used directly by households for heating, especially in more remote areas that do not have access to the DH systems and by lower income households. This demand is expected to decline as regulations for private coal boilers are tightening and the government is implementing a programme for their phase-out; however, the trajectory is unclear (see Chapter 4).

As part of its mandate, the Coal Commission also explored how a just transition in the mining regions could be achieved.

Just transition

Coal mining is important for employment and the economy in otherwise structurally weak regions. The coal phase-out concerns in particular the Ústi, Karlovy Vary and Moravian-Silesian regions that are economically heavily dependent on coal, either through direct or indirect employment, but also due to the regional taxes and other payments from mining companies. Unemployment rates in these three regions is consistently above that of other regions in the Czech Republic (Radulov et al., 2019). In line with the continuously declining role of coal in the energy mix, related employment has already dropped significantly over the last 15 years and this trend will accelerate in the future.

In 2015, the Czech Republic had 21 600 direct coal-related jobs: 18 000 in mining and 3 640 in power plants (Alves Dias et al., 2018). At the end of 2019, direct employment in coal mining had decreased to just over 13 000 (CSO, 2021), while indirect employment related to coal-mining activities is estimated at around 50 000.

The workforce of the hard-coal mining company OKD declined from over 13 000 employees in 2016 to around 8 400 in 2020. A small number of workers from closed mines is retained for the rehabilitation work, while some were reallocated to OKD’s other mines. With the expected full mine closure by 2023 at the latest, the majority of the employees plus some of those whose livelihood depends on the local economy generated by the miners will lose their jobs. Employment related to brown coal mining in the Ústí and Karlovy Vary regions in Bohemia is also steadily declining as coal-fired generation is being phased out, which further raises the need to ensure a just transition of the regions. The ČEZ Group has plans to retrain and redeploy all of its employees involved in coal mining and coal-fired generation to other parts of the company, for example in its large battery factory.

RE:START Programme

In 2015, the government launched the RE:START Programme as a comprehensive framework for the restructuring and fair transformation of the three concerned mining areas. The government adopted a strategic framework for the programme in January 2017 that targets the larger economic, social and environmental issues in the concerned areas beyond the impact of the immediate employment losses. The measures under the framework are implemented through annual action plans, one for each region, with the first ones starting in July 2017. This allows for regular evaluations and to flexibly adapt the programmes as needed (EC, 2019b).

A key feature of the RE:START Programme is its governance structure that links central government units with regional ones from the public and private sector and civil society. Notably, the programme is led by the Ministry of Regional Development. The ministry established a National Executive Team that further develops and implements the strategy jointly with regional counterparts that are organised in thematical working groups covering topics such as business and innovation, infrastructure, the environment, and human resources. In addition, "permanent district conferences" ensure that local expertise and knowledge feeds into the strategy and the action plans. The Ministry of Industry and Trade is closely involved in the RE:START Programme as it also maintains regional offices, including in the concerned mining areas (EC, 2019b).

One of the major hurdles identified in the early phase of the programme is the lack of human and technical capacity in the concerned regions to absorb the available funds. Beyond the identification of specific support projects, the RE:START Programme is therefore engaged in institution building at the regional level. Representatives of the RE:START Programme also participated in the Coal Commission and the RE:START Strategy and action plans will be updated once the recommendations of the Coal Commission have been accepted by the government (see above).

Beyond the employment-related aspects of the coal phase-out, its impact on regional and municipal budgets is also significant. Further to the mandatory payments under the Mining Act (see above), the mining companies have a history of providing sponsorship funding for a variety of causes. Those are estimated to be in the tens of millions of euros annually (Radulov et al., 2019). Part of the funds under the RE:START Strategy will, in effect, not be additional, but replace other sources of funding.

The RE:START Programme uses a mixture of national and EU funds, totalling EUR 1.5 billion for the third action plan, which covers the period 2019-30 (EC, 2019b). This provides long-term financial stability for planning and implementation, as the regional restructuring process will take decades. Around EUR 303 million are from the EU Structural and Investment Funds, EUR 80 million from the special national privatisation fund and the remainder comes from the Czech national budget (EC, 2019b). However, there is an expectation that in the next funding phase, contributions from the EU, especially from the new Just Transition Fund, and from private funds, will increase.

In 2020, the EU launched the European Green Deal and the Just Transition mechanism to mobilise investments for reaching climate neutrality by 2050 and to provide financial and practical support for the economic and social transformation this will bring. The aim is to mobilise EUR 100 billion for the programming period 2021-27 for the most affected regions in the EU, including EUR 7.5 billion, mainly as grants, under the Just Transition Fund. To access the funds, EU governments have to identify eligible territories through dedicated territorial just transition plans, which the Czech Republic has already done. Further, each

Euro from the Just Transition Fund must be matched with money from the European Regional Development Fund and the European Social Fund Plus and governments must also commit to provide additional national resources. The funding from the Just Transition Fund will be enhanced by technical assistance to the concerned regions and the aim is to also mobilise private sector funding. Moreover, the European Investment Bank will create a public sector loan facility to finance projects such as the modernisation of district heating networks and energy efficiency in the building sector (EC, 2020).

The Czech Republic is well placed to benefit from the Just Transition Fund given its ongoing RE:START Programme. Yet, concerns have been voiced that the RE:START Programme currently lacks sufficient in-depth assessment of the expected outcomes of the programmes to support the social, economic and skills transition.

Carbon capture, utilisation and storage

While the government supports research in carbon capture, utilisation and storage (CCUS) and related activities, there are no specific policies in place or being developed regarding CCUS. The framework for possible CCUS applications was established by a 2012 act that prohibited geological carbon storage until 1 January 2020. However, no permitting process is currently underway and there is no specific co-operation with neighbouring countries.

The Czech Geological Survey has found significant storage potential in the deep saline aquifers of the Central Bohemian basins and (semi-)depleted hydrocarbon fields of eastern Moravia. Storage capacity in the Silesian coal basin is estimated to be between 118 million tonnes carbon dioxide (Mt CO_2) to 380 Mt CO_2 (Alves Dias et al., 2018).

A small depleted hydrocarbon field in the Czech part of the Vienna basin was identified as a possible experimental storage site and first steps towards obtaining a storage permit and realisation of CO_2 injection in the future were undertaken at that time. This work was undertaken as a joint programme with Norway, which was the only bilateral support received by the Czech Republic for CCS. The programme ended in 2014 and talks to extend the project did not succeed. The Czech Geological Survey is seeking funding for further development of this demonstration project. There are no operational demonstration projects in the Czech Republic.

The Technology Agency of the Czech Republic provided financing for research and development of CCS technologies and CCS projects are also supported by specific R&D programmes of the Ministry of the Environment and the Ministry of Industry and Trade.

A new major project “Research centre for low-carbon energy technologies” was launched in 2018. It is focused on oxyfuel combustion of various sorts of biomass in a fluidised bed, oxy-gasification of biomass and utilisation of the captured CO_2 to produce liquid fuels. The project should be finalised by 2022.

In light of the expected phase-out of coal, R&D funding should focus more on the application of CCUS in emission-intensive industries such as cement and steel, which are hard to decarbonise. Focusing R&D on a repurposing strategy for existing coal-fired plants to use alternative fuels such as hydrogen, ammonia and biomass could also be considered.

Assessment

Coal is the most important fuel in the Czech energy mix. In 2020, it accounted for 43% of domestic energy production and 41% of electricity generation. In the same year, coal accounted for 30% of TES. The share of coal in the energy mix of the Czech Republic has declined noticeably since 2000, and is expected to gradually decline further. The country supply consists mostly of domestically produced lignite (85%), as well as metallurgical coal (9%) and thermal coal (6%). In 2016, the Czech Republic became a net importing country of coal, as imports of mainly hard coal surpassed coal exports.

As there is hardly any oil or gas production in the country, the government sees the domestic coal supply as important for energy security, but also as a source for employment in economically weak regions with little alternative employment opportunities. In the NECP, the government projects that coal will still account for 40% of domestic energy supply in 2030, with nuclear and renewables being the second- and third-largest sources.

In 2019, the government established a Coal Commission jointly chaired by the Minister of Industry and Trade and the Minister of the Environment. Its main task was to clarify the long-term role of coal in the energy mix, taking into account all relevant impacts, including generation adequacy, short-term electricity security, and social and economic impacts. The 19 members of the commission were from the relevant ministries and regions, unions, academia, and non-governmental organisations.

In December 2020, the Coal Commission recommended phasing out coal by 2038. In the power sector, nuclear, but mainly natural gas, is expected to fill the gap left by coal, while the share of renewable sources would only increase marginally beyond what is currently projected in the NECP for 2030. In the heating sector, coal would also be replaced by a combination of fuels; a specific heating strategy is currently being prepared. For comparison, according to the NECP, coal would still account for 38% of electricity generation in 2030. In heat production (mostly district heating), coal would still be the dominant source with 47% in 2030, down from 58% in 2019. In May 2021, the government requested that the Coal Commission assess the possibility for and impact of an earlier coal phase-out.

It should be noted that more stringent EU climate policies are under discussion, notably an ambition to reduce emissions by at least 55% by 2030, compared to the current goal of a 40% decrease. Such a higher target will most likely increase the EU ETS price for CO_2 emissions considerably and consequently reduce the competitiveness of coal-fired power and heat generation. In addition, new emissions limits for coal-fired plants became effective in 2021, adding additional pressure on the viability of coal. Several independent research studies have shown that a coal exit by 2030 is, at least in the power sector, possible, if the Czech Republic increases its ambition for the roll-out of renewables to be on par with other European countries.

While setting a date for the coal phase-out would offer certainty, clarity about the detailed path towards it is still missing and will be elaborated during the revision of the State Energy Policy that is underway and expected to be finalised by late 2023. Lacking this, investors may be reluctant to advance on plans for new power or heat generation, apart from those that can count on support from the government. A supportive investment framework for gas and for renewables is needed, especially since investments in gas-fired power and heat generation will be needed to bridge the gap to a fully decarbonised supply in 2050, which will likely become a stated goal of the government.

The Czech Republic's coal supply decreased by 18% from 2009 to 2019, which has already resulted in job cuts. In 2020, the Covid-19 pandemic caused a 17% drop in one year. The government established the RE:START Programme in 2015 to address the fair transformation of the concerned coal-mining areas. The programme is currently funded from the national budget and EU programmes. The ongoing RE:START Programme provides the country with an excellent base to tap into the funds provided under the EU's Just Transition Fund, which requires regional-specific transformation programmes as a precondition.

Both lignite and hard-coal mines exist, but most of the mined coal is lignite. The Czech Republic has sufficient reserves to allow lignite mining to continue up to 2040 for most of the mining sites and to 2055 for the Bílina mine, where limits for mining were expanded in 2015. In light of the coal phase out by 2038 at the latest, the government should no longer expand the limits of existing mines and should not provide new mining licences. Mining of hard-coal reserves is becoming increasingly unprofitable. The Covid-19 pandemic has affected mining operations and accelerated the closure of hard-coal mines due to increasing losses caused by dropping coal prices. The last hard-coal mine is expected to close at the latest by 2023, while the other two mines closed in 2021.

In 2020, there were still around 60 000 direct and indirect jobs related to coal. When the coal mines close, it will be a challenge to find new employment for these people, but the mining companies expect that with the help of the EU Just Transition Fund, most of the direct employees can be trained into new jobs for the same companies. However, those that are indirectly employed through coal mining face more difficulties and could also benefit from the Just Transition Fund. Repurposing of coal plants in regions could also help to save jobs in the region while at the same time provide services to the grid in areas where grid stability may be of concern after the coal exit.

The government supports research in CCUS and related activities, but no specific policies are in place or being developed. The framework for possible CCUS applications was established in 2012 with an act that prohibited geological carbon storage until 1 January 2020. However, no permitting process is currently ongoing and there is no specific co-operation with neighbouring countries.

Significant storage potential exists in the country and the government identified a small, depleted hydrocarbon field in the Czech part of the Vienna basin as a potential experimental storage site. Although first steps towards obtaining a storage permit and realisation of CO_2 injection have been undertaken, there is no operational demonstration project in the Czech Republic. Several hard-to-abate sectors (cement, steel, refineries) could benefit from a dedicated government programme on the application of CCUS in order to prepare them for a net-zero emissions future.

Recommendations

The government of the Czech Republic should:

- Make use of the EU's Just Transition Fund to redevelop the affected regions and train coal miners and workers in related companies for other jobs.
- Swiftly decide on the recommendations of the Coal Commission to provide clarity to potential investors in heat and power generation.
- Prepare for new incentive mechanisms that may be needed to trigger new investments in heat and power generation to substitute for coal-fired supply, taking into account generation adequacy and short-term security of supply.
- Support research and pilot projects for CCUS in hard-to-decarbonise industry sectors such as cement, steel and refineries.

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10. Natural gas

Key data (2019)

Domestic production: 0.2 bcm, -5% since 2009.

Net imports: 9.5 bcm (9.51 bcm imports, 0.03 bcm exports).

Share of gas: 1% of domestic energy production, 17% of total energy supply (TES),[1] 7% of electricity generation, 20% of total final consumption (TFC) (2019).

Gas consumption by sector: Industry 30%, residential 25%, electricity and heat generation 24%, services 18%, other energy 1%, transport 1%.

Exchange rates (2020):* Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* OFX (2021)

Overview

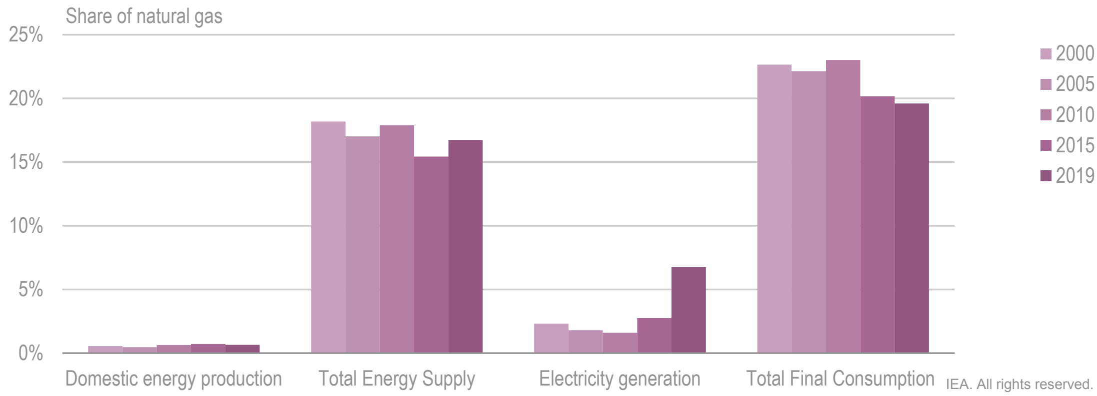
Natural gas accounted for 17% of total energy supply (TES) in 2019. The share has slowly decreased since 2000, but has always remained above 15% (Figure 10.1). Almost all natural gas supplied in the Czech Republic is imported. The share of electricity generation from natural gas increased from 2% in 2010 to 7% in 2019, as a new combined cycle gas-fired power plant was commissioned in Počerady in 2014. The share of natural gas in total final consumption (TFC) declined from 23% in 2010 to 20% in 2019.

In the context of the energy transition of the Czech Republic, natural gas is expected to remain an important fuel towards 2040, when the government expects its share in total primary energy consumption to be 18-25% (MIT, 2015). Natural gas will be an important fossil fuel in the transformation of the Czech energy sector when coal use will be phased out of the electricity generation sector, and the use of oil products in transport will be reduced. However, in the longer term towards 2050 and beyond, the use of natural gas is expected to decline through enhanced energy efficiency and the deployment of renewable energy.

Natural gas is also important for robust energy security, which can be further strengthened through diversification of gas import sources, the construction of a number of infrastructure projects and the effective functioning of domestic gas storage facilities by enhancing the liquidity on the wholesale market. The government has recently enhanced the security of gas supply though a number of projects.

[1] Total energy supply does not include oil used for international bunkering.

