

7th edition



Coal industry across Europe

Foreword

On 1st December last year, the new Von der Leyen Commission took office with a clear ambition: to make Europe the first climate-neutral continent by 2050. The European Green Deal, presented by the Commission just two weeks later, includes a comprehensive package of measures enabling European citizens and businesses to benefit from a sustainable green transition. This Deal represents the new growth strategy for Europe, aiming to reduce emissions while also creating jobs and boosting the economy. The energy sector is at its core.

As vital elements of the Green Deal, in January 2020, the Commission presented the Just Transition Mechanism and the Green Deal Investment Plan. The Just Transition Mechanism will ensure that no country, region nor person will be left behind in the green transition, by providing tailored financial and practical support to help reskilling the most impacted employees and generating investments and new jobs in those areas most affected by the transition. For the transformation to be a success, large-scale investment is absolutely essential. The overall financial package of the Mechanism is worth at least €100 billion. As for the Investment Plan, it will mobilise public investment and help unlock private funds through EU financial instruments, notably InvestEU, leading to a total of at least €1 trillion euros of investments in the European economy.

The Commission is conscious of the economic significance of coal to the economies of many regions in Europe. The coal sector still accounts for around one fifth of the total electricity production in the EU, and provides jobs to around 230 000 people in mines and power plants across thirty-one regions and eleven Member States. While for the time being coal remains an important fuel in the European energy mix, we need to acknowledge that change is already happening. In the context of climate change, the transition to cleaner sources of energy and innovative technologies is taking place and accelerates as coal is replaced by more sustainable and competitive alternatives. We as policy makers are committed to helping communities, which rely on the coal value chain during the progressive phasing out of coal from our energy mix over the next decades.



Kadri Simson, European Commissioner for Energy

To do so, the Commission already in 2017 launched the “Platform for Coal Regions in Transition”, to support coal and carbon-intensive regions in transition to be prepared for the upcoming changes. This shift is an ongoing reality in Europe and although the move to a low-carbon economy presents many opportunities, the economic and social impacts in many coal regions cannot be ignored. The transformation ahead of us Europeans is unprecedented, and it will only work if it works for all.

Co-operation and exchange of views with the coal industry has been and will continue to be important for the European Commission. It is in our common interest to secure that the clean energy transition is just, fair and informed by the views of those who are living through it.

February 2020

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President of EURACOAL*
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I. A sustainable transition needs a clear target but it requires global cooperation everywhere but particularly from major emitters to continue to reduce their emissions

II. As such, Energy transition is particularly important for the European Union countries and its members. That is why the EU has established a framework as well as tools and mechanisms to support a sustainable transition

III. The transition to a low-carbon energy system is a complex process that requires a comprehensive and coordinated approach across all sectors and regions

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Introduction

This publication, prepared by EURACOAL members, tells the story of a vital fuel: where coal comes from, what it is used for and the challenges it faces. Presenting facts and figures on the coal industry, it covers not only the European Union, but also countries that participate in the Energy Community.

Since we drafted the last edition of *Coal industry across Europe*, the Paris Agreement of 2015 has been signed and the European Commission has published its *Clean energy for all Europeans* package of proposals which have now been enacted. The package delivers on the commitments made by the European Union under the Paris Agreement. It took months of negotiation before EU member states were able to agree to all the proposals, but the new laws will help reduce greenhouse gas emissions with a transition away from fossil fuels towards clean energy. Central to the package remains the EU emissions trading system which will deliver the politically agreed reductions with certainty.

Towards the end of 2018, the European Commission presented its new strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050. Now, under the European Green Deal tabled in December 2019, this vision is being turned into legislative proposals that will transform society. Europeans must decide how committed they are to these ambitious proposals. Achieving climate neutrality will not be an easy task as it goes far beyond what other regions of the world have offered, but the European coal industry is preparing itself for such change and welcomes the promised structural investments in the coal-mining regions.

To demonstrate the coal industry's position as an important stakeholder, the coal-mining region of Silesia was pleased to host in December 2018 the 24th UNFCCC Conference of the Parties in Katowice (COP24). Although the leaders of the ten economies responsible for two-thirds of global greenhouse gas emissions were absent – China, the United States, India, Russia, Japan, Brazil, Indonesia, Germany, Canada and Iran – the *Katowice Rulebook* was adopted. It is a roadmap to implement the Paris Agreement and shows us that industrial decarbonisation is only one of the ways to tackle climate change; forestry and farming are also important. Unfortunately, no agreement was reached in Katowice or at COP25 in Madrid in December 2019 on the

important issue of international emissions trading. Although the Intergovernmental Panel on Climate Change (IPCC) report on the impacts of a 1.5°C global warming was not universally endorsed, that target looks now to be achievable in Europe.

Those EU member states who depend heavily on coal, such as Poland, Czechia, Bulgaria, Germany and Greece, have all submitted to the European Commission their draft national energy and climate plans, including assumptions on their future energy mixes. Following the cessation of subsidised hard coal mining in Germany and Spain at the end of 2018, as required under EU law, a growing number of countries are now expected to largely exit from coal and lignite use: France in 2021, the United Kingdom in 2025, Greece in 2028 and Germany in 2038. Other countries are likewise considering how and when to exit.

For this reason, the Coal Regions in Transition Platform, a welcome initiative of the European Commission, is gaining momentum. Replacing coal with renewable energy sources or nuclear power will take time, but progress is being made. Replacing the advantages of coal – its abundance, its affordability and its availability – is also a challenge, but one that can be met with massive investment in renewable energy sources and large-scale energy storage technologies.

The world is set to use around seven billion tonnes of coal each year through to 2040. The success of the energy transition in the European Union will be important not only for the European citizens who must pay the cost of transition which, according to estimates by the European Commission, will run to an *additional* €175 billion to €290 billion per year from 2031 to 2050, but also for the citizens of the world who will watch this experiment with deep interest. If it works, they will want to follow. For the European regions with coal mines and coal power plants, it means finding at least €25 billion each year from 2021 to replace these assets and associated jobs.

With the above in mind, EURACOAL members organised an Energy Summit in October 2019, co-operating with the Polish Ministry of Energy to formulate the expectations of the coal sector and the support needed to implement the energy transition in a way that builds on the coal value chain. We invite you to read the [summit declaration](#) and lend your support to a sustainable energy transition.

Coal will be used for many decades to come. While the volumes used by EU member states will continue to decline, meeting politically agreed emission-reduction targets, flexible and reliable coal-fired power generation will undoubtedly bring security to the energy transition and avoid an overdependence on fossil gas.

MEP Grzegorz Tobiszowski, former Secretary of State and Government Plenipotentiary for the restructuring of hard coal mining in Poland (left) and Mr. Tomasz Rogala, President of EURACOAL and Chairman of the Board, Polska Grupa Górnicza S.A.





DECLARATION

CONCERNING THE CONDITIONS FOR A SUSTAINABLE ENERGY TRANSITION

Energy transition is an industrial technology-driven transformation towards a low-emission economy employing diverse energy sources. This process should be carried out in compliance with social justice, taking into account rational economic decisions and the competitiveness of EU industry as well as respecting the natural environment.

- I. **A sustainable transition needs to address the climate challenge, including the Paris target, but it requires global solutions with adequate ambitions and valid contributions everywhere but particularly within the G20. The EU energy and coal sectors will continue to reduce their emissions under the reliable EU ETS.**
- II. **As such, Energy transition is a cost-intensively process and it will differ between particular European Union countries, reflecting the different starting points of each member state. That is why it is crucial to have the freedom to define the time framework as well as tools and instruments necessary to carry it out in a fair and sustainable way.**
- III. **The European mining and energy sector is the source of a value chain which should be actively included in this transition – therefore, the transformation we need is one that prevents impoverishment and social instability of the mining regions and incentivises innovation and investment.**
- IV. **There must be an appropriate balance between the objectives of the European Union’s energy policy of competitiveness, energy security and climate protection. This triangle without any overriding element can form the basis for functioning and fair development of the society and economy of every country.**

It is considered important that the message be taken into account when adopting strategies, policies, outlooks and directives issued by European Union authorities. We suggest that the transition process stakeholders co-operate with scientists and experts in order to evaluate the implemented process of transition and its compliance with the conditions included in this declaration.