Figure 10.1 Share of natural gas in the Czech energy system, 2000-19



The share of natural gas in the Czech Republic's total final consumption has decreased over time but it increased exceptionally in 2019 in total energy supply after a continuous decrease.

Source: IEA (2021a).

Supply and demand

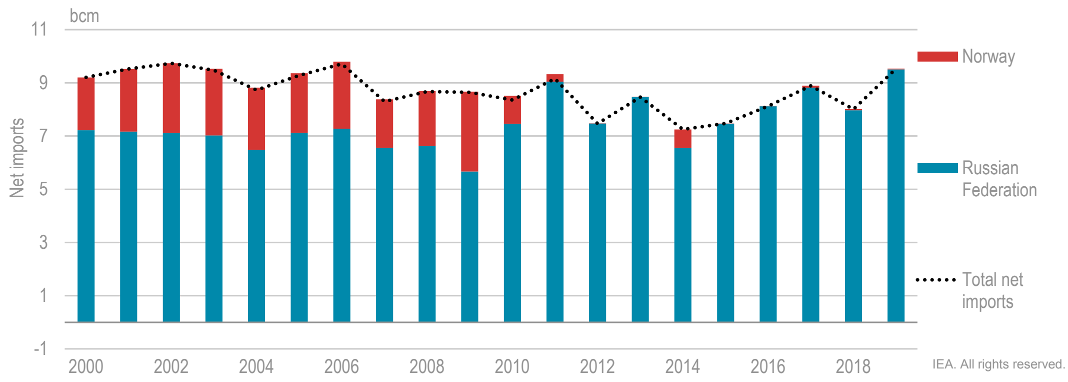
Supply

Domestic natural gas production in the Czech Republic is negligible and accounted for approximately 1.5% of the domestic demand (131 million cubic metres [mcm]) in 2019; the remaining 98.5% of Czech gas supply is imported through pipeline interconnections. As a landlocked country, the Czech Republic does not have any LNG terminals. Domestic natural gas production is concentrated in Southern Moravia (the eastern part of the country), produced by MND (Moravské naftové doly), and, to a lesser extent, Northern Moravia (produced by Green Gas DPB) for local needs in the region. In 2018, natural gas reserves stood at approximately 30.6 billion cubic metres (bcm), of which 4.6 bcm was recognised as extractable reserves.

Trade

In 2019, the Czech Republic imported 9.5 bcm of natural gas, almost entirely from the Russian Federation. Imports from Norway accounted for the remaining 0.03 bcm in 2019 (Figure 10.2). Gas imports from Norway peaked in 2009 when they accounted for 35% of domestic gas consumption. Since 2017, imports from Norway have continuously decreased. Presently, Czech importers have no long-term contracts with Norwegian gas suppliers. Exports of natural gas are negligible. However, the country is an important transit corridor for Russian natural gas into Western European markets. Some of the gas is also transited to Central and Eastern Europe via Lanzhot to the Slovak Republic and further on. In 2019, 73.6% of gas entering the Czech Republic was transit gas for neighbouring countries, and the remaining 26.4% was either consumed or injected into storage in the country.

Figure 10.2 The Czech Republic's natural gas net imports by country, 2000-19



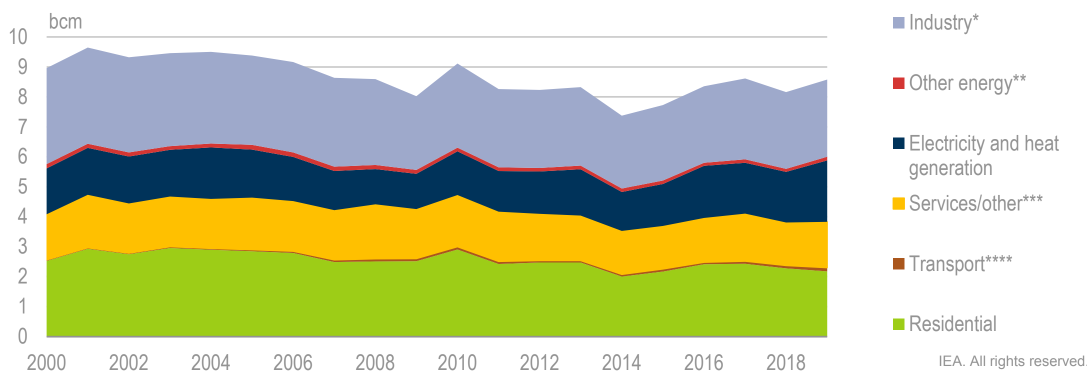
The Czech Republic is an importer of natural gas from Russia and Norway.

Note: Exports to Austria amount to less than 0.1 bcm (2003-13) and are not visible at this scale.
Source: IEA (2021a).

Demand

Natural gas consumption increased by 5% in the decade from 2009 to 2019, driven by a growing economy. The industry sector is the dominant consumer, followed by the residential sector and electricity and heat generation (Figure 10.3). In comparison with 2009, gas demand in 2019 from electricity and heat generation and industry sectors increased by 75% and 5% respectively, while demand over the same decade from the residential and services/other sectors declined by 13% and 7%, respectively. In the latter sectors, gas is used for heating purposes, and varies with weather conditions (see below the section on gas security and emergency response).

Figure 10.3 Natural gas demand in the Czech Republic by sector, 2000-19



Natural gas consumption has increased by 5% in the past decade in the Czech Republic.

* *Industry* includes non-energy use and energy demand from petroleum refineries.
** *Other energy* includes oil and gas extraction and other energy sector use.
*** *Services/other* includes commercial and public services, agriculture/forestry, and fishing.
**** *Transport* gas demand is poorly visible at this scale, at 0.1 bcm since 2006.
Source: IEA (2021a).

Gas policy and outlook for natural gas

Legal and Regulatory Framework

The key legislative framework for the Czech natural gas market and industry is laid down in Act No. 458/2000 Coll. (the Energy Act) on business conditions and state administration in the energy sector. Under this act and other relevant legal structures, the Ministry of Industry and Trade (MIT)[2] is responsible for ensuring the fulfilment of obligations arising from international agreements and treaties binding for the natural gas sector in the Czech Republic.

Since 2001, the Energy Regulatory Office (ERU) is the market regulator and is responsible for the oversight and economic regulation of the energy sector. The ERU sets regulations under the Energy Act. The market operator, OTE, carries out its activities under a licence awarded by the ERU, operates the Czech gas and electricity markets (OTE, 2018). NET4GAS holds the exclusive gas transmission system operator (TSO) licence and operates pipelines for international transit and national transmission of natural gas (NET4GAS, 2020a). At the distribution level, 65 companies hold a distribution system operator (DSO) licence

Natural gas outlook

In the period to 2040, natural gas will be an important fuel in the transformation of the Czech energy sector, supporting a gradual move away from the use of coal for electricity generation and a reduction of liquid fuels in transport. The SEP indicates that the share of natural gas in total primary energy consumption will rise from 15% in 2018 to 18-25% in 2040 (MIT, 2015). With the gradual phasing out of coal, the use of natural gas, biogas, biomethane and, in the more distant future, synthetic methane and hydrogen, is expected to increase. According to the SEP, from 2020 to 2040, the use of natural gas in heat supply will remain stable while the use in transport and electricity production will increase by 91% and 81%, respectively.

As other IEA countries, the Czech Republic sees a need of assessing when and how to end the use of coal. The national Coal Commission was established in July 2019 to clarify the long-term role of coal and its potential phase-out. In December 2020, the commission recommended phasing out coal by 2038, and in May 2021 the government requested the commission assess the possibilities for and implications of an earlier coal exit (see Chapters 2, 7 and 9). The SEP, which predates the recommendations from the Coal Commission, expects a moderate increase of the share of gas in electricity generation, from 4.4% in 2020 to only 8% in 2040. When deciding on the recommendations of the Coal Commission, the government should also clarify the long-term prospects of natural gas to ensure that business plans of the gas industry and gas policy agendas of the government become well aligned.

Gas policy

In the transport sector, the government aims to increase the number of vehicles using compressed natural gas (CNG) in municipal public transport, municipal waste collection

[2] See Annex A for more information on organisations and offices with relevancee to the energy sector.

and of large enterprises. From 2010 to 2018, the average sales of CNG vehicles grew by about 30% year-on-year, and in 2019 there were about 25 310 natural gas vehicles (23 036 passenger cars, 1 453 buses and 821 others – off-road cars, community vehicles) in the Czech Republic. In tandem, the infrastructure of CNG filling stations is developing: there were 217 public CNG filling stations and 2 LNG stations in the Czech Republic in 2020 (NVGA Europe, 2021). According to the 2019 update of the National Action Plan for Clean Mobility (NAP CM), the CNG vehicle market should reach 35 000 vehicles (about 0.6% of total fleet) and approximately 350-400 public CNG filling stations by 2030 (EC, 2019).

In order to reduce natural gas demand through enhanced energy efficiency and the deployment of renewable energy, the government also aims for the transformation of natural gas to biomethane, synthetic gas and hydrogen production, and their use in the gas system. However, the efforts to replace natural gas with sustainable gases need to be accelerated, as the future of natural gas in the energy mix is uncertain in light of the EU climate and emissions reduction targets.

The Czech Republic is focusing on hydrogen as an alternative fuel in the transport sector, which is in line with Directive 2014/94/EU on the implementation of alternative fuels infrastructure. The Czech government set a target for the development of hydrogen filling stations: three to five stations should be built by 2025, with further increases expected in the longer term. The government also established an expert group to address different questions related to development of hydrogen in the Czech Republic. Furthermore NET4GAS is part of the European Hydrogen Backbone project, which envisages the first use of the Gazelle pipeline for hydrogen transport around 2035.

The government is spurring the integration of the Czech gas market into the Central and Eastern European markets to achieve a highly competitive gas market, harmonised market rules, price setting and tariff mechanisms, and simplified access to the market. Specifically, the government has supported the integration of the gas markets of the Czech Republic, Germany, Hungary, Poland, the Slovak Republic as well as Austria, later to be linked to other markets within the EU.

Market structure

The implementation of Directive 2009/73/EC concerning common rules for the internal market in natural gas (EU, 2009) triggered the process of legally unbundling vertically integrated gas companies. It also gradually enabled all customers to choose their gas supplier. In this context, the ERU, is authorised to regulate segments in which competition is not feasible for technical or organisational reasons (i.e. gas transmission and distribution services and the market operator's services) as well as wholesale and retail markets, notably in terms of consumer protection and supplier switching. The TSO, the DSOs and storage system operators are legally unbundled from wholesale and retail suppliers.

The Energy Act, and the implementing acts based thereon, guarantee the right to switch gas supplier to all customers. This change is free of charge. Subject to the existing commercial terms and conditions, every customer therefore has the right and opportunity to select their gas supplier.

Wholesale market

The Czech gas market has been liberalised since 2007 and has gradually been modified in compliance with the European Commission's third energy package (EC, 2021). The ERU does not have the competence to set prices for gas traded in wholesale markets; they are set by the market. Since the Czech Republic does not have any significant indigenous gas resources, most of the gas is imported then traded between gas market participants. Traders operating in the wholesale gas market can buy gas at commodity exchanges, under short-term and long-term contracts, or market participants enter into bilateral contracts. Long-term contracts are no longer preferred by gas shippers and consumers; their share is declining. Reasons for this may be the better prices on the spot market, and that buying gas on a long-term basis is riskier due to the uncertainty in the development of the portfolio of customers who supply gas. However, a significant quantity of the gas traded between gas market participants is imported into the Czech Republic under historical contracts, which were agreed before market liberalisation in 2007 (ERU, 2019).

The number of registered participants in the gas wholesale market increased from around 80 in 2014 to 98 in 2019, with a total traded volume of 13 752 gigawatt hours (GWh) (of which 81% was traded in the spot gas market) (ERU, 2019). In 2019, the churn rate was 2.97. Nevertheless, market shares are concentrated among a few suppliers. As of January 2020, four companies (Innogy Energie, ČEZ Prodej, Pražská plynárenská and E.ON Energie) served 75% of customers and 60% of gas consumption. According to the ACER-CEER *Market Monitoring Report 2019* (Gas Wholesale Market Volume), the Czech wholesale gas market is highly concentrated, with a Herfindahl-Hirschmann Index (HHI)[3] of 7 371 points in 2019, which is one of the highest in the EU (the average of EU member countries was 4 057 points in the same year) (ACER, 2020).

Retail market

At the end of 2019, there were 2 834 509 consumer supply points connected to regional distribution systems in the Czech retail gas market, compared to 2 870 000 in 2010 (a decrease of 1.2%). A more detailed overview of the structure of customers taking gas in the Czech Republic is shown in Table 10.1.

Table 10.1 Overview of natural gas customers in the Czech Republic, 2019

Customer category	Number of supply points	Share (%)
High-demand customers*	1 692	0.06%
Medium-demand customers**	6 760	0.24%
Low-demand customers***	206 264	7.28%
Households	2 619 793	92.42%
Total	**2 834 509**	**100.00%**

* High-demand customers are customers using more than 4 200 megawatt hours (MWh) per year.

** Medium-demand customers are customers using between 630 MWh and 4 200 MWh per year.

*** Low-demand customers are customers using up to 630 MWh per year.

Source: ERU (2019).

[3] The Herfindahl-Hirschman Index (HHI) is an indicator for market competition. It ranges between 0 for an infinite number of small firms (maximum competition) and 10 000 for one firm with a 100% market share (no competition). An HHI above 2 000 signifies a highly concentrated market with a small number of firms.

In 2019, there were 125 active gas suppliers; of those, 81 had more than 100 gas supply points registered in the OTE system. In terms of quantities supplied, the largest market shares were held by three suppliers (innogy Energie, Pražská plynárenská and E.ON Energie), which together accounted for over 50% of the total retail market. According to the ACER-CEER *Market Monitoring Report 2019* (Energy Retail and Consumer Protection Volume), the Czech retail gas market for households is regarded as being moderately concentrated, with an HHI close to 2 000 points, which is the 6th lowest in the EU.

Since January 2007, all final consumers in the Czech Republic are entitled to freely switch supplier. In 2019, the annual switching rate was 7.6%, decreasing from 9.3% in 2018. The largest number of supplier switches, 190 446, took place in the household category and accounted for 7.3% of all household connections (decreasing from 8.6% in 2018). It also accounted for 88.8% of all supplier switches in 2019 (OTE, 2019a).

Should any supplier be declared insolvent, a supplier of last resort is appointed to ensure gas supply for six months. Suppliers of last resort supplied 60 000 cubic metres in 2018. In 2019, no supplier was declared insolvent.

Retail prices and taxation

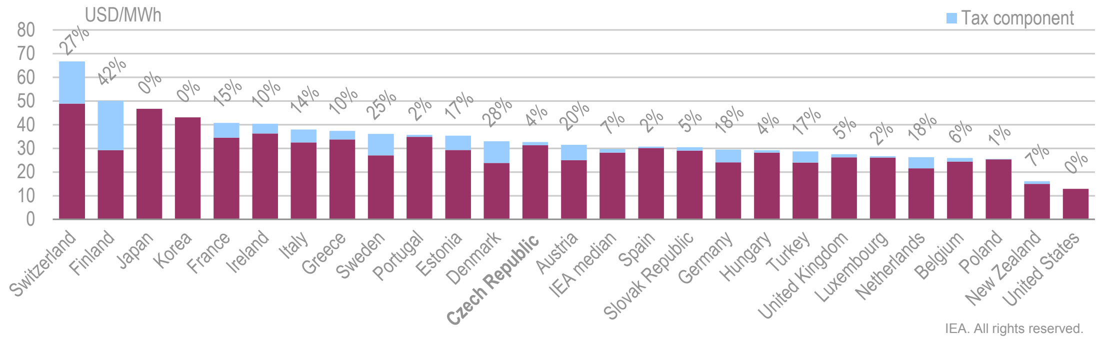
In the fully liberalised gas market of the Czech Republic, the ERU sets only the tariffs for transport and distribution. Gas prices and the charge for commercial services depend on the trader's business strategy and are subject to contractual relationships between suppliers and customers.