From Energy Union to a carbon-neutral Europe via a just transition

An energy transition is coming. No one is quite sure what precise shape it will take as some elements are missing, such as diurnal and seasonal energy storage. The transition is being driven by technological change and political will. In the media, the environmental impacts of growing energy use feature prominently, especially in light of reports by the UN Intergovernmental Panel on Climate Change (IPCC) which warn of “profound consequences for ecosystems and people” if man-made global warming is not limited to well below 2°C above pre-industrial levels. Other, related issues attract less attention, such as energy security, and the costs and time needed for a revolution on the scale of the Industrial Revolution.

Figure 1
The UN IPCC states that a sustainable energy transition needs to address the climate challenge with an equitable global response that eradicates poverty.



Source: IPCC, 2018

The vision

In the UNFCCC Paris Agreement of 2015, world leaders set the 2°C guardrail on global warming and agreed that each country would deliver according to its ability. The Katowice Rulebook of 2018 outlines reporting standards which will provide a picture of the overall level of ambition. Parties to the UNFCCC are encouraged to inform citizens and explain what progress is being made to avert a climate catastrophe.

Box 1 Energy Union

A communication on Energy Union was published by the European Commission in February 2015. It heralded a fundamental transformation of Europe’s energy system, promising a sustainable, low-carbon and climate-friendly economy. To reach this goal means moving away from an economy driven by fossil fuels; although with a strategy for imported fossil gas. The Energy Union proposal consists of five main pillars:

- energy security, solidarity and trust;
- a fully integrated European energy market;
- energy efficiency contributing to moderation of demand;
- decarbonising the economy; and
- research, innovation and competitiveness.

The fourth pillar is based on an EU-wide carbon market under the EU emissions trading system (ETS), with the vision of making Europe the number one in renewable energy sources.

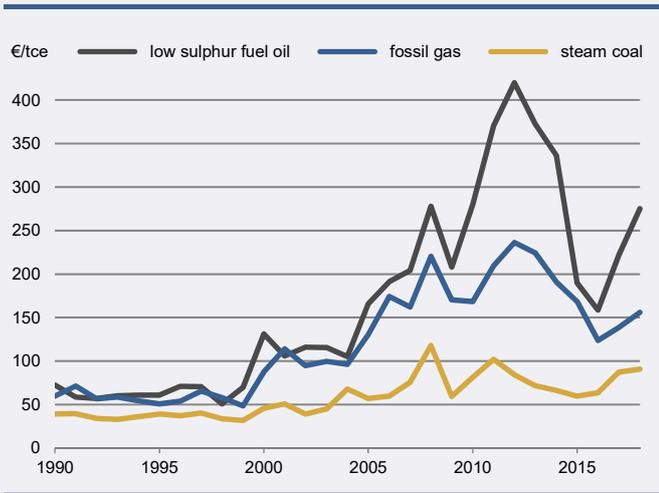
Energy systems have never been static, always changing and modernising with, for example, larger, more efficient power generation units, more robust grids and evermore imaginative ways to use electricity. The way coal is used has changed – from the burning of raw coal to the controlled combustion and gasification processes of today, with modern pollution control technologies to further reduce environmental impacts. The new political vision is of a carbon-neutral energy system that relies on renewable energy sources, smart grids, decentralised power production and the active participation of *prosumers* through the digitalisation of energy services. These are the aims of Energy Union in the EU.

The challenge

Energy transition is complex and to achieve it on the scale needed will require the wide deployment of new technologies.

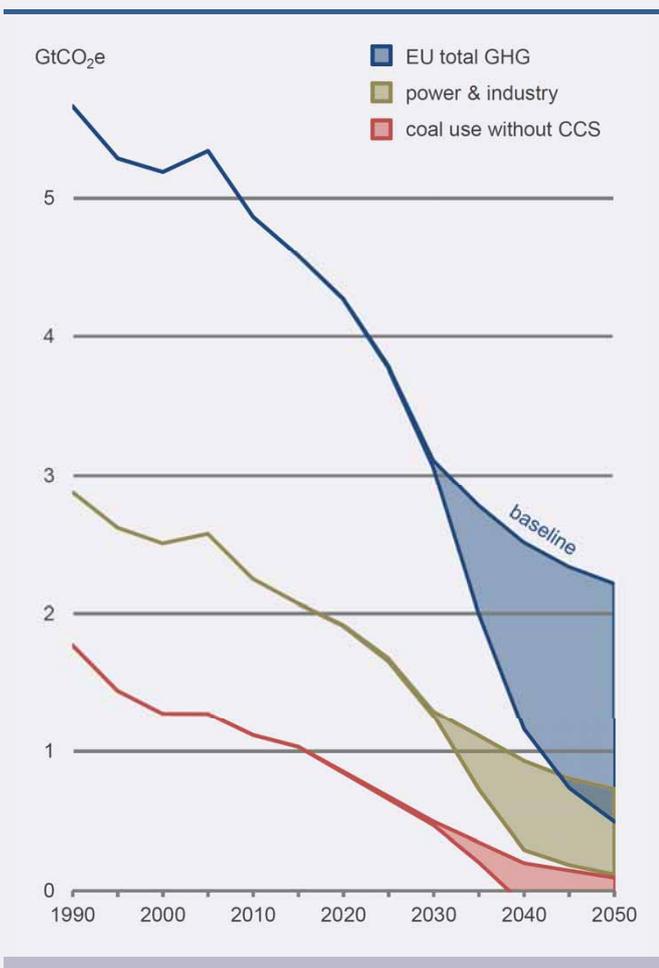
The EU emissions trading system (ETS) should remain the *only* instrument used to drive down CO₂ emissions from the power sector: it delivers a politically agreed emission reduction target. By 2050, the power sector and other energy-intensive industries must have reduced their CO₂ emissions by around 90% compared with 2005, and no new emission allowances will be auctioned after 2058. Following recent political decisions to tighten the ETS, the price of emission allowances surged and the cheapest fuel suppliers (*i.e.* coal and lignite mining companies – see Figure 2) and power utilities now struggle to deliver the cheapest electricity to consumers. Such moves have damaged the ETS as a reliable and predictable policy instrument.

Figure 2
Oil, gas and coal prices in the EU since 1990 – compared on an energy basis, € per tonne of coal equivalent



Sources: IEA databases, BAFA in BP, 2019 and IHS, 2019

Figure 3
GHG emission reduction pathways in the EU, 1990-2050 showing the range of scenarios reported by the European Commission in its long-term strategic vision for a climate-neutral economy



Sources: European Commission, 2018, IEA databases and EURACOAL estimates for CO₂ emissions from coal use based on industry trends.

Box 2
EU climate strategy to 2050: a clean planet for all



In November 2018, the European Commission published its new vision for reducing greenhouse gas (GHG) emissions to achieve a carbon-neutral European Union by 2050. The long-term strategy for a climate-neutral economy would require joint action by member states in seven strategic areas:

- energy efficiency;
- deployment of renewables;
- clean, safe and connected mobility;
- competitive industry and a circular economy;
- energy infrastructure and interconnections;
- bio-economy and natural carbon sinks; and
- carbon capture and storage to address remaining emissions.

Member states were invited to submit draft National Climate and Energy Plans by the end of 2018. These continue to be reviewed and refined so that the EU’s climate and energy targets for 2030 and 2050 can be met through the aggregated efforts of member states.