Retail natural gas prices in the Czech Republic are composed of wholesale gas costs, network tariffs and the value-added tax (VAT). In 2019, the average price for gas for household customers consisted of 62.2% of wholesale gas costs, 1.2% of transmission costs, 19.1% of distribution costs, 0.1% of costs for the market operator's services and 17.4% of VAT (ERU, 2019).

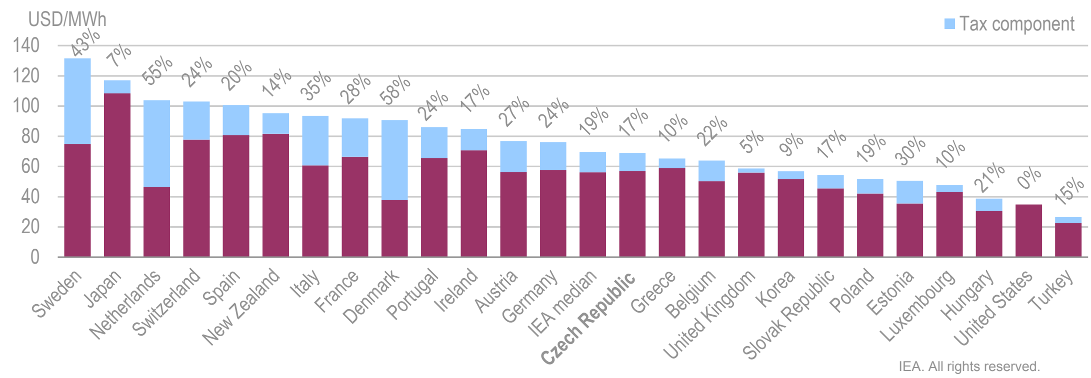
In 2019, the retail gas price for industry was close to the median of IEA member countries (Figure 10.4). Industrial consumers paid 33 US Dollar (USD) per megawatt hour (USD/MWh), with a tax share of just 4%, the 13th highest price, but with a lower tax share compared to other IEA countries. The household gas price was 69 USD/MWh, with a 17% tax share, the 12th lowest price, and with an average tax share compared to other IEA countries. The Czech Republic's industry and household gas prices show trends similar to those of its neighbouring European countries (Figure 10.5).

Figure 10.4 Natural gas retail prices in IEA countries, 2019

Industry



Household



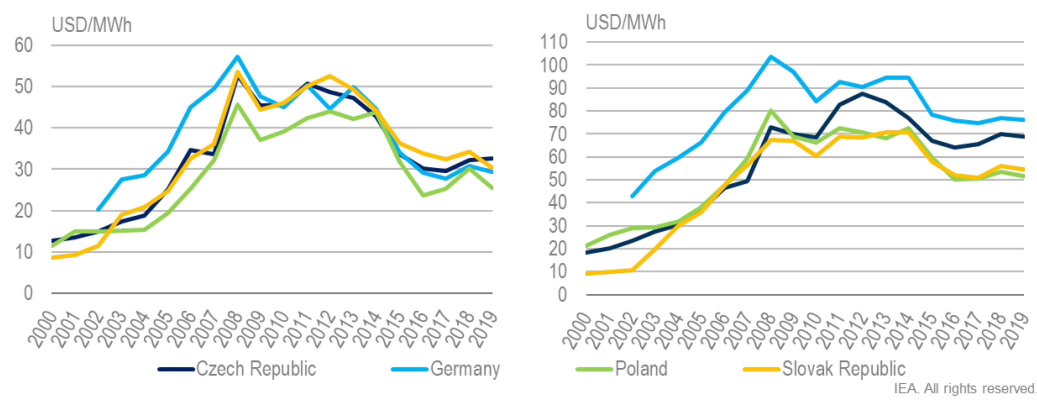
The Czech Republic's household natural gas price was the 14th highest amongst IEA countries in 2019, while its industry prices were close to the IEA median.

* Tax information is not available for the United States.

Notes: Industry price data are not available for Australia, Mexico or Norway, as the data were not submitted at the time of publication. Household price data are not available for Australia, Finland, Mexico or Norway, as the data were not submitted at the time of publication.

Source: IEA (2021b).

Figure 10.5 Industrial and household gas prices in selected IEA countries, 2000-19



Industry and household gas prices in the Czech Republic follow trends similar to those in other Central European countries.

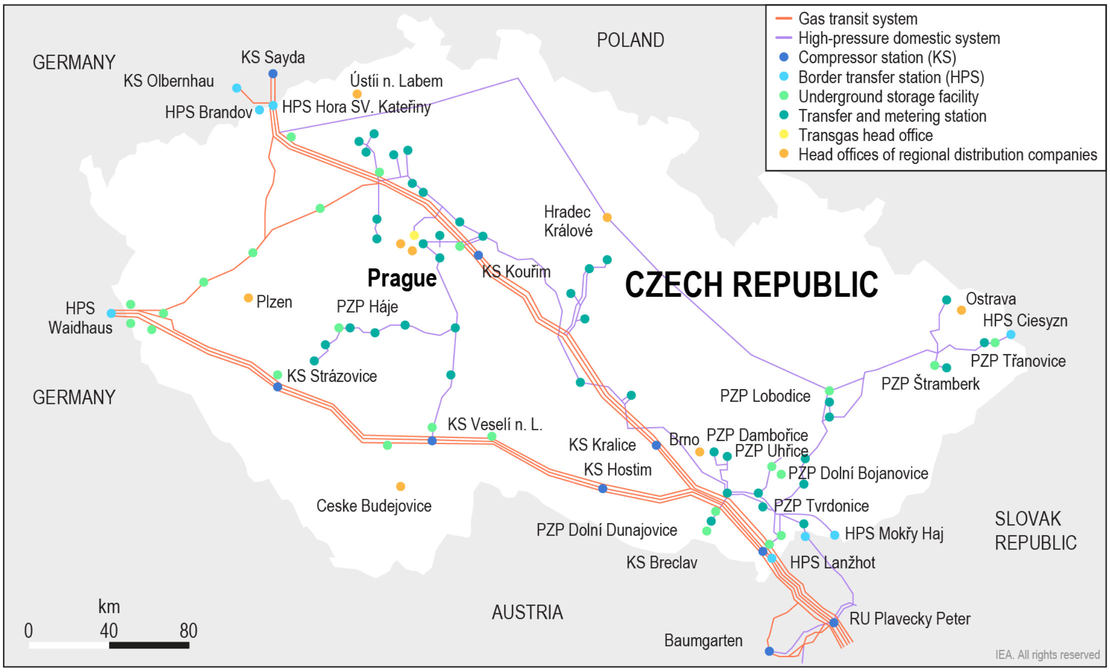
Source: IEA (2021b).

Gas infrastructure

Interconnection points

There are seven high-pressure pipeline interconnection points between the gas transmission networks of the Czech Republic and its neighbouring countries: four interconnections with Germany, two with the Slovak Republic and one with Poland (Figure 10.6). Together they can provide an import capacity of 129 bcm/y and an export capacity of 86 bcm/y.

Figure 10.6 Map of interconnection points and transmission system in the Czech Republic



The Czech gas transmission system plays a central role in supplying gas to Central and Eastern Europe as well as to Germany and Western Europe. On a yearly basis, around 35-40 bcm of natural gas is transported through this system, more than four times the annual gas consumption of the Czech Republic. The past ten years have, however, seen a major change in gas flows. In 2010, more than 80% of the transit gas flows through the Czech Republic went from east to west (mainly from the Slovak Republic to Germany). Today, almost all the transit flows run from west to east (from Germany to the Slovak Republic) and through the Gazelle pipeline from north to south (from eastern Germany to southern Germany).

In order to diversify natural gas transport routes, NET4GAS was planning two cross-border infrastructure projects: 1) the Bidirectional Austria-Czech Interconnection (BACI) that would connect the Czech Republic and Austria for the first time to allow access to Austria's Baumgarten natural gas storage complex; and 2) the second Czech-Polish interconnection (the STORK II project). Development of the BACI would also enable the Czech Republic to gain access to the Krk LNG terminal in Croatia and sources from the Caspian region. The STORK II would allow the Czech Republic to access the LNG terminal in Swinoujscie in Poland, to which Norwegian gas is transported. These projects are included in the 10-Year Plan for the Development of the Transmission System in the Czech Republic (NET4GAS, 2020c). However, both projects were excluded from the EU's 2019 list of projects of common interest, and the 2020 update of NET4GAS' 2021-30 Development Plan indicates that the company has shelved both projects (Reuters, 2020).

The Capacity4Gas (C4G) project, a follow-up infrastructure to Nord Stream II and the subsequent European Gas Pipeline Link (EUGAL), is currently under construction. The project increases transmission capacity with about 35 bcm/year to supply gas to the Czech Republic and further transit via the Slovak Republic (NET4GAS, 2019).

Storage

The Czech Republic has eight natural gas underground storage facilities, most of which are concentrated near the Czech-Slovak border. These facilities have a combined maximum storage capacity of 3.3 bcm (about 38% of the annual consumption covering 140 days of domestic demand in 2019), with maximum withdrawal and injection capacities of 75.5 mcm/d and 53.6 mcm/d, respectively (Table 10.2). The facilities are operated by three storage system operators: RWE Gas Storage (operating six storage facilities), MND Gas Storage and Moravia Gas Storage (operating one storage facility each). Access to the storages is regulated through negotiated third-party access.

The Moravia Gas Storage facility in Dambořice is undergoing an expansion from its reported capacity in 2020 of 370 mcm to 448 mcm in 2021 (Moravia Gas Storage, 2021). In addition, the company SPP Storage operates another facility in Southern Moravia with a storage capacity of 0.6 bcm, which is currently used exclusively for supplying the Slovak Republic, but is planned to be connected to the Czech gas network in 2022.

Table 10.2 Gas storage facilities in the Czech Republic, 2019

Operator	Underground storage	Capacity (mcm)	Maximum withdrawal capacity (mcm/day)	Maximum injection capacity (mcm/day)	Withdrawal ability into transmission system
RWE Gas Storage	Tvrdonice	525	8.7	8.5	Yes
	Lobodice	177	5.0	3.0	No
	Dolní Bojanovice	900	21.3	12.0	Yes
	Štramberk	500	7.0	7.0	No
	Háje	75	6.0	6.0	Yes
	Třanovice	530	8.0	6.5	Yes
RWE Gas Storage total		**2 707**	**56.0**	**43.0**	
MND Gas Storage	Uhřice	330	12.0	6.1	Yes
Moravia Gas Storage	Dambořice	298	7.5	4.5	Yes
Czech system in total		**3 335**	**75.5**	**53.6**	
SPP Storage	Dolní Bojanovice	643	8.8	6.9	No
Czech in total		**3 978**	**84.4**	**60.5**	

Source: OTE (2019b).

Transmission network

The Czech natural gas transmission network is composed of 2 637 km of transit pipelines, 1 181 km of domestic pipelines and five compressor stations with a total installed mechanical capacity of 281 megawatts (MW) (NET4GAS, 2020b). The network is divided into four branches: the Northern and Southern branches, which run from Lanžhot to the Czech-German borders; the Western branch, which connects the Northern and Southern branches; and the Moravian branch, which supplies the Moravian region (southeastern part of the country) and connects with Poland (Figure 10.6). These branches are well interconnected, except for North Moravia, which is only connected to the national transmission system via a single pipeline.

In accordance with the Energy Act, every year NET4GAS prepares a Ten-Year Plan for the Development of the Transmission System of the Czech Republic, which analyses the development of maximum daily and annual consumption and the adequacy of input and output capacity for the Czech Republic. The planned development of the gas infrastructure should be in line with the approved Ten-Year Plan; current projects are aimed both at maintaining the capacity of the transmission system and its modernisation. One of the key projects is the C4G mentioned above (connecting to NordStream II and EUGAL), which is to increase the transit role of the Czech Republic.

Distribution network

The Czech distribution network, mostly operated by three privately owned DSOs consists of 72 914 km of high-, medium- and low-pressure pipelines and serves the residential, commercial, and small and medium-sized industrial sectors. The geographical area of each DSO is clearly defined: Prazska Plynarenska Distribuce serves mostly the region of Prague; E.ON Distribuce serves mostly the South Bohemia region; GasNet covers the rest of the Czech Republic. Most of the gas enters the distribution systems through transfer stations connected to the transmission system. A small part of the gas supply comes from domestic extraction and directly feeds into the distribution system. In order to ensure supply reliability, individual regional distribution systems are connected with other distribution systems. Distribution systems do not have compressor stations and are not directly connected to gas storage facilities (EC, 2019).

Gas security and emergency response

The Czech Republic maintains a high degree of natural gas supply security through a combination of several measures, including a relatively high capacity of underground commercial gas storage and well-established safety standards of the supply infrastructure by the TSO and DSOs. As discussed, the country seeks to improve security of supply through capacity extensions of a number of storage facilities and increased flexibility and interconnections of its gas network.

The Czech Republic's natural gas emergency response policies are in line with EU Regulation 2017/1938. According to the regulation, every four years the Czech Republic must prepare risk assessments, a preventive action plan and emergency plans as part of the emergency planning at national, regional and EU level. In particular, the Czech Preventive Action Plan describes the measures needed to remove or mitigate identified security risks related to the natural gas transmission system. The Emergency Plan describes the measures to be taken to resolve or mitigate the impact of an actual natural gas supply disruption. The EU Regulation also includes an obligation to establish and maintain a security standard of gas supply. In the Czech Republic, this obligation is specified in the Energy Act and Decree No. 344/2012 Coll.

The MIT monitors compliance with safety and reliability standards for the gas and electricity networks, and implements protective measures for emergencies. The TSO has a number of obligations, including securing the safe and reliable operation and maintenance of the transmission system, improving the transmission system and interconnection with neighbouring states, as well as solving problems during a gas emergency. In the event of an accident, the dispatching centres of the TSO, DSOs and storage facility operators are capable of co-operating to operate the network safely together.

Gas reserves and emergency response measures

There are no government-owned strategic reserves of natural gas in the Czech Republic. All natural gas storage is on a commercial basis. An important measure to safeguard security of gas supply is the obligation imposed on those suppliers that deliver to protected customers to have gas emergency stocks in storage facilities in the country or elsewhere in Europe, with priority to store in domestic facilities, as these are closer to customers and enhance security of supply.

Czech natural gas traders supplying protected customers are required to maintain gas reserves corresponding to 30 days of exceptionally high gas demand of protected customers based on EU Regulation 2017/1938. These stocks should be available between 30 September and 1 April to ensure that high gas demand is met during the winter. The average level of mandatory gas reserves in the winter season 2019/20 was 325 mcm, sufficient to cover about 11 days of gas supply in winter and equivalent to 14 days of average gas demand in 2019.

Both the storage system operators and the suppliers to protected customers have to report stock levels to the market operator and the ERU on a monthly basis between September and March. In case gas is stored outside of the Czech Republic, suppliers also have to report on the transport capacity booked in order to bring the gas into the country.

Mobilisation of gas security stocks is one of the key non-market-based emergency response measures. But before these stocks can be released, market-based measures, such as increase of imports and the use of bi-directional capacity, possible at all cross-border connection points, should be used and exhausted. The Central Crisis Management Committee, composed of representatives from the TSO, DSOs, storage operators, gas producers, market operators and the MIT, decides on the release of compulsory gas stocks from underground storages, after the committee declares a state of emergency. In the history of the Czech Republic, there have not been any physical supply disruptions which seriously affected the national gas system or required the release of gas emergency stocks. The large storage capacity and the diversification of supply sources supported by several pipeline interconnections with neighbouring countries, as well as the obligated gas storage for the protected customers, allows for a resilient security level in the Czech gas system.

Resilience of gas supply

Thanks to its large gas storage capacity and multiple interconnectors with reversible capacity, the Czech Republic has a resilient gas system. The Czech government has a particular focus on the development of the transmission system in order to ensure system adequacy and security of gas supply (EC, 2019). The Czech N-1 indicator[4] for 2021 is expected to be 391.8% (the indicator was 396% in 2020), and would exceed the legislative requirement of 100 by almost fourfold. After 2021, the N-1 indicator is expected to be even higher, once the C4G project is commissioned and the capacity of the transmission system increases. The government expects the N-1 indicator to be 461.9% in 2030 (NET4GAS, 2020c).

In addition, it should be noted that consumption of natural gas in the Czech Republic has a typical seasonal pattern, with demand for gas being the lowest in the summer months and highest in the winter. Gas demand in the heating season (October-March) accounted for approximately 70% of total annual consumption in 2019. In 2019, daily peak demand was 50.8 mcm and occurred in January. In comparison, the maximum import capacity is 353.4 mcm/d, while the total storage facility in the country has a maximum withdrawal capacity of 75.5 mcm/d.

Assessment

In 2019, the Czech Republic consumed about 9 bcm of natural gas, equivalent to 17% of the Czech Republic's TES. Over the past ten years, natural gas consumption has fluctuated between 7 bcm and 9 bcm per year, depending mainly on weather conditions, as natural gas is to a large extent used for heating. This is also reflected by the seasonal pattern of the gas consumption, with high levels of consumption in the winter and low levels in the summer. The Czech Republic has a small domestic gas production of around 0.13 bcm per year. As increased production is unlikely, in the future most natural gas consumed in the country will need to be imported.

Industry has the highest share of natural gas consumption, fluctuating at around 30%. The next largest group is the residential sector, with a share of around 25%. Over the past ten years, the number of natural gas consumers has shown a slow, but steady decline, from around 2 870 000 in 2010 to 2 835 000 in 2019. In 2019, around 24% of natural gas was used for electricity and heat production, and natural gas represented 6% of gross electricity generation. The past decade has, however, seen a steady increase in the share of electricity generation from natural gas, from 2% in 2010 to 7% in 2019.

The share of natural gas in the Czech TES is expected to rise from 17% in 2019 to 18-25% in 2040, as natural gas is considered to be an important fuel in the transition of the energy sector. The increased share will support a gradual move away from the use of coal in electricity and heat generation and a reduction of liquid fuels in transport. However, it is unclear what the role of natural gas will be after the phase-out of coal; the current scenario based on the Strategic Energy Plan expects that the share of gas in electricity generation

[4] The N-1 criterion is an indicator to evaluate the supply resilience of a network. A network complies with this indicator if it has enough technical capacity to satisfy total demand in the event of a disruption of the single largest component of the infrastructure.

will increase by only 3.6% from 2020 to 2040. This seems to imply that natural gas will only play a marginal role in the coal phase-out.

Moreover, in the longer term, the use of natural gas may become unsustainable, given the EU's climate and emissions targets. It is, however, not clear how the Czech Republic intends to deal with this challenge nor how natural gas in the long term will be replaced by sustainable gases such as biogas, biomethane and synthetic methane, hydrogen and other renewable energy sources. Regarding hydrogen, the government has established an expert group to address different questions related to the development of hydrogen in the Czech Republic. In parallel, the Czech TSO is part of the European Hydrogen Backbone project, which envisages the first use of the Gazelle pipeline for hydrogen transport around 2035.

Clarity is lacking about the national and European conditions under which hydrogen could be injected into the grid, which may hamper initiatives from investors. The government should prepare, within the current EU legislation, the necessary legal and regulatory framework to allow for the future injection of hydrogen into the national gas grid by using a regulatory sandbox approach, thereby keeping in mind that the Czech Republic is an important transit country for which it is not possible to violate transit contracts guaranteeing a certain gas quality.

The Czech retail gas market is well developed, with over 120 active gas suppliers delivering gas to final consumers and considered to be a relatively competitive market among EU member states. This marks a fair contrast from the wholesale gas market, that is regarded as one of the most concentrated markets in the EU, and further efforts should be pursued for the creation of a more liquid and competitive wholesale market. The integration of the Czech gas market into the Visegrad Central European region and Austria, which is mentioned in the SEP, might alleviate this situation.

The Czech gas transmission system is highly interconnected with the gas transmission systems of its neighbouring countries, in particular with Germany and the Slovak Republic, and to a lesser extent with Poland. The supply of gas to neighbouring countries is more than four times higher than domestic gas consumption; the Czech gas transmission system plays a critical role in Central and Eastern Europe.

Although the Czech transmission and distribution networks are well developed, there is still one bottleneck. This concerns gas supply to the Czech region of North Moravia, which is connected only by a single pipeline to the national transmission system. There is a capacity expansion project tabled to address this situation, but progress appears to be slow.

The Czech TSO has planned two cross-border infrastructure projects, BACI and STORK II, by which the Czech Republic would gain access to a number of LNG terminals in the Baltic and Adriatic regions. In July 2020, the Czech TSO decided to postpone and scale back both projects, as they were excluded from the EU's 2019 list of projects of common interest, which means that they are no longer eligible for funding from the Connecting Europe Facility. The future of these project is hence uncertain.

Given the geographical location of the Czech Republic as a landlocked country and its significance as a gas transit hub in Central and Eastern Europe, diversification and improvement of interconnections are important, and clear guidance is required for future gas infrastructure projects.

An important feature of the Czech gas system is the high amount of gas storage capacity. Current capacity is 3.3 bcm and once the ongoing expansion projects are completed in 2022, the country's total storage capacity available will be almost 4 bcm. This is almost half the current annual gas consumption of the Czech Republic, and such a ratio is very high compared to the level of storage capacity in other countries. Gas storage is operated by three gas companies, and access is through negotiated third-party access. However, storage operators are not free to decide which storage products they can offer, as this is determined by the ERU, which may hamper the storage operators' business opportunities.

The Czech Republic's natural gas security policy is generally well established. The N-1 value of the Czech gas system for 2020 was 396%, and the government expects this value to increase to 461.9% in 2030, which demonstrates that the Czech gas system is well equipped to deal with an outage of its largest gas infrastructure, the Lanzhot entry point.

The Czech Republic's gas transmission system is highly interconnected with its neighbouring countries, which enables gas from multiple directions to enter the Czech territory. Considering this high level of interconnection, the Czech Preventive Action Plan and Emergency Plan for gas emergency response could give more detail on enhanced regional co-operation and regional assistance in case of security of supply problems.

Recommendations

The government of the Czech Republic should:

- Set out a long-term road map for natural gas, focusing on the role natural gas can play in the phase-out of coal, and taking into account longer term opportunities of replacing natural gas with sustainable gases, hydrogen and other renewable energy sources.
- Improve the functioning of the wholesale gas market, notably by integrating the Czech wholesale market with the wholesale markets of its neighbouring countries, thereby creating a more liquid and competitive market with multiple supply sources.
- Provide guidance on the future of gas infrastructure projects, which are aimed to further improve the interconnectivity of the Czech gas transmission system with the gas transmission systems of its neighbouring countries.
- Accelerate the Moravia Capacity Expansion project to strengthen the domestic transmission capacity, thereby enhancing natural gas security in the medium and long terms.

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11. Oil

Key data (2019)

Domestic crude oil production: 10.8 thousand barrels per day (kb/d), -4% since 2009.

Net imports of crude oil: 156.3 kb/d, +7% since 2009.

Domestic oil products production: 176 kb/d, +7% since 2009.

Net imports of oil products: 36.8 kb/d, -7% since 2009.

Oil consumption by sector: total: 207 kb/d (domestic transport 139 kb/d, international bunkering 9 kb/d, industry including non-energy consumption 56 kb/d, services and agriculture 8 kb/d, residential 1 kb/d, energy sector including power generation 1 kb/d).

Share of oil: 23% total supply (total energy supply [TES] and international bunker fuels), 34% total final consumption (TFC), 0% in electricity generation, 1% domestic energy production.

Biofuels: 0.34 Mtoe, 7.2% of renewables TES, 75% increase since 2009.

Exchange rates (2020):* Czech Koruna (CZK) 1 = US dollar (USD) 0.043 = EUR 0.038

* OFX (2021)

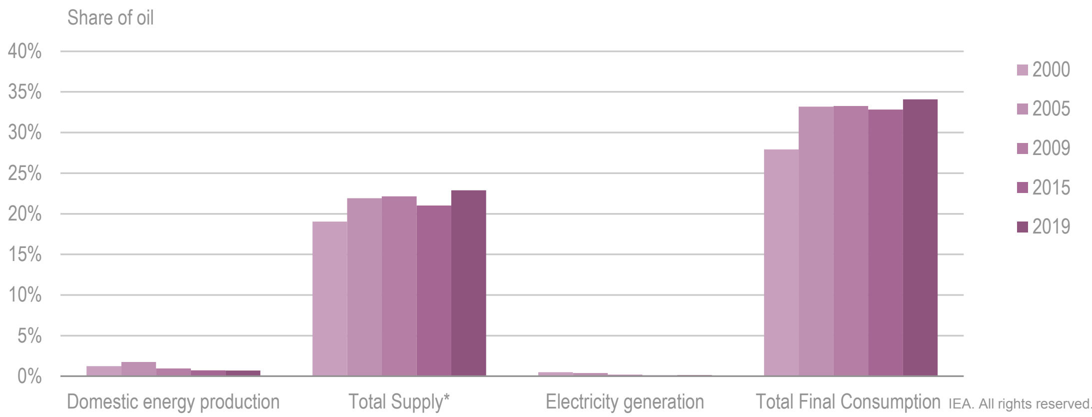
Notes: Crude oil imports include crude oil, natural liquid gases and feedstocks. TES does not include oil used for international bunkering

Overview

Without substantial domestic oil production, the Czech Republic imported 97% of its crude oil supply (156 thousand barrels per day [kb/d]) in 2019. Oil represented 23% of total energy supply (TES) in the same year (Figure 11.1). The share of oil in total final consumption (TFC) was 34% in 2019, while oil use for electricity generation was close to zero. The share of oil both in TES and TFC has gradually increased over the last two decades, primarily led by strong oil demand for domestic transportation and by industry.

The Czech Republic aims to reduce oil consumption in line with its policy to reduce greenhouse gas (GHG) emissions, by promoting the development of low-emission mobility. In the medium term, the country is expected to reduce import dependency of petroleum products and to increase product exports, particularly to Central and Eastern Europe. The diversification of crude oil import routes and cross-border co-ordination with its neighbouring countries further enhances the country's oil security.

Figure 11.1 Share of oil in the Czech energy sector, 2000-19



The Czech Republic's oil demand has increased steadily in total supply and total final consumption.

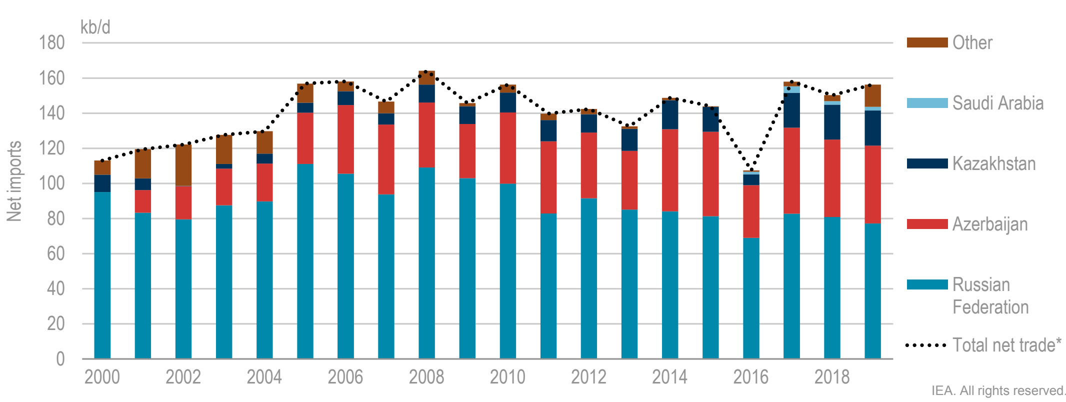
* *Total supply:* share of oil in total energy supply (TES) plus international bunker fuels.
Source: IEA (2021a).

Supply and demand

Crude oil imports

The Czech Republic does not have substantial crude oil resources. Domestic production covers only 3% of domestic consumption, and known domestic crude oil reserves are expected to be depleted in the next two decades. In 2019, Czech net imports of crude oil were 156.3 kb/d (Figure 11.2). Crude oil imports, including natural gas liquids and feedstocks, came primarily from the Russian Federation, 77.2 kb/d in 2019, followed by 44.4 kb/d from Azerbaijan and 20.1 kb/d from Kazakhstan. The remaining small shares were covered by a number of other countries. The Czech Republic exported marginal amounts of crude oil to neighbouring countries, less than 1 kb/d between 2000 and 2019.

Figure 11.2 The Czech Republic's crude oil imports by country, 2000-19



The Czech Republic has diverse oil import sources, dominated by Russia, followed by Azerbaijan and Kazakhstan.

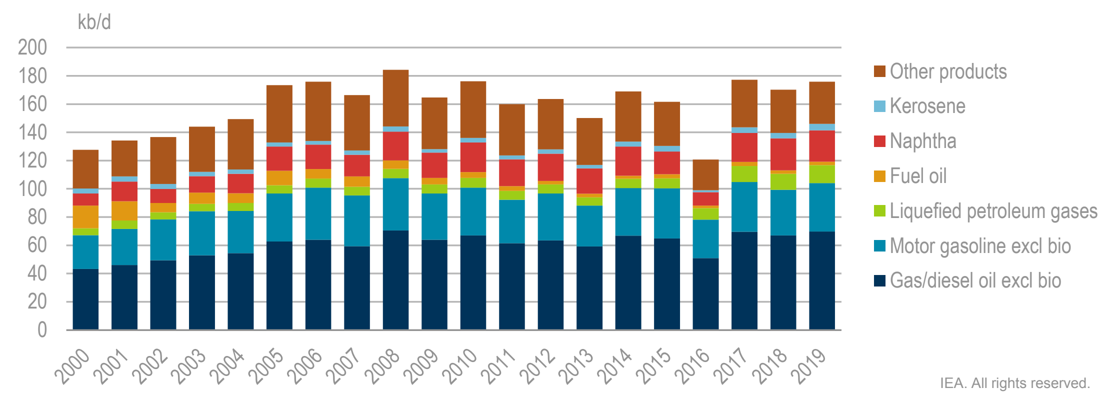
Source: IEA (2021a).

Oil products supply and trade

There are two refineries in the Czech Republic, predominantly producing gas/diesel oil, motor gasoline and naphtha (Figure 11.3). Over the past decade, oil products production has been around 170 kb/d. The only exception was a sharp decrease in oil products production in 2016 to 121 kb/d. This was due to the shutdown of the Kralupy refinery between May and September 2016, caused by an accident in the fuel catalytic cracking unit.

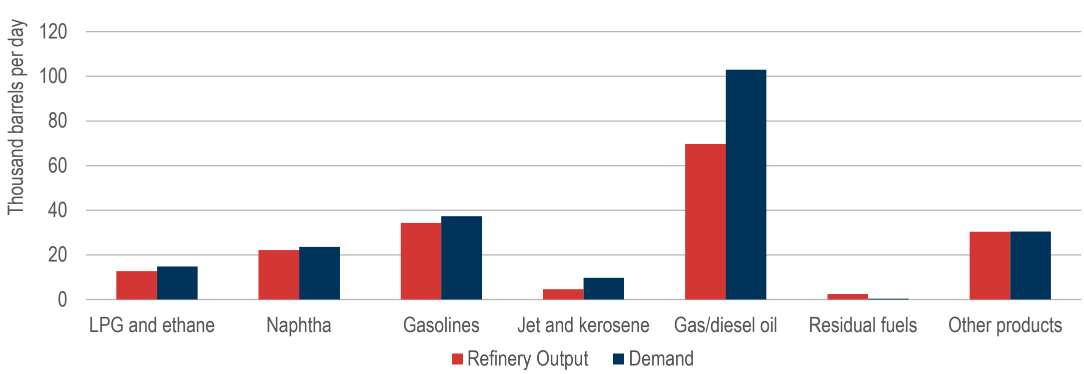
In 2019, Czech refined oil products output was around 176 kb/d, with gas/diesel accounting for the largest share at 40% (70 kb/d), followed by motor gasoline at 20% (34 kb/d), naphtha at 13% (22 kb/d), liquefied petroleum gas (LPG) at 7% (13 kb/d), kerosene at 3% (5 kb/d) and fuel oil at 1% (2 kb/d). Czech refineries produce a significant proportion of all products consumed in the country, with imports making up the shortfall. Domestic demand has exceeded refinery output for most oil products, and the country has been a net oil products importer (Figure 11.4).