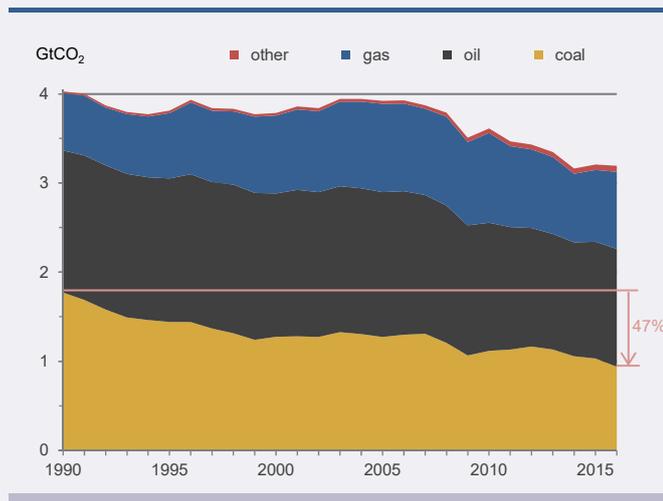
Carbon neutrality by mid-century is a challenge, even for progressive regions like the European Union. It will require substantial changes not only to the energy system, but also to the way we all live: what food we eat and how it is produced, packaged and transported; how we travel and whether we can fly or drive; what fuels we use to keep warm; and where we live. Cities are changing in response to the transition – from the deep renovation of old buildings to make them energy efficient, through new smart buildings and low-energy lighting, to roads that limit the space for cars in favour of bicycles and buses.

With the right impetus, change can come quickly. Mobile or cell phone subscribers grew from just a few in 1990 to an estimated 5.4 billion in 2020; 69% of the global population willingly pays for a communication system that existed only in sci-fi forty years ago. The climate challenge also requires global solutions, with similar ambitions everywhere. However, when it comes to energy supply, not all countries have the same possibilities.

The response

The coal sector has invested heavily in environmental technologies such as flue gas desulphurisation (FGD) for SO₂ and selective catalytic reduction for NO_x. The fall in pollutant emissions has been impressive – by between 60% and 90% since 1990. In the European Union, CO₂ emissions from the coal sector fell from 1990 to 2016 by an astonishing 47%, helping to meet the EU’s ambitious climate targets. Now, the circular economy concept can be taken to a new level, not just using ash for cement making and FGD gypsum for plasterboard, but closing the carbon cycle. Much work is in progress to capture CO₂ and convert it using renewable energy into useful products such as basic chemicals and plastics, or as replacements for oil-based fuels. During the transition, coal should be used in the cleanest possible ways. This means continued technical research on current issues and also on alternative uses of coal for a carbon-neutral era.

Figure 4
CO₂ emissions from fuel combustion by fuel type in the EU-28, 1990-2016

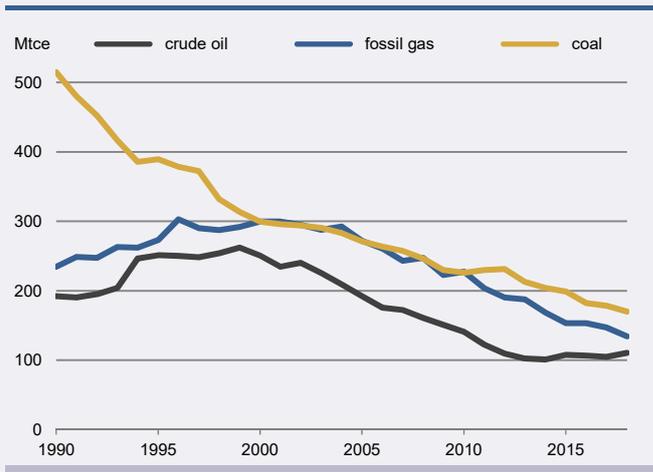


Source: IEA, 2018

While it is true that the coal industry is in decline in some member states, this is merely the continuation of a long-term trend that began decades ago. There are member states that will stop using coal in the next few years. For them, switching to fossil gas is relatively easy and not disruptive. In other member states, with a continued high dependence on coal (as well as oil shale and peat), the switch is not as straightforward. They will still need coal in their energy portfolios for decades to come. The switch away from coal needs to be supported with major investments in new energy infrastructure which will increase national debts.

The total *additional* cost of transition, over and above business-as-usual, is estimated by the European Commission to be €175 billion to €290 billion each year out to 2050 (COM(2018) 773). This would achieve net-zero emissions at a cost of up to US\$10 trillion – more than €500 each year for every man, woman and child in the EU.

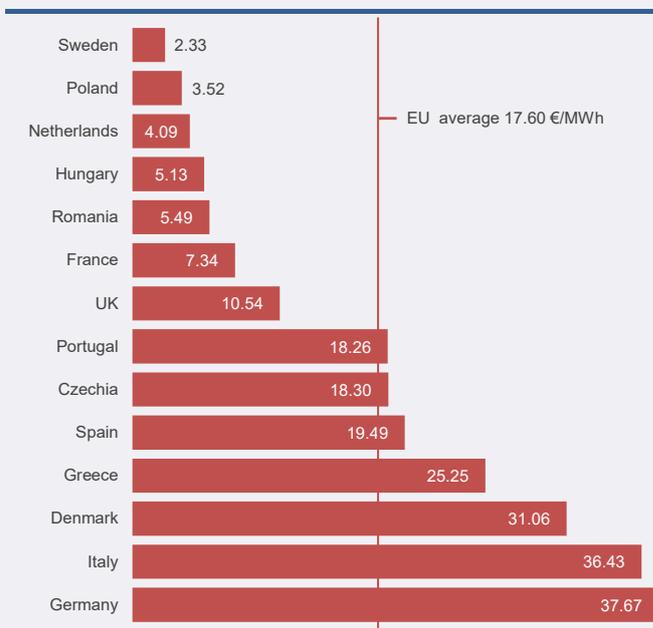
Figure 5
EU coal, crude oil and fossil gas production, 1990-2018



Source: IEA databases

The cost of transition is not shared uniformly across the EU. For example, in 2016, €57 billion was spent in support of renewable power generation (Figures 6 and 11), or over €100 per person. This subsidy added 17.60 €/MWh to the average cost of all EU electricity. Germany paid the most for renewables: €24 billion to subsidise one quarter of its power production, adding 37.67 €/MWh to the cost of all electricity consumed – more than its wholesale value. Not all countries can afford to invest so heavily in renewables, especially as conventional plants must also be kept operating as backup.

Figure 6
RES electricity support per unit of gross electricity, 2016



Source: CEER, 2018

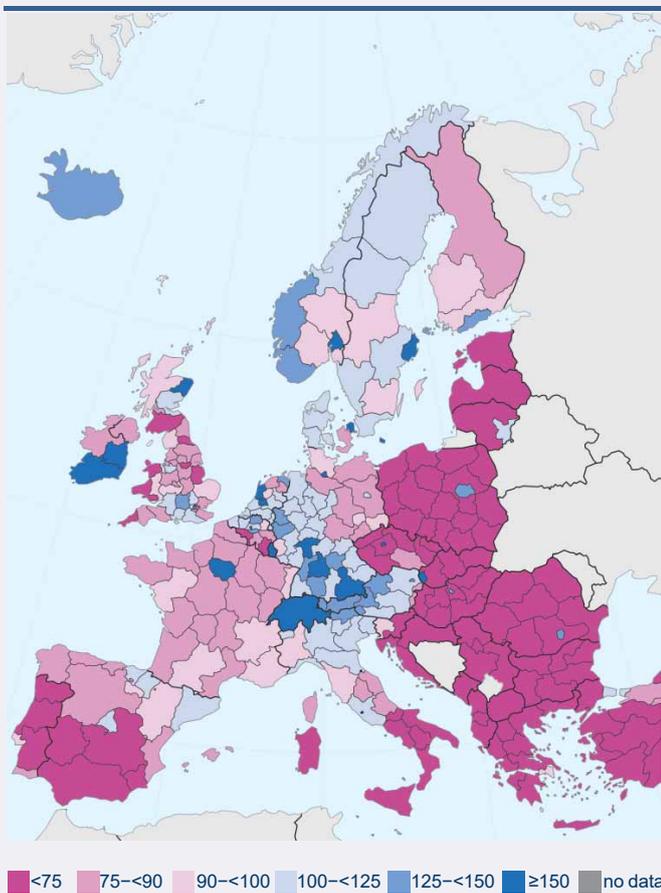
“Energy transition is a costly process and it will differ between particular EU countries, reflecting the different starting points of each member state. That is why it is crucial to have the freedom to define the timeframe as well as tools and instruments necessary to carry it out in a fair and sustainable way.”