Figure 11.3 Oil products production in the Czech Republic, 2000-19



Source: IEA (2021a).

Figure 11.4 Refinery output versus domestic oil product demand in the Czech Republic, 2019

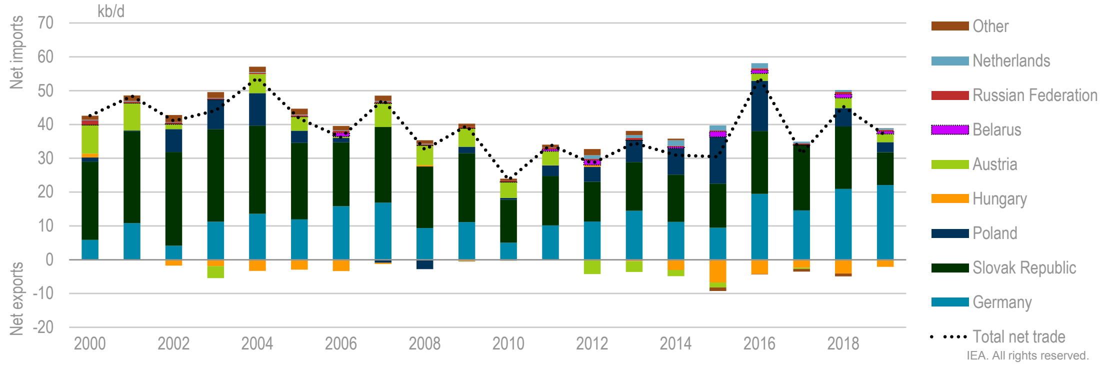


In 2019, except for residual fuels, Czech refinery output fell behind domestic demand for most oil products, with a notable deficit for gas/diesel oil.

Source: IEA (2021b).

The Czech Republic has been a net oil products importer, but occasionally has exported to Austria, Hungary and Poland (Figure 11.5). Total net imports in 2019 stood at 36.8 kb/d, with net imports with Germany representing 22.1 kb/d, the Slovak Republic 9.7 kb/d and Poland 3.0 kb/d. The sharp increase in oil products trade in 2016 at 53.8 kb/d was the result of the refinery outage, with an increase in German oil products imports of 19.5 kb/d. With the reopening of the refinery, oil products imports decreased in 2017 compared to 2016, at 31.4 kb/d 2017.

Figure 11.5 The Czech Republic's oil products net trade by country, 2000-19



The Czech Republic mainly imports its oil products from neighbouring countries.

Source: IEA (2021a).

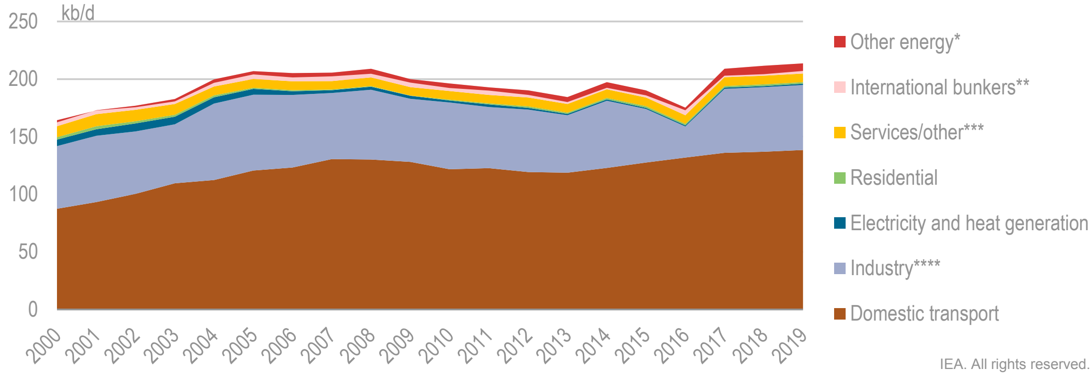
Oil products demand

Oil products demand in the Czech Republic gradually declined after 2008, but started to increase again in 2017, mainly driven by the steadily growing transport sector and the recovery of the industry sector (Figure 11.6). Czech oil products demand reached a record high in 2019, at 207 kb/d.

The transport sector is the largest oil-consuming sector in the Czech Republic, with 67% of total oil consumption, at 139 kb/d in 2019. The industry sector's consumption accounted for 56 kb/d (27% of total) and the services sector for 8 kb/d (4%). Oil demand in the industry sector increased by 3% compared to 2009, and oil consumption in services by 3%, while the demand in the transport sector increased by 8%. Oil consumption in electricity and heat generation has decreased by 58% in the past decade, from 2.6 kb/d in 2009 to only 1.1 kb/d in 2019. Demand in the residential sector increased from 0.2 kb/d in 2009 to 1.4 kb/d in 2019.

The domestic transport sector has consistently been the largest source of oil products demand in the Czech Republic, accounting for around 60-70% of total oil products demand from 2009 to 2019. Oil products, including diesel, gasoline, LPG, kerosene and jet fuel, are the dominant fuel for transport in the Czech Republic, accounting for 91% of domestic transport demand in 2019, with 8% of demand covered by alternative fuels, such as biofuels, natural gas or electricity. Road transport is by far the main mode of transportation, accounting for 96% of domestic transport energy demand in 2019, with 67% of road transport demand covered by diesel.

Figure 11.6 The Czech Republic's oil demand by sector (in total energy supply), 2000-19



The Czech Republic's oil demand is dominated by the transport sector, followed by the industry sector.

* *Other energy* includes oil and gas extraction and other energy consumed within the industry. It is barely visible on this scale.

** *International bunkers* includes bunker fuels for international aviation and navigation.

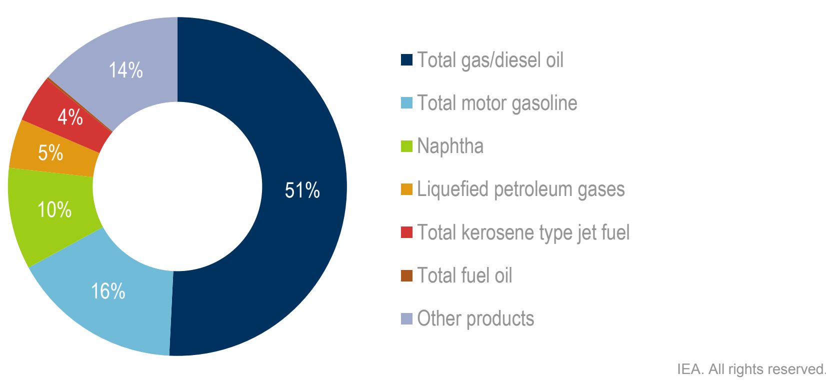
*** *Services/other* includes commercial and public services, agriculture, forestry, and fishing.

**** *Industry* includes demand from oil refineries.

Source: IEA (2021a).

In 2019, diesel accounted for the largest share of oil products demand (51%), while gasoline accounted for 16% (Figure 11.7). Naphtha, used primarily for industrial processes in the chemical industry, accounted for the third-largest share of oil products demand (10% in 2019). The Czech Republic also has a small demand for LPG (5% of oil products demand in 2019). Most of this demand comes from industry non-energy use, passenger cars and small municipal vehicles, supported by a highly developed distribution infrastructure (there are approximately 900 LPG-filling stations in the country) and heating and cooking by households that are not connected to the natural gas grid. Total demand for LPG in 2019 was 14 kb/d, with industry demand accounting for 9.8 kb/d (of which 9.1 kb/d was for non-energy use), transport for 2.8 kb/d, residential for 1.4 kb/d and services/other for 0.5 kb/d.

Figure 11.7 Oil product demand in the Czech Republic by type, 2019



More than half of the Czech Republic's oil demand is gas/diesel oil.

Source: IEA (2021a).

Oil policy

Oil consumption is expected to increase only in the transport sector, and to decrease in other sectors, in line with the government's policy to reduce GHG emissions. In the transport sector, the government envisages a gradual partial replacement of oil-based fuels by alternative energy sources and the further electrification of urban public transport. In order to promote the introduction of alternative fuels, passenger and freight vehicles using alternative fuels (hybrid drives, electric motors, compressed natural gas [CNG], LPG and bioethanol) are exempt from road tax, and a lower excise rate is also applied to natural gas used in transport. The State Energy Policy (SEP) of 2015 indicates that the share of oil and petroleum products in total primary energy sources will decline from 20% in 2016 to 14-17% in 2040, and that oil products will continue to have a dominant role in the transport sector (MIT, 2015). Nonetheless, the government stresses the importance of monitoring developments in all oil-related sectors in order to secure stable supply of fuel for transport and raw materials for the petrochemical industry.

The Czech Republic is promoting the use of biofuels through the mandatory reduction of GHG emissions from fuels; the country has a biofuels blending mandate that directly reduces diesel and gasoline demand, notably in accordance with Act No. 201/2012 Coll. on air protection, which requires a minimum share of biofuels in the total amount of vehicles using diesel and gasoline. As of 2019, fuel suppliers are obliged to blend diesel transport fuels with at least 6% biofuels and motor gasoline with 4.1% of biofuels by energy content.

Policies to support the development of low emissions mobility are also contained in the National Action Plan for Clean Mobility (NAP CM). The NAP CM deals with electromobility, CNG and also with hydrogen technology (or fuel cell technology). Particularly, the NAP CM focuses on legislative measures, direct incentives to purchase alternative fuel vehicles, tax incentives, non-financial incentives on the demand side, research, technological development and demonstration, and other measures to promote low emissions mobility in the country (MIT, 2015).

In terms of stable and continuous supply of oil, the import of oil from Russia and other key producing countries and self-sufficiency in oil refining remain crucial aspects of the Czech Republic's oil sector policy. The government strives to ensure adequate and diversified crude oil transport capacity for the needs of the domestic refineries through projects such as the capacity increase of the Transalpine (TAL) oil pipeline, which is 753 km long and runs across Italy, Austria and Germany, and the construction of an oil pipeline between the refineries in Litvínov (Czech Republic) and Leuna (Germany) (see infrastructure section).

The Czech product oil pipeline system is one of the most important European pipeline networks in terms of location and connections to the Slovak pipeline systems. Hence, the government aims to support more efficient use of the existing domestic product pipelines. It has also promoted active co-operation between the national oil transporter (ČEPRO)[1] and the Association of Oil Pipeline Operators, Druzhba, particularly to gain early warning of any business or technical issues which could result in the temporary interruption of oil supplies to the country (MIT, 2015).

[1] See Annex A for more information on organisations and offices with relevancee to the energy sector.

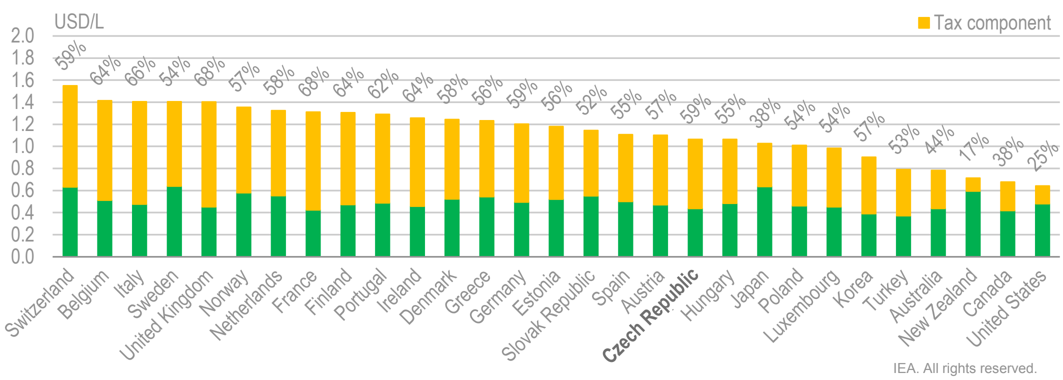
Ensuring emergency oil reserves is one of the main measures to provide for energy security. The Czech Republic places a strong emphasis on maintaining, and even aims to increase, emergency stocks of oil and petroleum products in accordance with its IEA and EU obligations, as well as Decree No. 165/2013 Coll. on the types and the composition of petroleum products for storage as emergency oil reserves, on the calculation of the level of emergency oil reserves and on the reporting of emergency oil reserves (see also the section on emergency response and stockholding).

Prices and taxation

End-user fuel prices in the Czech Republic are fully liberalised and their levels are not subject to any regulation. The excise tax and road tax are used as incentives to encourage the uptake of alternative fuels. Act No. 353/2003 Coll., on excise tax, sets the tax rate for individual fuels and the conditions under which pure and high-percentage biofuels are subject to a reduced or zero excise rate; no excise tax is levied on 100% fatty-acid methyl esters (FAME) and a partly reduced charge is applied to diesel/FAME (30%) blend. Minimum duties and taxes are also applied to CNG and LPG for use in transport.

In the second quarter of 2020, prices for automotive diesel and unleaded gasoline in the Czech Republic were below the IEA median. The Czech automotive diesel price was the 11th lowest, at USD 1.1/L, with a tax component of 59% (Figure 11.8). For unleaded gasoline, the Czech Republic ranked the seventh lowest, at USD 1.1/L, 66% of which was tax (Figure 11.9). Price for light fuel oil in the Czech Republic was also the seventh lowest among IEA countries at USD 0.5/L, with tax accounting for 35% of the price (Figure 11.10).

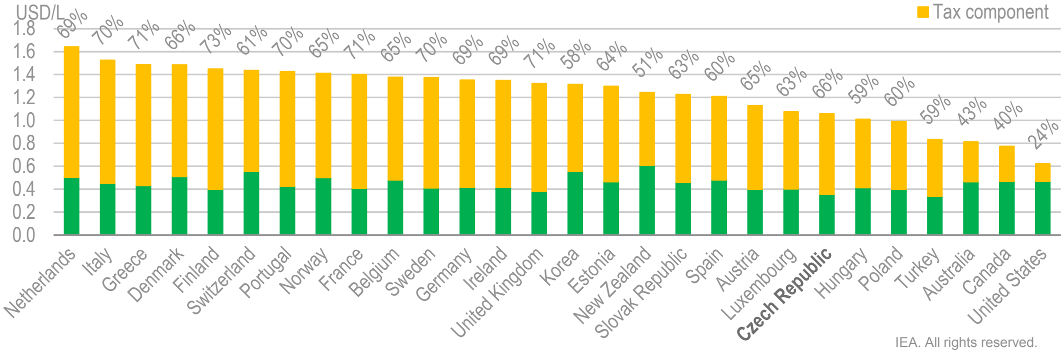
Figure 11.8 Price comparison for automotive diesel in the IEA, 2Q 2020



The Czech Republic's automotive diesel price was the 11th lowest among IEA countries.

Note: Automotive diesel data do not include Mexico, as data were not submitted at the time of publication.
Source: IEA (2021c).

Figure 11.9 Price comparison for unleaded gasoline (95 RON) in the IEA, 2Q 2020

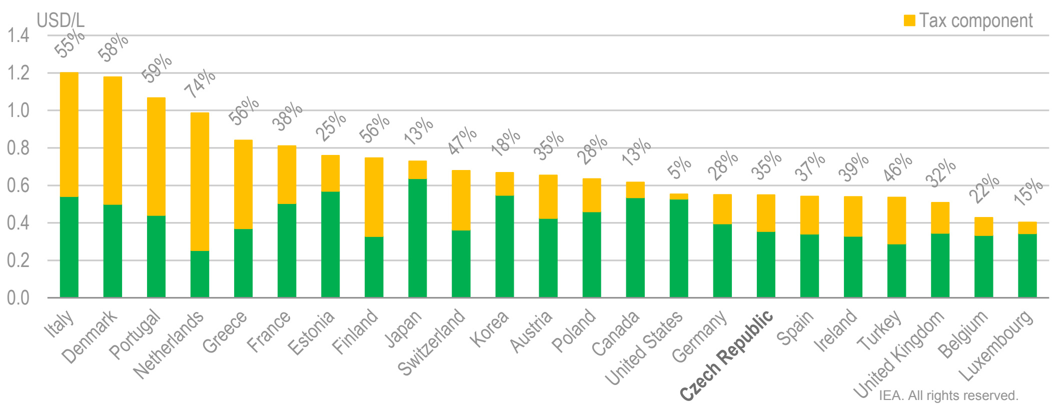


The Czech Republic's unleaded gasoline price was seventh lowest among IEA countries.