Energy Summit Declaration, Warsaw, October 2019

The social dimension

Around the world, 862 million people do not have access to electricity and 2 651 million are without clean cooking fuels (IEA, 2019a). In the European Union, despite efforts to reduce economic disparity, the prosperity map is unequal when viewed along the east-west, and north-south axes. Average salaries can be five times lower in some member states compared with others for nominally similar work. This discrepancy reflects the wide range of *per capita* GDP in member states, even on a purchasing power parity basis. It is often the less wealthy eastern and south-eastern member states who are most dependent on coal.

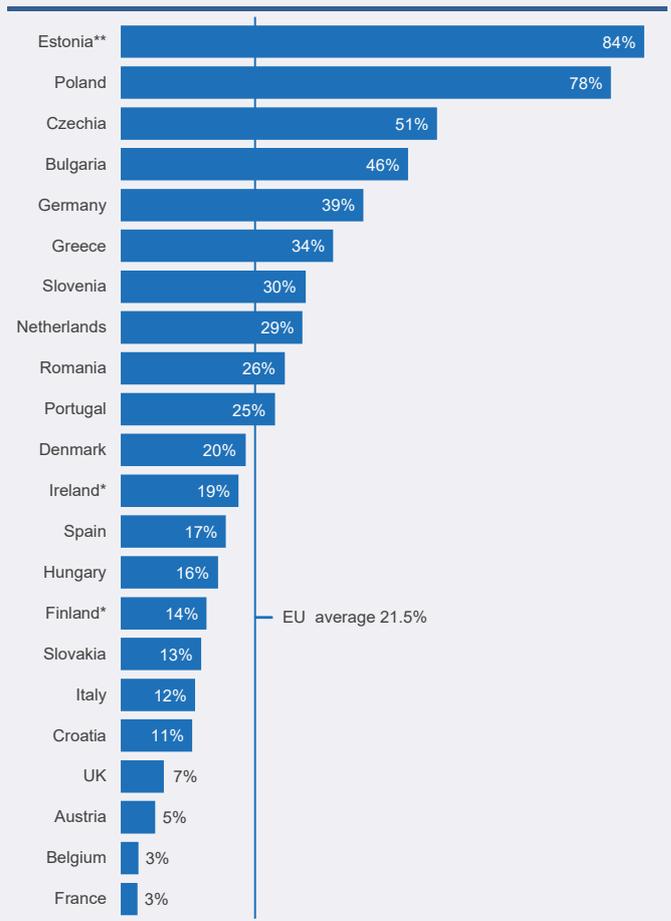
Figure 7
Inequality across European Union regions as shown by *per capita* GDP in NUTS 2 regions, 2017
 (purchasing power standards, EU average = 100)



Source: Eurostat databases *nama_10r_2gdp*, *nama_10r_3popgdp*, *nama_10_gdp* and *nama_10_pe*, last update 28.06.2019

The policy push towards carbon neutrality places coal mining and coal power companies in the less wealthy member states in a particularly difficult position. Unlike other industrial enterprises, they are first and foremost local companies serving local markets. Whatever the cost, they must remain in place to supply essential energy and electricity until viable alternatives become available. For them, relocation outside of the EU is not an option.

Figure 8
Share of coal in the energy mix for EU electricity generation, 2017



Source: Eurostat database *nrg_bal_peh*, last update 25.06.2019 (n.b. coal includes coke oven / BF gas, peat* and oil shale**)

If coal power utilities were not burdened with expensive CO₂ allowances (a c.100% tax for lignite producers), they could be in position to diversify their activities: switching to other fuels or entering new industrial markets that require similar skill sets. However, diversification needs legal certainty and the availability of funds to invest.

There is much talk of a “just transition”, leaving nobody behind; coal miners are promised workplaces after coal is phased out. It will take time to restore land and attract investors to establish new activities in the coal regions. The “green economy”, though it promises new jobs, is not well developed in these regions. Therefore, it would be wise to include coal companies in any discussions on structural change in the regions as they can contribute and offer solutions – some of a bridging nature, others more permanent.

“The European mining and energy sector is the source of a value chain which should be actively included in this transition – therefore, the transformation we need is one that prevents impoverishment and social instability of the mining regions and incentivises innovation and investment.”

Energy Summit Declaration, Warsaw, October 2019

Box 3 European Green Deal

In July 2019, the President-elect of the European Commission presented her 2019-2024 political agenda to the European Parliament. In a radical departure from free-market economics, a Green Deal is proposed that will affect all areas of life in Europe. By March 2020, the Commission will propose:

- a 50% GHG reduction target by 2030;
- the first climate-neutral continent by 2050;
- an extension of the EU ETS to cover maritime, traffic and construction;
- a Carbon Border Tax to avoid carbon leakage;
- a review of the Energy Taxation Directive;
- a Circular Economy Action Plan and decarbonisation of energy-intensive industries;
- a zero-pollution ambition (e.g. air and water quality, industrial emissions and plastics);
- a Biodiversity Strategy for 2030;
- a Farm-to-Fork Strategy for sustainable food;
- a European Climate Pact for the regions, local communities, civil society, industry and schools;
- a new Just Transition Fund so that nobody in any region is left behind, with targeted support to industrial, coal and energy-intensive regions and energy islands;
- a ten-year, €1 trillion Sustainable Europe Investment Plan led by the European Investment Bank.

A large majority of member states have already endorsed the EU objective of climate neutrality by 2050.

Figure 9
Solidarity and Just Transition Silesia Declaration



To this end, the European coal sector supports the European Commission's *Coal Regions in Transition Platform* initiative – being actively involved from the initial proposal to participating in a fully-fledged interest group with hundreds of stakeholders. The World Bank, the European Commission and the Energy Community are also engaged in establishing a similar coal platform for the Western Balkans and Ukraine.

A just transition

The term “just transition” has been embraced by the European Commission, trade unions, and environmental NGOs who call for the “fair” treatment of workers during what they see as the necessary and inevitable de-industrialisation of society in order to save the planet for future generations.

During the energy transition, some sectors are expected to shrink and hundreds of thousands of jobs will disappear. The role of the European Commission is not only to present a vision for the EU, but also to secure this vision in a way that avoids social unrest and the extinction of economic activity in those regions of Europe which depend on fossil fuels and heavy industry. More generally, across Europe, there is a risk associated with rising energy prices. The issues of energy poverty and industrial competitiveness have to be addressed.

At the UNFCCC COP24 conference in December 2018, the *Solidarity and Just Transition Silesia Declaration* was signed by fifty-six heads of state. The declaration demands that no one be left behind during the energy transition. In the long term, the implementation of a solidarity-based transition will help garner and maintain public support for policies to reduce emissions. In turn, this should enable the successful implementation of a transition which is a prerequisite for achieving global climate policy objectives.

The €5 billion Just Transition Fund, as called for by the European Parliament in November 2018, will surely not be enough to cover the costs of energy transition in the coal regions. However, the European Commission proposes using the existing Structural Funds and Cohesion Fund to support the transition. With such support, the coal regions can look forward to a bright, carbon-neutral future.