Note: Premium unleaded gasoline data are not available for Japan or Mexico, as data were not submitted at the time of publication.

Source: IEA (2021c).

Figure 11.10 Price comparison for light fuel oil in the IEA, 2Q 2020



The Czech Republic's light fuel price was seventh lowest among IEA countries.

Note: Light fuel data are not available for Australia, Hungary, Mexico, New Zealand, Norway, the Slovak Republic or Sweden, as data were not submitted at the time of publication.

Source: IEA (2021c).

Market structure

Oil extraction and transportation

Upstream activities in the Czech Republic are limited; two companies are active in the sector, MND, the biggest Czech group producing crude oil in the country, and LAMA GAS & OIL, which is part of the LAMA Energy Group. Their combined production meets only a marginal level of domestic crude demand, approximately 3%. The largest share of oil for the Czech Republic comes from imports. Both companies have carried out exploration activities and continued to produce hydrocarbons in the southeastern region of Moravia (the eastern part of the country).

The transportation of crude oil for refining is provided by the state-owned MERO, which is the owner and operator of crude oil pipelines, including the Czech sections of the Druzhba and Ingolstadt-Kralupy-Litvínov (IKL) pipelines, and crude oil storage capacities (see the section on infrastructure).

Distribution of petroleum products

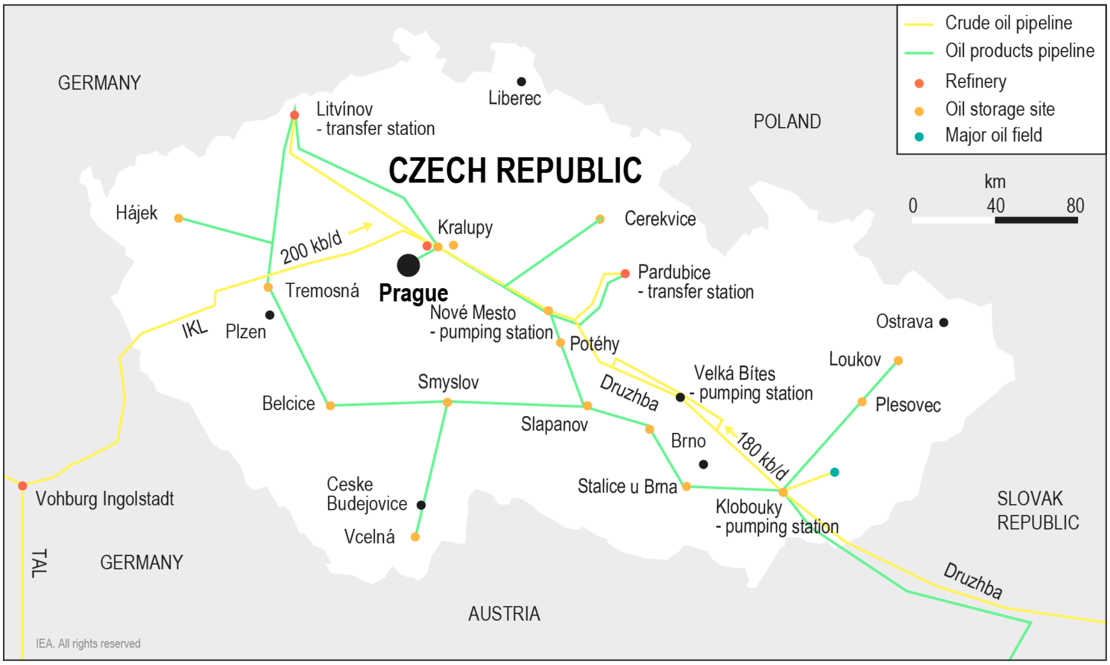
The distribution of petroleum products in the Czech Republic is provided by both the two refineries themselves and independent distributors, who buy part of their products abroad. The largest distributor of petroleum products in the country is ČEPRO. Its key corporate mission is to provide transportation, storage and the sale of petroleum products and to hold emergency stocks of petroleum products. The company also operates the Euro Oil filling station network with 200 mostly small, rural filling stations that are located off the main roads (ČEPRO, 2020a). There are approximately 140 private distributors registered in the Czech Republic. Some own a network of retail service stations, whereas others are only engaged in distribution. Notably Benzina, a retail part of the Unipetrol Group, operates the largest network of petrol stations in the Czech Republic. In 2020, it operated 416 service stations in the country, with a 25% market share (Benzina, 2020).

As of February 2019, a total of 7 061 petrol stations were registered in the Czech Republic, of which 3 991 were public petrol stations, 690 petrol stations with limited access where fuels are sold to only a small number of contractors, and 2 380 were non-public filling stations which serve as fuel dispensing points for the operators' own consumption. The public petrol stations consisted of 2 833 multi-product stations (71.0%), 459 stations selling only diesel and biodiesel (11.5%), 533 stations selling only LPG (13.4%), 151 stations selling only CNG (3.8%), and 15 others (0.4%). The petrol stations with limited access consisted of 609 stations selling only diesel and biodiesel, 55 multi-product stations (8%), 14 stations selling only CNG (2%), 1 station selling only LPG (0.1%) and 11 others (1.7%) (MIT, 2019).

Infrastructure

The Czech Republic has two major refineries. As a landlocked country, it does not have any oil ports, but crude oil is supplied to the refineries through two major crude oil pipelines connected with neighbouring countries. The oil security of the country is also backed by major oil storage facilities managed by two Czech state-owned enterprises (Figure 11.11).

Figure 11.11 Oil infrastructure in the Czech Republic, 2020



Refining

There are two refineries in the Czech Republic (Kralupy and Litvinov), with a combined capacity of 8.7 million tonnes per year (Mt/y) (or 175 kb/d). Both refineries are owned by the Unipetrol Group, which is 100% owned by PKN Orlen, a Polish oil refiner and petrol retailer. The refineries produce a significant proportion of oil products consumed in the country; more than 80% of petrol consumption and approximately 75% of diesel consumption can be covered by domestic refining.

The refinery in Litvínov-Záluží (capacity 109 kb/d or 5.4 Mt/y) processes medium-heavy Russian Export Blend, which is transported to the Czech Republic via the Druzhba oil pipeline. It is a modernised refinery with a high hydrotreating capacity, operating two oil distillation units and four conversion units. Major products of the Litvínov refinery are motor gasoline, diesel and LPG.

In contrast, the Kralupy refinery (capacity 66 kb/d or 3.3 Mt/y) processes light sweet crudes (including Azeri, Kazakh and North African crudes) imported to the Czech Republic via the IKL pipeline (see below), in addition to the crude oil produced domestically and transported from Moravia via the Druzhba pipeline. Major products of the refinery are high-octane unleaded petrol and jet kerosene, which is used for domestic air transport.

It is worth noting that Unipetrol completed the construction of the new polyethylene unit in the Litvínov-Záluží complex in April 2020 (Unipetrol, 2020). This is the largest investment in the history of the Czech petrochemical industry so far, amounting to CZK 8.5 billion (USD 365 million). It is one of the most modern production facilities of its kind in Europe. The new polyethylene unit is expected to help increase the production capacity of polyethylene by more than twofold to approximately 275 thousand tonnes per year and at the same time contribute to greater interconnection of petrochemical and refinery production in the Czech Republic.

Pipelines

The Czech Republic has two major crude oil pipelines, the 180 kb/d capacity Druzhba pipeline and the 200 kb/d capacity of the IKL pipeline, both of which are owned, operated and managed by MERO.

The Czech portion of the Druzhba pipeline, which transports crude oil from Russia, is 473 km long (its total length is 3 840 km) and its transport capacity usable for the Czech Republic is 180 kb/d. Flowing from the Slovak Republic, the Druzhba pipeline enters the Czech Republic from southeastern part of the country and heads into the Litvínov refinery. The utilisation rate of the Druzhba over the past decade was about 40-50%.

The Czech portion of the IKL pipeline, which transports crude oil mainly from the Caspian region, is 168 km long (its total length is 347 km) and its transport capacity usable for the Czech Republic is 200 kb/d. Starting from Vohburg in Germany, the IKL pipeline enters the Czech Republic in the western part of the country and ends at the oil depot in Nelahozeves near Prague. The utilisation rate of the IKL in recent years was about 20-40%. In Vohburg, the IKL pipeline is connected to the TAL pipeline, with a capacity of 868 kb/d, which receives oil via the oil port in Trieste, Italy (MERO, 2008a). The IKL and TAL pipelines provide an important alternative supply route for the country's oil imports, reducing overall reliance on the Druzhba.

The network of product pipelines in the Czech Republic is exclusively owned and managed by ČEPRO, which connects the main consumer regions, the oil storages and distribution centres of ČEPRO and the refineries in Litvínov, Kralupy, as well as in Bratislava in the Slovak Republic. The 1 100 km network enables direct pumping and supply between its individual nodes and is fully reversible.

Diversification of crude oil transport capacity is one of the priorities of the Czech government's oil policies. There are two projects for further diversification of oil and petroleum product supplies to the country: 1) increasing the capacity of the TAL pipeline; and 2) the construction of an oil pipeline connection between the Litvínov and Spergau (Leuna) refineries in Germany. The Litvinov-Spergau pipeline project, the extension of the Druzhba pipeline to the refinery in Spergau, has been promoted by MERO, targeting the commissioning in early 2025 (EC, 2020), but active support by the government would accelerate the process.

Storage

The Czech Republic has 17 oil product storage facilities, with a total capacity of 1.5 million cubic metres (mcm), and one key crude oil storage facility, with a capacity of 1.675 mcm. The product storage sites are connected by a 1 100 km long pipeline and consist mainly of gasoline and gasoil. 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 MERO (crude stocks) and ČEPRO (product stocks), which both provide storage facilities for the public stocks managed by the State Material Reserves Administration of the Czech Republic (ASMR). MERO operates the Central Oil Tank Farm (CTR), which is utilised for the storage of strategic emergency oil reserves, short-term intermediate storage of oil transported through the Druzhba and IKL pipelines, and for the preparation of different crude oil blends according to customers' requirements.

Over the past few years, MERO has gradually increased its storage capacity at the CTR; in 2020, the CTR storage capacity consists of 17 above-ground crude storage tanks with a combined capacity of 1.7 mcm (MERO, 2008b). ČEPRO has 17 product storage sites, consisting of above-ground and underground storage tanks with a combined capacity of 1.8 mcm, along the domestic product pipeline network (which the company also owns and operates) (ČEPRO, 2020b).

Oil emergency response and stockholding

The Czech Republic's legal oil emergency framework is primarily governed by two acts. The first is Act No. 189/1999 Coll. on Emergency Oil Stocks, the main legislation that lays down the basic principles, rules and measures of emergency response policy. The second is Act No. 97/1993 Coll. on the competence and role of the ASMR in the oil emergency system. Furthermore, Decree No. 165/2013 Coll. regulates the technical aspects of oil emergency stocks. All of these reflect Council Directive 2009/119/EC on imposing an obligation on EU member states to maintain minimum stocks of crude oil and/or petroleum products.

The main planning document for oil emergency is the Standard Plan for major oil supply disruptions. The plan elaborates the measures set by Act No. 189/1999 Coll. into concrete activities, procedures and organisational measures carried out by the ASMR. These measures are further worked out in individual crises plans of central administrative authorities (ministries), regional authorities and municipalities. The ASMR is responsible for creating and regularly updating the Standard Plan for foreseeable oil disruptions. The feasibility of the plan is regularly verified (almost every year) during crisis exercises organised by central administrative authorities (ministries) and regional authorities.

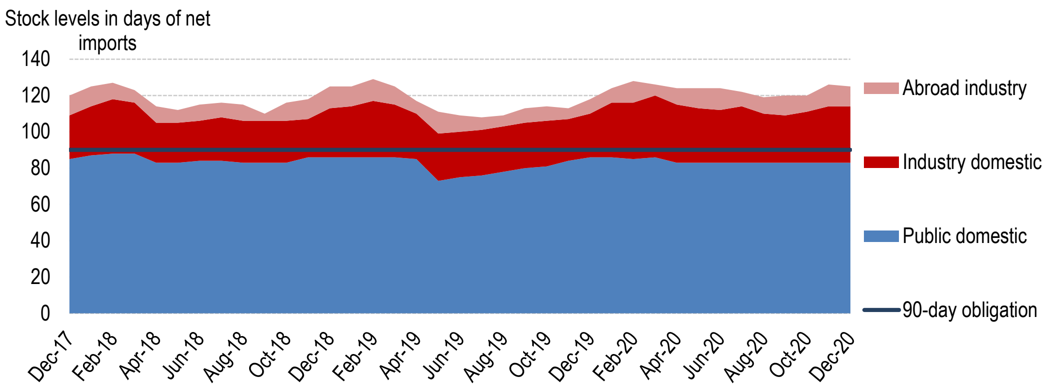
A key component of the Czech oil emergency response is a stock drawdown, and Act No. 189/1999 Coll. lays down the use of oil emergency stocks. The ASMR chairperson has the mandate to decide on the release of emergency stocks as long as the stocks do not fall below the level of 90 days of net imports. For any larger stock releases, explicit approval from the government is required. Upon the receipt of the proposal by the ASMR, the government has the power to order the release of emergency oil stocks to safeguard the national economy or to participate in IEA collective actions.

Emergency oil reserves

The Czech Republic meets its stockholding obligation to the IEA by holding public stocks managed by the ASMR. All Czech oil emergency stocks are government stocks stored within the national territory; there is no compulsory stockholding obligation on the Czech oil industry. Emergency stocks may be stored only by a natural/legal person who has a contract with the ASMR. On the basis of such a contract, contractors – mostly state-owned enterprises – provide for storage and further care for entrusted oil emergency stocks. In general, MERO stores crude oil while ČEPRO stores petroleum products. Another contractor is Unipetrol, which stores a small amount of crude oil emergency stocks.

The Czech Republic has been in compliance with the IEA's minimum obligation since 2004 (see Figure 11.12 regarding the situation since December 2017). As of end-December 2020, the Czech Republic held 125 days of net imports. Nevertheless, according to the EU methodology of emergency stock calculation (under Council Directive 2009/119/EC), which eliminates amounts of commercial stocks, the amount of emergency stocks in the country was 83 days as of end-December 2020. The government has an objective to ensure that stocks remain above the level of 90 days of net imports based on the EU methodology, with the prospect of increasing those stocks to 120 days of net imports depending on the future financial capacity of the state and to keep those stocks at that level (MIT, 2015).

Figure 11.12 The Czech Republic's emergency oil stocks by type, December 2020



The Czech Republic's emergency stocks are above the IEA minimum stock requirements.

Source: IEA (2021b).

As mentioned above, there is no stockholding obligation on the Czech oil industry. The ASMR is the only entity required by legislation to keep emergency oil stocks. Operational stocks stored by Unipetrol usually amount to only a couple of days of refinery intake. Thus, at the time of a limited oil supply disruption, the refineries have to already ask for the release of ASMR crude oil stocks to avoid shutting down. The last time this happened was in 2019 when Russian crude oil imports to the Czech Republic through the Druzhba pipeline were disrupted due to contamination.

Moreover, all crude oil stocks kept by the ASMR are of the Russian Export Blend type, despite the fact that the Kralupy refinery runs the much more efficient light sweet type of crude oil. In order to keep emergency stocks in line with the refinery input and enhance emergency preparedness, replacement of a part of the emergency oil stocks of the Russian Export Blend with lighter sweet crude oil could be pursued.

Recent domestic supply disruption

In the spring of 2019, the Czech Republic experienced a major supply disruption as the result of organic chloride contamination of crude oil in the Druzhba pipeline system. As a consequence, Russia interrupted west-bound flows to customers in April 2019, which hit refiners in the Czech Republic as well as in Belarus, Germany, Hungary, Poland, the Slovak Republic and Ukraine. In the Czech Republic, Unipetrol refused to accept the contaminated Russian crude oil and the Druzhba pipeline delivery to the Czech Republic was cut off on 26 April 2019. Around 50% of Czech crude oil imports were stopped and the refineries found themselves with operational crude oil stocks sufficient for only about five days.The Czech government took the decision to release emergency stocks as it was impossible to get additional crude oil from neighbouring countries as they were facing the same supply disruption; 2.6 mb of crude oil was supplied to Unipetrol to ensure the supply of the domestic fuel market. Druzhba deliveries were finally restored on 27 May 2019.

Assessment

The share of oil in the Czech Republic’s TES is 23%, making it the second-largest primary energy source after coal, and oil represents the largest share of energy consumption with more than one-third of TFC. The vast majority (67%) of oil is used in the transport sector. While remaining an important energy source, the SEP expects oil consumption to gradually fall in the coming decades due to increased energy efficiency and, in particular, due to a growing portion of alternative fuels in the transport sector. In line with the SEP, the government is promoting the electrification of mobility and the introduction of alternative low-emission fuels such as CNG, LPG and bioethanol by means of a number of policy measures, which should be continued and further accelerated.

The Czech Republic is highly dependent on crude oil imports, with only 3% of supply covered by domestic production. The main sources of crude oil imports are Russia, Azerbaijan and Kazakhstan, which together account for 91% of the total, while the remaining share is covered by several other countries. Russian imports flow predominantly through the Druzhba pipeline entering the Czech Republic to the east from the Slovak Republic. The remainder of crude oil imports is transported through the IKL pipeline from Germany, which is connected to the TAL pipeline system.

To further improve the diversification of crude oil import routes, two infrastructure projects are planned, including the capacity increase of the TAL oil pipeline and the construction of an oil pipeline between the Litvínov and Spergau (Leuna) refineries. Notably, the Litvinov-Spergau pipeline project would be important for enhancing the oil security of the Czech Republic, since such a pipeline connection between the two refineries would enable oil supplies to be routed between the refineries in case of problems on either of the branches of the Druzhba or TAL pipeline systems. The projects could be supported by the government after a thorough assessment of the future role of oil in the Czech energy transition and its significance for energy security. If these projects were to be implemented, these diversified import routes could be used to increase the importance of the Czech Republic as a crude oil transit country, for example by utilising the reverse flow on the Druzhba pipeline interconnection with the Slovak Republic.

The Czech Republic has two refineries. The Litvinov refinery has a slightly greater capacity than the Kralupy refinery, and processes the heavier and sourer Russian Export Blend type of crude oil. The Kralupy refinery processes lighter and sweeter crude types from sources other than Russia. Their combined production covers over 80% of the Czech Republic’s petroleum products consumption. While part of the refinery production is exported, the Czech Republic is a net importer of petroleum products.

The Czech Republic has a considerably advanced and extensive oil infrastructure for storage and pipeline distribution. Most of the crude oil storage capacities are operated by the state-owned enterprise MERO, which is also the operator of the Czech Republic’s crude oil pipeline system. Another state-owned enterprise, ČEPRO, operates most of the petroleum products storage facilities and has a share in the retail market through a network of filling stations. ČEPRO also operates the large product pipeline network to distribute petroleum products throughout the country.

There is no stockholding obligation imposed on industry. The ASMR is the only entity obliged to keep emergency stocks and manages the reserves and measures for crisis situations. It keeps about half of the emergency stocks in the form of crude oil, the other half in petroleum products. The current amount of public emergency stocks corresponds to 84 days of daily net imports, which is lower than the minimum level required by the Czech Act on Emergency Oil Stocks (No. 189/1999 Coll.). Therefore, further efforts to increase the amount of emergency stocks should be pursued. If commercial industry stocks are included, the Czech Republic complies with the IEA stockholding obligation, with more than 120 days of daily net imports.

Recommendations

The government of the Czech Republic should:

- Lower dependency on crude oil imports through efforts to reduce oil consumption, especially by continuing effective support and promoting alternative fuel sources in the transport sector.
- Assess the need for further diversification of crude oil import routes and for support for the proposed new projects, namely the TAL capacity extension and the Litvinov-Leuna (Spergau) pipeline interconnection.
- Ensure constant public stockholding of emergency oil stocks at least at the level required by domestic legislation, i.e. 90 days of daily net imports, to be able to respond to all types of supply disruptions and to be in line with the Czech Republic's international obligations in the area of oil security.

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ANNEX A: Institutions

The **Ministry of Industry and Trade (MIT)** is the central body responsible for the energy sector. It is responsible for the development and implementation of energy policies, such as the State Energy Policy, and for most of the energy-related legislations. The MIT ensures the fulfilment of obligations arising from international agreements and treaties that are binding for the Czech Republic. It issues state approval to build new source facilities in the electricity sector and new selected gas equipment. The MIT can – when deemed necessary – organise a tender for new generation capacity and new gas storage capacities. It monitors compliance with safety and the reliability of the electricity and gas network, the implementation of protective measures in case of an emergency prevention, an emergency and the elimination of the consequences of a sudden crisis in the energy market.

The **Ministry of the Environment (MoE)** has the lead for climate and environmental matters. In the energy sector, it strives to minimise the impact of obtaining energy, promotes rational energy consumption and supply of energy, and introduces wherever possible principles of sustainable development.

The MIT, the MoE, the **Ministry of Transport** and the **Ministry of Regional Development** share responsibility for the implementation of the energy efficiency programmes.

The MIT also manages the energy emergency response of the country in the electricity, oil and gas sectors. The **Administration of State Material Reserves (ASMR)** is responsible for the administration and management of emergency measures and the state material reserves, including their acquisition. The ASMR is the central stockholding entity and also manages public stocks.

The **Energy Regulator Office (ERU)** is an independent regulatory body charged with the oversight and economic regulation of the electricity and gas sectors. It is charged with granting and revoking licences, exercising the supply obligation beyond the scope of the licence during emergencies, and controlling the charges for the transmission and distribution of electricity and gas, among other services. The ERU is also tasked to support renewable energy sources, co-generation and decentralised power generation. The ERU has significant competencies in the area of consumer protection. The **Office for the Protection of Competition (ÚOHS)** is the independent central authority of the state administration with competencies to protect the completion and oversight of public procurement and to ensure that the markets function in accordance with the competition rules and to the benefit of consumers.

The **Electricity Market Operator (OTE**) is 100% state-owned and operates the Czech electricity and gas markets. It carries out its functions under a licence awarded by the ERU. OTE provides comprehensive services to individual electricity and gas market players, such as evaluation, billing and settlement of imbalances between the contracted and metered electricity and gas supply. It is also responsible for the organisation of the short-term electricity and gas market in co-operation with the transmission system operators.

For the electricity sector, the **transmission system operator ČEPS** is responsible for the operation, maintenance and development of the transmission system and publishes an annual generation and system adequacy report. **NET4GAS** holds the exclusive gas transmission system operation licence and is obliged to ensure economically efficient, safe and reliable gas transmission services for customers and to provide sufficient capacities in all relevant supply situations based on a non-discriminatory and transparent approach. **RWE Gas Storage CZ** is the country's biggest underground gas storage operator which ensures security of supply.

The **State Energy Inspection (SEI**) is responsible for ensuring the compliance of, and issuing sanctions for non-compliance of, electricity and gas market participants with relevant legislation in the energy sector. SEI can impose fines for breaches of legislation. The **State Office for Nuclear Safety** is the main government body responsible for administration and supervision in the use of nuclear energy and radiation and of radiation protection. The **Radioactive Waste Repository Authority (RAWRA)** provides for the safe disposal of radioactive waste in accordance with the requirements of nuclear safety and human and environmental protection. The RAWRA manages radioactive waste repositories, co-ordinates the preparation for the construction of a deep geological repository and verifies that the waste to be disposed of meets the strict standards set by the State Office for Nuclear Safety.

ČEPRO is owned 100% by the Ministry of Finance. Its core mission is to provide transportation, storage and the sale of petroleum products and to hold emergency stocks of petroleum products. The company also operates the country's largest network of petrol filling stations. **MERO** is also owned 100% by the Ministry of Finance and as the only transporter of crude oil to the Czech Republic and the owner and operator of the Central Crude Oil Tank Farm, it ensures the storage of strategic emergency crude oil reserves.

The **ČEZ** Group is the country's largest energy sector company. The Czech Republic owns close to 70% of its shares. ČEZ owns and operates most of the major coal-fired plants and all nuclear plants in the Czech Republic. In 2019, ČEZ accounted for 70% of total electricity generation. It also has a major presence on the electricity wholesale and retail markets.

ANNEX B: Organisations visited

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 conducted by the IEA. The Shared Goals are presented in Annex D.

Review team and preparation of the report

The in-depth reivew team visit took place virtually from 2 to 13 November 2020. The review team met with government officials, energy suppliers, market participants, interest groups in the public and private sector, consumer representative associations, research institutions, and other organisations and stakeholders.

The report was drafted on the basis of the information obtained during these meetings, the team's preliminary assessment of the Czech Republic's energy policy, the response of the government of the Czech Republic to the IEA energy policy questionnaire, and information on subsequent policy developments from the government and private sector sources. The members of the team were:

IEA member countries

Mr Kaj Forsberg, Sweden (team leader)

Ms Sarah Neumann, Austria

Ms Songül Tekeli, Turkey

Mr Radoš Horáček, European Commission

Ms Miriam Bueno Lorenzo, Spain

Mr Wim van 't Hof, Netherlands

Mr Jakub Kristin, Slovak Republic

Mr Adrian Howe, United States

OECD Nuclear Energy Agency

Mr Michel Berthélemy, Nuclear Energy Analyst, Division of Nuclear Technology Development and Economics

International Energy Agency

Mr Aad van Bohemen, Head of Energy Policy and Security Division

Ms Dagmar Graczyk, Senior Energy Policy Analyst and in-depth review co-ordinator

Mr Shuto Fukuoka, Energy Security Analyst

The team is grateful for the co-operation and assistance of the many people it met during the visit. Thanks to their kind hospitality, openness and willingness to share information, the visit was highly informative, productive and enjoyable.

The team wishes to express its gratitude to Deputy Minister René Neděla, Ministry of Industry and Trade, for taking the time to share his views with the team which helped frame all of the discussions during the review visit.

The team also wishes to thank Mr Tomáš Smejkal, Head of the Strategy Unit, Ministry and Industry and Trade, and Ms Lea Záhradníková, Department of International Co-operation in Energy, Ministry of Industry and Trade, and many of their colleagues for sharing their views and answering the team's many questions during the review week, and for their time, encouragement, and tireless efforts and professionalism in planning and organising the review visit as well as for their patience and diligence in supporting the team throughout the review process.

The review was prepared under the guidance of Mr Keisuke Sadamori, Director, Energy Markets Directorate, IEA, and Mr Aad van Bohemen, Head of the Energy Policy and Security Division, IEA. Ms Dagmar Graczyk managed the review and is the main author of the report. Mr Shuto Fukuoka wrote the chapters on oil, natural gas and electricity security. Mr Michel Berthélemy wrote the chapter on nuclear energy. Mr Alessio Scanziani, Ms Clémence Lizé, Ms Dahyeon Lisa Yu, Ms Bomi Kim, Ms Alan Choi and Ms Myriam Badri prepared and drafted the sections relating to energy data contained in each chapter.

Helpful comments, chapter reviews and updates were provided by the following IEA staff: Mr Carlos Fernández Alvarez, Mr Peter Fraser, Mr Nicholas Howarth, Mr Stefan Lorenczik, Ms Diana Louis, Mr Kieran McNamara, Mr Jean-Baptiste le Marois and Ms Sara Moarif.

Special thanks to the IEA secretariat with regard to the data, publication and editing. Mr Alessio Scanziani, Ms Bomi Kim, Ms Clémence Lizé, Ms Myriam Badri and Ms Alan Choi ensured the preparation of the design of the report with figures, tables and maps. Mr Steve Gervais, Mr Arnau Risquez Martin and Ms Erica Robin from the Energy Data Centre participated in the data and statistics discussions during the visit. Mr Victor García Tapia, Ms Suzy Leprince, Mr Domenico Lattanzio, Mr Jungyu Park and Ms Roberta Quadrelli provided support on statistics and data. Ms. Therese Walsh managed the editing process and Ms. Astrid Dumond the production process. Ms. Isabelle Nonain-Semelin finalised the production. Support for the maps was provided by Ms Tanya Dyhin. The report was edited by Ms. Jennifer Allain.

Organisations visited

Administration of State Material Reserves

AKU-BAT (Association for Energy Storage)

Association for District Heating of the Czech Republic

Association for International Affairs

Association of Municipalities' Energy Managers (SEMMO)

ČEPRO (petroleum product distributor)

ČEPS (electricity transmission system operator)

ČEZ

Chamber of Renewable Energy Sources

Chance for Buildings

Charles University, Faculty of Natural Science, Geothermal Energy Litoměřice

Confederation of Industry of the Czech Republic

Czech Chamber of Commerce

Czech Gas Association

Czech Geological Survey

Czech Statistical Office

Czech Technical University in Prague

Energy Regulatory Office (ERU)

E.ON Distribuce

Green Circle

Greenpeace

Jan Evangelista Purkyně University

Masaryk University

MERO (crude oil pipeline company)

Ministry of the Environment

Ministry of Finance

Ministry of Industry and Trade

Ministry of Regional Development

NET4GAS (gas transmission system operator)

Office of the Protection of Competition

OTE (Czech electricity and gas market operator)

RWE

RWE Gas Storage CZ

Sev.en Energy

Severočeské doly (ČEZ Group)

Škoda Auto

Solar Association

SÚRAO (radioactive waste repository authority)

Technical University Ostrava

Technology Agency of the Czech Republic

Technology Centre of the Czech Academy of Science

Technology Platform “Sustainable Energy for the Czech Republic” (TPUE)