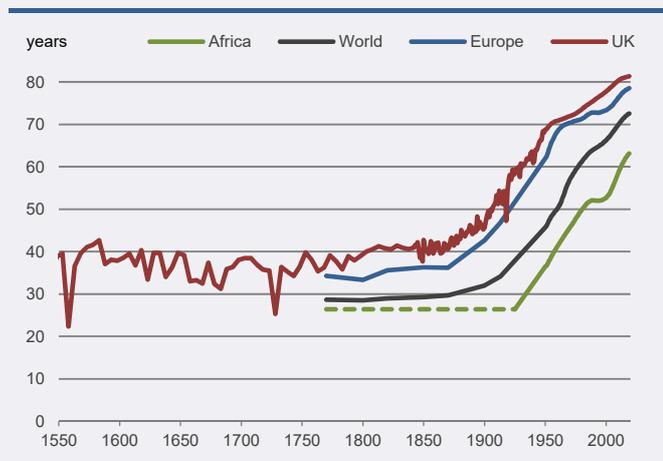


Added value from coal

Coal is abundant, affordable and available – that is why it is the fuel of choice for electricity generation in many developed and developing countries. In Europe, coal ensures a truly competitive energy market. Without inter-fuel competition from coal, industrial and residential electricity consumers would face much higher power prices.

Since the beginning of the Industrial Revolution, coal has brought prosperity to many nations. Industrialisation has improved living conditions, health care and communications. Life expectancy in the United Kingdom has doubled thanks to industrialisation – a picture repeated around the world. As society has aged so the global population has increased, creating a higher demand for energy. Forecasts predict that energy demand will continue growing, so new energy technologies will be needed to meet the expectation of higher living standards for all and a clean environment.

Figure 10
Life expectancy in rich and poor countries around the world has increased with industrialisation



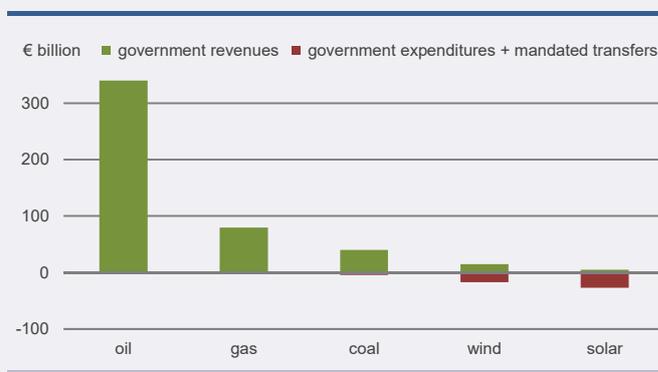
Sources: Riley, 2005; Clio Infra, 2015 in Zijdeman, 2015; and UN Population Division, 2019. N.b. life expectancy at birth is the average number of years a newborn would live if the pattern of mortality in the given year were to stay the same throughout its life.

In the European Union, coal remains an important energy source, meeting 15% of primary energy demand in 2017. At 187 million tonnes of coal equivalent (Mtce), indigenous coal and lignite production exceeded EU production of oil or fossil gas. Ample reserves of coal and lignite are found in many member states.

Coal mining companies create well-paid jobs with above-regional-average salaries (Figure 12). They pay national taxes and contribute to local authority budgets. Overall, EU companies making up the coal-value chain (e.g. mining, supply, power generation and coke making) paid a net

€35 billion to governments in 2015 (Figure 11). Unlike renewable energy sources, the oil, gas and coal sectors make net contributions to the public purse.

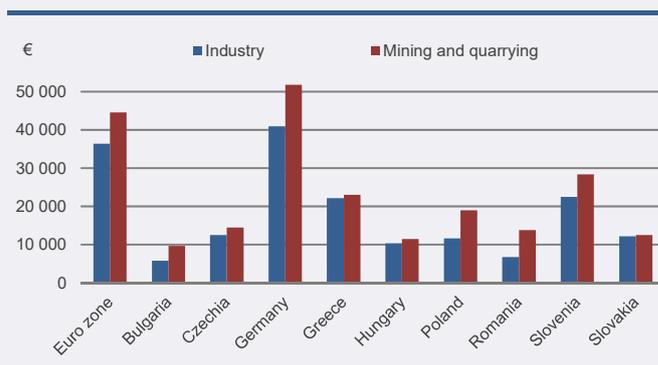
Figure 11
EU28 + Norway net government revenues and mandated transfers, 2015



Source: NERA analysis for IOGP, 2018

In 2018, across the EU, 76 million tonnes of hard coal and 367 million tonnes of lignite were produced. Mining this coal employed 163 thousand people, some at integrated mine and power plants. In the greater Europe, including the Balkans, Turkey and Ukraine, this number rises to 291 thousand people (Table 1). Adding the indirect jobs supported by coal mining at suppliers of equipment, services and materials leads to a total of around 800 thousand people whose livelihoods depend on the coal industry. Coal mining is often the main employer in regions which would otherwise be depressed and suffering from high unemployment.

Figure 12
Average annual wages in the mining and quarrying sector, which includes coal mining, compared with wages across industry in EU member states, 2014



Source: Eurostat database earn_ses14_27, last update 18.05.2018

The annual value of EU-wide coal and lignite production, based on its calorific value and on international hard coal prices, totalled around €18 billion in 2018.¹ Adding coal imports lifts the total value of coal used in the EU to €34 billion. To replace this coal with fossil gas would mean a greater dependency on non-EU gas as the EU itself has insufficient indigenous fossil gas production to meet its *existing* needs. In 2017, the EU was 74% dependent on gas imports.

In 2017, power generation from coal and other solid fuels – indigenous and imported – accounted for 21.5% of gross electricity production in the EU. With the growth of intermittent renewable power generation from wind and solar, the flexibility of conventional thermal power plants matters more and more. Coal-fired power plants respond as quickly as gas-fired plants to the ups and down of electricity supply and demand, helping to keep electricity grids in

balance and our lights on, whatever the time of day, whatever the weather and whatever the season.

Note

¹ Indigenous coal production of 76 Mt, lignite production of 367 Mt (approximately 133 Mt at 6 000 kcal/kg) and imports of 167 Mt in 2018, at an average price of 92 US\$/tonne for steam coal and double this for coking coal (IHS, 2019).

Table 1
Manpower in the European coal industry, 2015 and 2018

	2015			2018		
	Hard Coal	Lignite	Total	Hard Coal	Lignite	Total
Bosnia and Herzegovina	-	14 382	14 382	-	13 323	13 323
Bulgaria	-	11 765	11 765	-	10 294	10 294
Czech Republic	10 131	7 869	18 000	6 757	7 147	13 904
Germany	9 640	15 428	25 068	4 125	15 876	20 001
Greece	-	4 919	4 919	-	4 082	4 082
Hungary	-	1 655	1 655	-	1 400	1 400
Norway	267	-	267	126	-	126
Poland	89 924	9 574	99 498	82 843	8 583	91 426
Romania	4 442	10 600	15 042	3 022	13 000	16 022
Serbia	1 600	12 360	13 960	3 500	14 850	18 350
Slovakia	-	2 190	2 190	-	2 000	2 000
Slovenia	-	1 274	1 274	-	1 252	1 252
Spain	3 324	-	3 324	1 549	-	1 549
Turkey	15 668	28 856	44 524	14 251	37 596	51 847
Ukraine	122 000	-	122 000	44 300	-	44 300
United Kingdom	1 975	-	1 975	647	-	647
Total	258 971	120 872	379 843	161 120	129 403	290 523

Source: EURACOAL members



International coal market and global energy trends

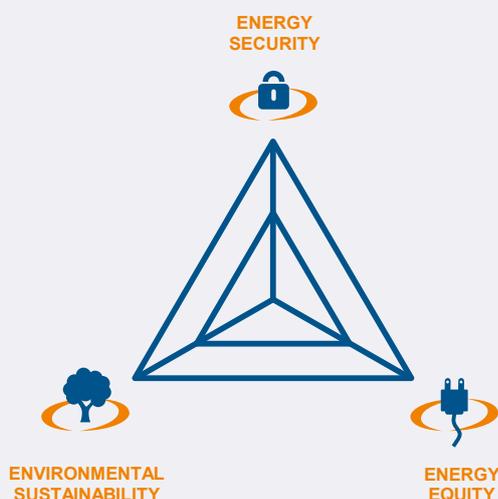
Around the world, coal makes a crucial contribution to the security of energy supply. It is a very competitive fuel and adds economic value wherever it is used: for steelmaking, for cement production and, most importantly, for electricity production. Coal oils the wheels of industry. A diverse energy mix with coal can be part of any strategy that aims to reduce risks and underpin sustainable economic growth.