ÚJV Řež /Czech Nuclear Society

UNIPETROL

University of Economics in Prague

ANNEX C: Energy balances and key statistical data

Unit: Mtoe

SUPPLY		1973	1990	2000	2010	2018	2019	2020E
TOTAL PRODUCTION		**38.51**	**41.17**	**30.84**	**32.07**	**27.66**	**26.84**	**23.57**
Coal		37.82	36.31	25.05	20.83	14.69	13.43	10.15
Peat		0.19	-	-	-	-	-	-
Oil		0.04	0.22	0.38	0.27	0.22	0.19	0.13
Natural gas		0.36	0.20	0.17	0.20	0.18	0.17	0.16
Biofuels and waste[1]		-	1.05	1.55	3.12	4.33	4.68	4.82
Nuclear		-	3.28	3.54	7.32	7.82	7.90	7.85
Hydro		0.09	0.10	0.15	0.24	0.14	0.17	0.18
Wind		-	-	-	0.03	0.05	0.06	0.06
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	..	..	0.07	0.24	0.23	0.22
TOTAL NET IMPORTS[3]		**6.73**	**7.39**	**9.23**	**11.22**	**15.68**	**17.15**	**15.61**
Coal	Exports	2.56	7.26	5.78	5.24	2.13	1.68	1.16
	Imports	0.15	1.57	1.04	2.36	3.06	2.95	2.85
	Net imports	-2.42	-5.69	-4.74	-2.88	0.92	1.27	1.69
Oil	Exports	0.03	6.55	1.08	1.63	2.23	2.23	1.79
	Imports	8.88	15.13	8.60	10.60	11.99	11.85	10.50
	Int'l marine and aviation bunkers	-0.24	-0.22	-0.16	-0.31	-0.41	-0.42	-0.14
	Net imports	8.61	8.36	7.36	8.66	9.35	9.21	8.57
Natural gas	Exports	0.00	-	0.00	0.13	-	-	-
	Imports	0.73	4.79	7.48	6.98	6.60	7.86	6.26
	Net imports	0.72	4.79	7.48	6.85	6.60	7.86	6.26
Electricity	Exports	0.44	0.76	1.61	1.86	2.19	2.07	2.02
	Imports	0.25	0.70	0.75	0.57	1.00	0.95	1.15
	Net imports	-0.19	-0.06	-0.86	-1.29	-1.20	-1.13	-0.87
TOTAL STOCK CHANGES		**-0.08**	**1.25**	**1.17**	**1.84**	**0.04**	**-1.23**	**0.97**
TOTAL SUPPLY (TES)[4]		**45.16**	**49.80**	**41.24**	**45.13**	**43.39**	**42.76**	**40.14**
Coal		35.39	31.46	21.64	18.73	15.77	14.28	12.18
Peat		0.19	-	-	-	-	-	-
Oil		8.66	8.73	7.72	8.97	9.42	9.46	8.48
Natural gas		1.02	5.25	7.50	8.07	6.82	7.16	7.28
Biofuels and waste[1]		-	1.05	1.55	3.00	4.33	4.62	4.77
Nuclear		-	3.28	3.54	7.32	7.82	7.90	7.85
Hydro		0.09	0.10	0.15	0.24	0.14	0.17	0.18
Wind		-	-	-	0.03	0.05	0.06	0.06
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-0.00	0.06	0.24	0.23	0.22
Electricity trade[5]		-0.19	-0.06	-0.86	-1.29	-1.20	-1.13	-0.87
Shares in TES (%)								
Coal		*78.4*	*63.2*	*52.5*	*41.5*	*36.4*	*33.4*	*30.3*
Peat		*0.4*	-	-	-	-	-	-
Oil		*19.2*	*17.5*	*18.7*	*19.9*	*21.7*	*22.1*	*21.1*
Natural gas		*2.3*	*10.5*	*18.2*	*17.9*	*15.7*	*16.7*	*18.1*
Biofuels and waste[1]		-	*2.1*	*3.8*	*6.6*	*10.0*	*10.8*	*11.9*
Nuclear		-	*6.6*	*8.6*	*16.2*	*18.0*	*18.5*	*19.5*
Hydro		*0.2*	*0.2*	*0.4*	*0.5*	*0.3*	*0.4*	*0.5*
Wind		-	-	-	*0.1*	*0.1*	*0.1*	*0.1*
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	*-0.0*	*0.1*	*0.5*	*0.5*	*0.5*
Electricity trade[5]		*-0.4*	*-0.1*	*-2.1*	*-2.8*	*-2.8*	*-2.6*	*-2.2*

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	1990	2000	2010	2018	2019	2020E
TFC	**31.35**	**32.98**	**26.12**	**26.84**	**26.89**	**26.96**	**..**
Coal	20.06	12.32	4.78	2.56	2.32	2.09	..
Peat	0.19	-	-	-	-	-	..
Oil	7.75	8.27	7.30	8.60	9.14	9.19	..
Natural gas	0.81	4.24	5.92	6.18	5.26	5.29	..
Biofuels and waste[1]	-	1.04	1.26	2.40	3.09	3.32	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	0.01	0.02	0.02	..
Electricity	2.54	4.14	4.25	4.66	5.00	5.03	..
Heat	-	2.96	2.62	2.43	2.07	2.03	..
Shares in TFC (%)							
Coal	*64.0*	*37.4*	*18.3*	*9.5*	*8.6*	*7.8*	..
Peat	*0.6*	-	-	-	-	-	..
Oil	*24.7*	*25.1*	*27.9*	*32.1*	*34.0*	*34.1*	..
Natural gas	*2.6*	*12.9*	*22.6*	*23.0*	*19.5*	*19.6*	..
Biofuels and waste[1]	-	*3.2*	*4.8*	*8.9*	*11.5*	*12.3*	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	*0.0*	*0.1*	*0.1*	..
Electricity	*8.1*	*12.6*	*16.3*	*17.4*	*18.6*	*18.6*	..
Heat	-	*9.0*	*10.0*	*9.0*	*7.7*	*7.5*	..
TOTAL INDUSTRY[6]	**18.77**	**17.72**	**11.30**	**9.69**	**9.60**	**9.54**	**..**
Coal	11.24	7.21	3.32	1.56	1.50	1.37	..
Peat	0.19	-	-	-	-	-	..
Oil	5.27	4.70	2.79	2.78	2.64	2.64	..
Natural gas	0.46	2.42	2.60	2.31	2.11	2.13	..
Biofuels and waste[1]	-	0.01	0.18	0.54	0.68	0.74	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	-	-	-	..
Electricity	1.61	2.32	1.63	1.87	2.09	2.09	..
Heat	-	1.08	0.78	0.63	0.57	0.58	..
Shares in total industry (%)							
Coal	*59.9*	*40.7*	*29.4*	*16.1*	*15.7*	*14.3*	..
Peat	*1.0*	-	-	-	-	-	..
Oil	*28.0*	*26.5*	*24.7*	*28.7*	*27.5*	*27.7*	..
Natural gas	*2.4*	*13.6*	*23.0*	*23.8*	*22.0*	*22.3*	..
Biofuels and waste[1]	-	-	*1.6*	*5.6*	*7.1*	*7.8*	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	-	-	-	..
Electricity	*8.6*	*13.1*	*14.4*	*19.3*	*21.8*	*21.9*	..
Heat	-	*6.1*	*6.9*	*6.5*	*5.9*	*6.0*	..
TRANSPORT[4]	**2.17**	**2.59**	**4.23**	**5.88**	**6.62**	**6.72**	**..**
OTHER[7]	**10.41**	**12.67**	**10.59**	**11.27**	**10.68**	**10.69**	**..**
Coal	8.70	5.12	1.46	1.00	0.82	0.72	..
Peat	-	-	-	-	-	-	..
Oil	0.59	1.26	0.56	0.39	0.42	0.42	..
Natural gas	0.35	1.83	3.29	3.80	3.07	3.06	..
Biofuels and waste[1]	-	1.04	1.02	1.63	2.10	2.24	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	0.01	0.02	0.02	..
Electricity	0.76	1.56	2.42	2.65	2.76	2.78	..
Heat	-	1.88	1.84	1.79	1.50	1.45	..
Shares in other (%)							
Coal	*83.6*	*40.4*	*13.8*	*8.9*	*7.6*	*6.8*	..
Peat	-	-	-	-	-	-	..
Oil	*5.7*	*9.9*	*5.3*	*3.5*	*3.9*	*3.9*	..
Natural gas	*3.4*	*14.4*	*31.0*	*33.7*	*28.7*	*28.6*	..
Biofuels and waste[1]	-	*8.2*	*9.6*	*14.4*	*19.7*	*20.9*	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	*0.1*	*0.2*	*0.2*	..
Electricity	*7.3*	*12.3*	*22.8*	*23.5*	*25.8*	*26.0*	..
Heat	-	*14.9*	*17.4*	*15.9*	*14.0*	*13.6*	..

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							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1990**	**2000**	**2010**	**2018**	**2019**	**2020E**
ELECTRICITY GENERATION[8]							
Input (Mtoe)	9.69	18.92	20.41	23.51	22.05	21.49	..
Output (Mtoe)	3.54	5.36	6.27	7.34	7.48	7.38	6.89
Output (TWh)	41.17	62.27	72.91	85.31	86.98	85.86	80.15
Output shares (%)							
Coal	*85.1*	*76.4*	*75.4*	*58.3*	*50.1*	*45.9*	*40.8*
Peat	-	-	-	-	-	-	-
Oil	*11.3*	*0.9*	*0.5*	*0.2*	*0.1*	*0.1*	*0.1*
Natural gas	*0.9*	*0.6*	*2.3*	*1.6*	*4.3*	*6.7*	*8.5*
Biofuels and waste[1]	-	-	*0.7*	*2.6*	*5.6*	*6.0*	*6.6*
Nuclear	-	*20.2*	*18.6*	*32.8*	*34.4*	*35.2*	*37.5*
Hydro	*2.6*	*1.9*	*2.4*	*3.3*	*1.9*	*2.3*	*2.7*
Wind	-	-	-	*0.4*	*0.7*	*0.8*	*0.9*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	*0.8*	*2.8*	*2.8*	*2.9*
TOTAL LOSSES	**15.13**	**14.34**	**14.88**	**17.08**	**16.00**	**15.35**	**-0.01**
of which:							
Electricity and heat generation[9]	6.15	9.86	10.82	12.69	11.98	11.55	..
Other transformation	7.41	1.64	1.24	1.01	1.06	0.94	-0.01
Own use and transmission/distribution losses	1.57	2.83	2.82	3.38	2.96	2.86	..
Statistical differences	**-1.31**	**2.49**	**0.25**	**1.21**	**0.49**	**0.45**	**..**
INDICATORS	**1973**	**1990**	**2000**	**2010**	**2018**	**2019**	**2020E**
GDP (billion 2015 USD)	89.15	120.14	126.27	172.89	209.26	214.10	202.10
Population (millions)	9.92	10.36	10.27	10.52	10.63	10.67	10.70
TES/GDP (toe/1000 USD)[10]	0.51	0.41	0.33	0.26	0.21	0.20	0.20
Energy production/TES	0.85	0.83	0.75	0.71	0.64	0.63	0.59
Per capita TES (toe/capita)	4.55	4.81	4.01	4.29	4.08	4.01	3.75
Oil supply/GDP (toe/1000 USD)[10]	0.10	0.07	0.06	0.05	0.05	0.04	0.04
TFC/GDP (toe/1000 USD)[10]	0.35	0.27	0.21	0.16	0.13	0.13	..
Per capita TFC (toe/capita)	3.16	3.18	2.54	2.55	2.53	2.53	..
CO_2 emissions from fuel combustion ($MtCO_2$)[11]	149.4	150.2	121.2	110.8	99.0	94.3	84.3
CO_2 emissions from bunkers ($MtCO_2$)[11]	0.7	0.7	0.5	0.9	1.2	1.3	..
GROWTH RATES (% per year)	**73-90**	**90-00**	**00-10**	**10-17**	**17-18**	**18-19**	**19-20**
TES	0.6	-1.9	0.9	-0.6	0.1	-1.4	-6.1
Coal	-0.7	-3.7	-1.4	-2.4	-0.3	-9.5	-14.7
Peat	-100.0	-	-	-	-	-	-
Oil	0.0	-1.2	1.5	0.6	1.0	0.5	-10.4
Natural gas	10.1	3.6	0.7	-1.6	-5.3	5.0	1.6
Biofuels and waste[1]	-	3.9	6.8	5.2	1.1	6.8	3.3
Nuclear	-	0.8	7.5	0.2	5.5	1.1	-0.7
Hydro	0.4	4.2	4.7	-5.5	-13.0	23.6	6.4
Wind	-	-	-	8.4	2.0	15.4	-
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	..	..	19.1	11.2	-2.1	-7.3
TFC	0.3	-2.3	0.3	0.2	-1.0	0.2	..
Electricity consumption	2.9	0.2	0.9	0.8	1.2	0.6	..
Energy production	0.4	-2.8	0.4	-2.1	-0.2	-3.0	-12.2
Net oil imports	-0.2	-1.3	1.6	0.6	3.5	-1.6	-7.0
GDP	1.8	0.5	3.2	2.3	3.2	2.3	-5.6
TES/GDP	-1.2	-2.4	-2.2	-2.8	-3.0	-3.7	-0.6
TFC/GDP	-1.4	-2.8	-2.8	-2.1	-4.0	-2.0	..

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 comprise 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 ambient heat used in heat pumps.

[3] In addition to coal, oil, natural gas and electricity, total net imports also include biofuels 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 TES 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, CHP 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 autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for nuclear and 100% for hydro, wind and solar photovoltaic.

[10] Toe per thousand US dollars at 2015 prices and exchange rates.

[11] "CO_2 emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach methodology from the *2006 IPCC Guidelines.* Emissions from international marine and aviation bunkers are not included in national totals.

ANNEX D: 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 hydro power, 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 in Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

ANNEX E: 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.

Acronyms and abbreviations

AMM	advanced metering management
ASMR	Administration of State Material Reserves
BACI	Bidirectional Austria-Czech Interconnection
CCS	carbon capture and storage
CCUS	carbon capture, utilisation and storage
CNG	compressed natural gas
CO_2	carbon dioxide
CPP	Climate Protection Policy
CTR	Central Oil Tank Farm
CZK	Czech koruna (currency)
DH	district heating
DSO	distribution system operator
EC	European Commission
EFEKT	Support of Energy Savings and Use of Renewable Secondary Energy Sources
ESD	Effort Sharing Decision
ERU	Energy Regulatory Office
ESR	Effort Sharing Regulation
ETS	Emissions Trading System
EU	European Union
EV	electric vehicle
FAME	Fatty-acid methyl esters
GDP	gross domestic product
GDP PPP	gross domestic product with purchasing power parity
GHG	greenhouse gas
HHI	Herfindahl-Hirschmann Index
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
ITS	intelligent transport system
JTF	Just Transition Funds
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry

MIT	Ministry of Industry and Trade
MoE	Ministry of the Environment
MoT	Ministry of Transport
MRD	Ministry of Regional Development
NAPCM	National Action Plan for Clean Mobility
NCC	National Competence Centre
NDC	Nationally Determined Contribution
NECP	National Energy and Climate Plan
NO_X	Nitrogen oxide
NRDIP	National Research, Development and Innovation Policy
OECD	Organisation for Economic Co-operation and Development
PPA	power purchase agreement
PPP	purchasing power parity
PV	photovoltaic
R&D	research and development
RD&D	research, development and demonstration
RD&I	research, development and innovation
RED	Renewable Energy Directive
SAIDI	System average interruption duration index
SAIFI	System average interruption frequency index
SEI	State Energy Inspection
SEP	State Energy Policy
SMR	small modular reactor
SONS	State Office for Nuclear Safety
SO_X	Sulphur Oxide
TCP	Technology Collaboration Programme
TES	total energy supply
TFC	total final consumption
TFEC	total final energy consumption
TPES	total primary energy supply
TSO	transmission system operator
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar (currency)
VAT	Value-added tax
VOC	volatile organic compound
VVER	water-water energetic reactor

Units of measure

bcm	billion cubic metres
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
g CO_2	gramme of carbon dioxide
GJ	gigajoule
GJ/t	gigajoule per tonne
GW	gigawatt
GWh	gigawatt hour
kb/d	thousand barrels per day
kg CO_2	kilogramme of carbon dioxide
km	kilometre
koe	kilogrmme of oil equivalent
kt	kilotonne
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
kWt	kilowatt thermal
mb	million barrels
mcm	million cubic metres
Mt	million tonnes
Mt CO_2	million tonnes carbon dioxide
Mt CO_2-eq	million tonnes of carbon dioxide equivalent
Mt/y	million tonnes per year
Mtoe	million tonnes of oil equivalent
MW	megawatt
MW_e	megawatt electric
MWh	megawatt hour
MWt	megawatt thermal
PJ	petajoule
pkm	passenger kilometre
t CO_2	tonne of carbon dioxide
TJ	terajoule
toe	tonne of oil equivalent
TWh	terawatt hour

IEA Publications
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Typeset in France by IEA - September 2021
Cover design: IEA

Czech Republic 2021

Energy Policy Review

The International Energy Agency (IEA) regularly conducts in-depth peer reviews of the energy policies of its member countries. This process supports energy policy development and encourages the exchange of international best practices and experiences.

Fossil fuels, notably coal, still dominate the energy and electricity generation mix of the Czech Republic, but new climate targets at the European level will make coal less and less competitive. Therefore, the question is no longer if, but when, coal will exit the country's energy mix. To boost investor confidence and ensure adequate electricity generation up to 2030 and beyond, the government will need to establish a firm pathway for phasing out coal. The phase-out of coal use and mining also poses important economic and social challenges, which the government is currently addressing by providing support for the economic restructuring and fair transformation of mining areas.

Although the Czech Republic has decoupled economic growth from energy consumption since 2009, the country's energy intensity remains above the IEA average. This highlights the need to make energy efficiency the "first principle" of energy policy making.

This report includes a series of recommendations to support the Czech Republic's efforts to tackle these challenges and to meet its energy and climate goals.