The aim of this section is to give an overview of how coal production and use in the European Union fit with the wider global picture of expanding coal consumption. Although it is impossible to forecast the future, it is instructive to look at current energy trends and examine how climate and energy policies may influence these trends.

Coal and sustainability

The European coal industry believes that the three energy sustainability objectives – security of supply, competitiveness and environmental compatibility – must be pursued with equal effort. Europe's energy sector faces considerable challenges to ensure security of energy supplies and investment in new energy infrastructure. Conventional thermal power generation, including nuclear power plants and, to an even greater extent, coal-, lignite- and gas-fired power plants, will continue to be needed for decades to come, so, they need to be sustainable.

Figure 13
The energy trilemma according to the World Energy Council



Source: World Energy Council, 2015

A key requirement for the development of sustainable energy supplies in Europe is competitiveness. Energy at affordable and equitable prices helps to maintain the competitiveness of European industry as a whole and allows people to enjoy comfortable lives. At present, the EU imports 55% of all the energy it consumes, at a cost of around €266 billion per year. The EU imports 87% of its crude oil needs, 74% of its fossil gas and 44% of its coal: all are rising.

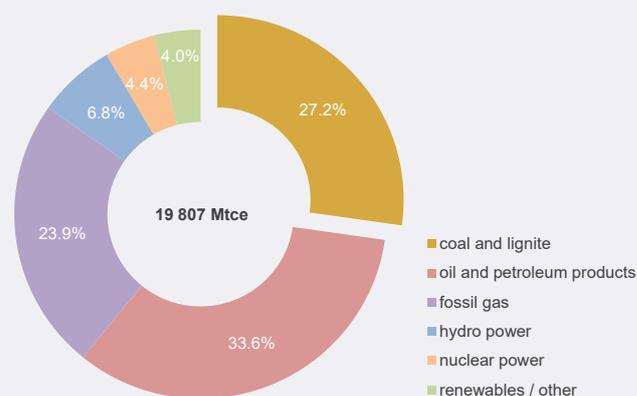
Managing energy-supply risks is an integral part of the Energy Union strategy of 2015. Two essential elements of a secure energy system are a diversity of energy sources and a diversity of energy technologies. A diverse energy mix, comprising indigenous and imported energy sources, including hard coal and lignite, helps to limit supply risks.

Electric power is no longer generated using conventional hydro, coal, fossil gas and nuclear energy alone. Today, new renewable energy sources, such as wind turbines and solar PV, are growing in importance, but still require reliable backup from conventional sources, at least until large-scale electricity storage options become available. By valuing the flexibility and reliability of coal- and lignite-fired power generation, there is great scope for developing and implementing renewable energy sources to the maximum possible extent. The key to Europe's future power generation lies in a broad mix of energy sources, so that supply risks are minimised, reliability maximised, affordable electricity enjoyed and further progress made in environmental protection.

Global energy mix and coal

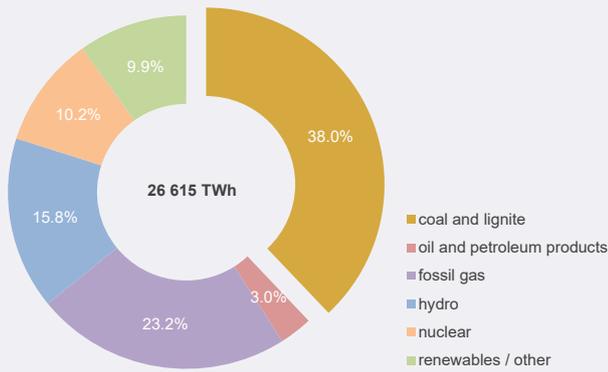
World total primary energy supply in 2018 was 19.8 billion tonnes of coal equivalent (Gtce) of which 27.2% came from coal. Coal is of particular significance for electricity generation. Some 38.0% of global power generation and 20.0% of EU power generation in 2018 was based on coal.

Figure 14
World total primary energy supply by fuel, 2018



Source: BP, 2019 (excludes non-commercial biofuels)

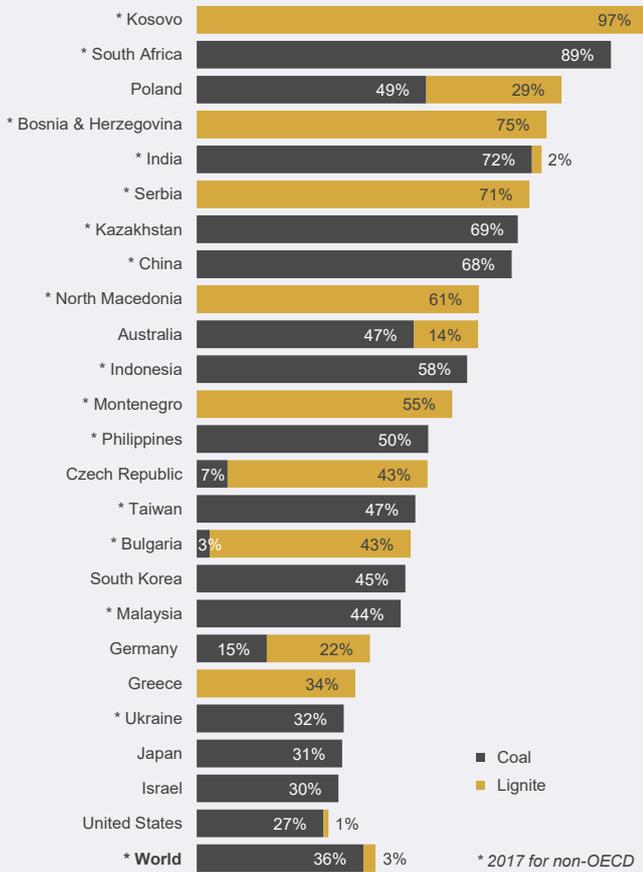
Figure 15
World electricity generation by fuel, 2018



Sources: IEA databases, BP, 2019 and own estimates

According to ENTSO-E (2019), 592 TWh of net electricity generation in the EU came from solid fuels in 2018 (284 TWh from hard coal, 294 TWh from lignite and the remainder from oil shale and peat). Hard coal-fired power plants in the EU have a total capacity of 99 GW and lignite-fired power plants add a further 52 GW. Individual countries have very different energy mixes for power generation, with coal being indispensable for many (Figure 16 and table on page 83).

Figure 16
Share of coal- and lignite-fired gross power generation in selected countries, 2017 and 2018

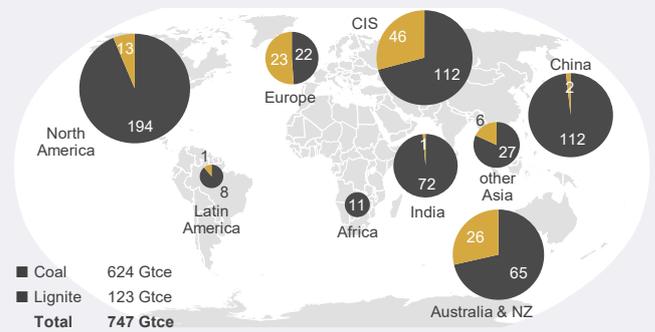


Source: IEA databases (including coal gases and coal products)

World coal resources

Reserves of coal and lignite are abundant; total resources are estimated at 17 489 billion tonnes of coal equivalent (Gtce) of which only 1.2% have been extracted since 1950. Reserves amount to 747 Gtce and are substantially greater than those of either oil or fossil gas, even if one includes non-conventional oil and gas reserves. In fact, coal reserves account for over half of all non-renewable energy reserves and are distributed more equally than those of fossil gas or oil. The world coal market is a free commodity market, which – in contrast to oil and fossil gas markets – is not influenced by geopolitics or the formation of cartels.

Figure 17
Global hard coal and lignite reserves as at 1.1.2018



Source: BGR, 2019 and own calculations

EU coal resources

The availability of coal and lignite resources in Europe and around the world, combined with the high productivity of European coal and lignite producers and the diversity of coal exporters to Europe, guarantee a high degree of supply security and competitive prices. Indigenous energy production, diversified sources of import supply and the storage capacities available at mines, ports and consumers all help to ensure a stable supply chain. Unlike oil and fossil gas, coal does not require strategic stocks to safeguard against political risks.

Table 2
Non-renewable energy reserves in the European Union

	Gtce	share
Hard coal	20.6	51.0%
Lignite	16.4	40.5%
Oil	1.4	3.5%
Fossil gas	1.7	4.2%
Uranium	0.3	0.8%
Total	40.5	100.0%

Source: BGR, 2019

International coal market

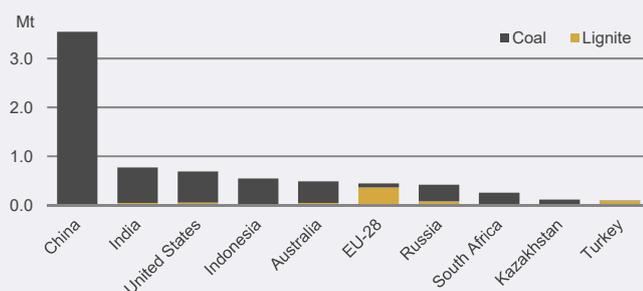
The largest coal producers in 2018 were China and India, followed by the United States and Indonesia. Australia was the fifth largest coal producer and is the world's largest exporter of steam and coking coal by value. The European Union was the sixth largest producer, being the world's largest producer of lignite by a wide margin. The top-10 producers accounted for 94% of total world production.

Table 3
Largest coal producers, 2018

Country	Coking coal (Mt)	Steam coal (Mt)	Lignite (Mt)	Total (Mt)
1 China	3026.4	523.7	-	3550.1
2 India	676.4	49.2	45.3	770.9
3 United States	561.7	71.9	51.7	685.4
4 Indonesia	543.0	5.6	-	548.6
5 Australia	257.8	179.4	46.0	483.1
6 EU-28	15.5	60.2	366.9	442.6
7 Russia	245.4	93.0	81.4	419.8
8 South Africa	254.2	4.4	-	258.7
9 Kazakhstan	96.4	10.8	6.4	113.7
10 Turkey	1.9	0.7	85.2	87.8
others	298.1	34.4	120.3	452.6
World	5976.8	1033.3	803.2	7813.3

Source: IEA Coal Information 2019 and EURACOAL members

Figure 18
Largest coal producers in 2018, billion tonnes



Source: IEA Coal Information 2019

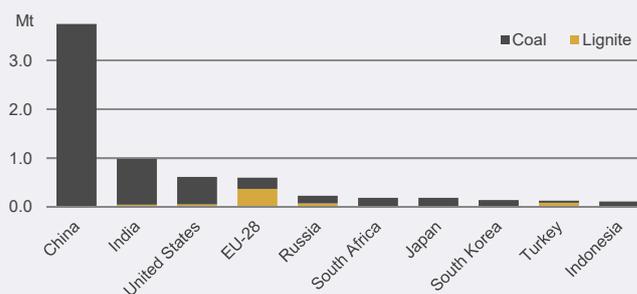
The largest coal consumers in 2018 were China and India, followed by the United States. The European Union was the fourth largest consumer, with steam coal for electricity generation being the main use of coal, accounting for three quarters of all coal and lignite use on an energy basis. The top-10 consumers accounted for over 90% of total world consumption, with the European Union accounting for 7.8%. At 1.2 tonnes, the annual *per-capita* coal consumption of European Union citizens is above the global average of 1.0 tonne of coal per person.

Table 4
Largest coal users, 2018

Country	Coking coal (Mt)	Steam coal (Mt)	Lignite (Mt)	Total (Mt)
1 China	587.4	3157.8	-	3745.1
2 India	97.4	842.3	45.3	985.0
3 United States	16.7	545.4	52.4	614.5
4 EU-28	55.0	175.9	368.6	599.6
5 Russia	64.5	93.4	73.8	231.7
6 South Africa	3.3	186.1	-	189.4
7 Japan	46.7	139.3	-	186.0
8 South Korea	36.9	106.9	-	143.8
9 Turkey	7.7	33.1	84.9	125.7
10 Indonesia	7.5	107.6	-	115.1
others	69.0	547.8	168.5	785.3
World	992.1	5935.6	793.5	7721.2

Source: IEA Coal Information 2019 and EURACOAL members

Figure 19
Largest coal users in 2018, billion tonnes



Source: IEA Coal Information 2019

Global seaborne hard coal trade is estimated at 1 210 million tonnes in 2018, of which 906 million tonnes were steam coal and 304 million tonnes were coking coal. Seaborne coal trade can be divided into Pacific and Atlantic markets, each with different supply patterns.

Figure 20
World traded coal flows in 2018



Source: VDKi, 2019

Important exporting countries for steam coal and coking coal are Australia, Indonesia, Russia, the United States, Colombia and South Africa and who together accounted for 91% of all coal exports in 2018 (Table 5).

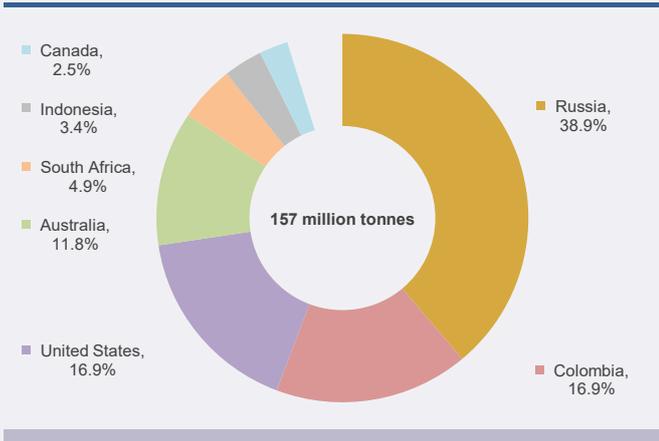
Table 5
Largest coal exporters, 2018

	Country	Coking coal (Mt)	Steam coal (Mt)	Total (Mt)
1	Indonesia	3.5	435.4	439.0
2	Australia	179.2	202.7	381.9
3	Russia	26.4	183.4	209.9
4	United States	55.8	49.1	104.9
5	Colombia	2.4	79.5	81.9
6	South Africa	1.2	68.2	69.3
7	Mongolia	25.7	8.3	34.0
8	Canada	28.9	0.9	29.9
9	Kazakhstan	3.6	22.2	25.8
10	Mozambique	6.2	5.4	11.6
	others	3.9	28.2	31.9
	World	336.8	1083.3	1420.1

Source: IEA Coal Information 2019

Top coal importing countries are China, India, Japan, South Korea and Taiwan, together accounting for 65% of all coal trade in 2018. In the European Union, Germany and Poland were the biggest coal importers in 2018, followed by Spain, Italy and France. Leading exporters to the European Union are Russia, Colombia, the United States, Australia and South Africa. In 2017, 38.9% of all coal imports into the European Union came from Russia.

Figure 21
Hard coal imports into the EU by country of origin, 2017



Source: European Commission DG Energy, 2019

Global energy trends

Future world energy scenarios to 2040 and beyond from the International Energy Agency (IEA) and other respected bodies show a marked increase in world total primary energy

consumption, with more or less similar proportions of oil, coal and gas in the energy supply mix.

In contrast to the global picture of growing fossil fuel use and hence rising carbon emissions, leaders of the European Union have agreed to reduce greenhouse gas emissions by 80-95% by 2050 compared with 1990 levels. Their ambition is to achieve carbon neutrality by 2050, such that residual man-made emissions are balanced by enhanced removals. The European Commission presented its *Energy Roadmap 2050* in December 2011, accompanied by an impact assessment in which it details various scenarios to achieve an 80% reduction in greenhouse gas emissions by 2050. While all sectors are analysed, the power sector is seen as the one carrying most of the burden of emission reductions.

The IEA *World Energy Outlook* analyses future energy supply and demand to 2040. In its Stated Policies Scenario, the Agency assumes the cautious implementation of already announced policy measures. Figures 22 and 23 show that coal and lignite are expected to remain an important albeit smaller component of EU energy supply for many years.

Figure 22
EU production of coal and lignite

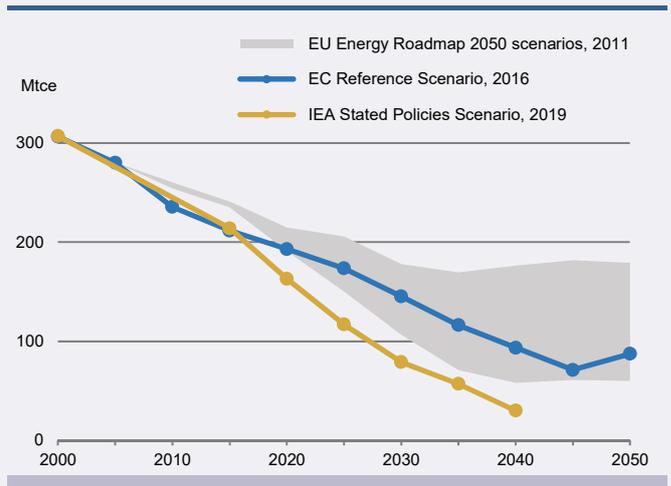
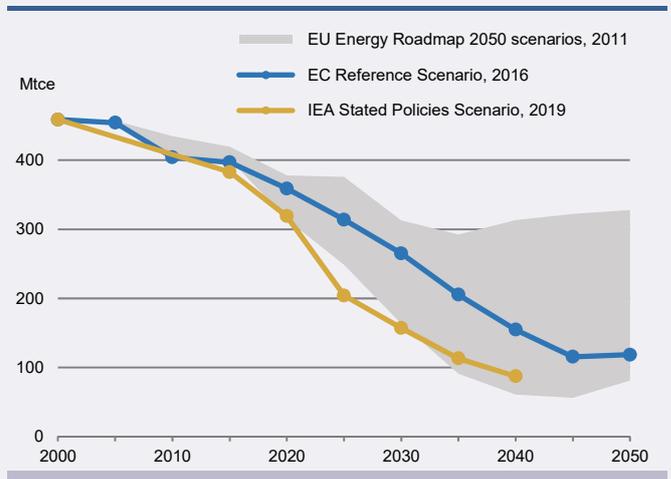
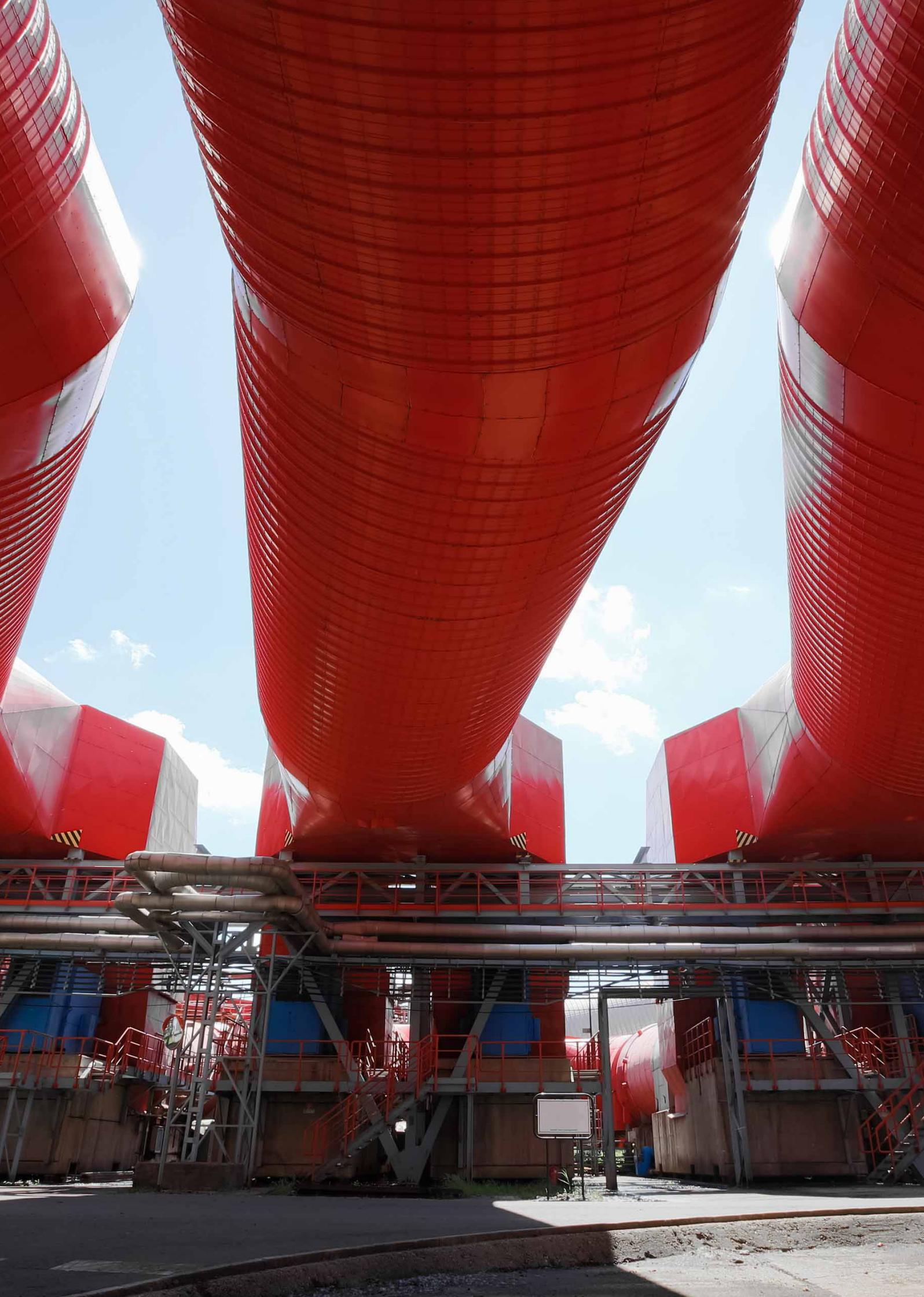


Figure 23
EU consumption of coal and lignite



Sources: European Commission, 2011 & 2016 and IEA, 2019a





Bulgaria



Since the global economic crisis of 2007-08, the Bulgarian economy has grown steadily, by up to 4% per year. In 2018, GDP growth was 3.4% and the unemployment rate was 5.2%. The driving forces for this growth are investment and domestic consumption as disposable household incomes rise. EU funds and low interest rates on loans provide favourable investment conditions.

With its large resource potential, the mining sector is of great importance to Bulgaria and has developed strongly over the years. The mining sector has attracted considerable local and foreign investment with several companies investing in world-class exploration, extraction and processing projects. The *National Strategy for the Development of the Mining Industry to 2030* envisages further growth of the sector.

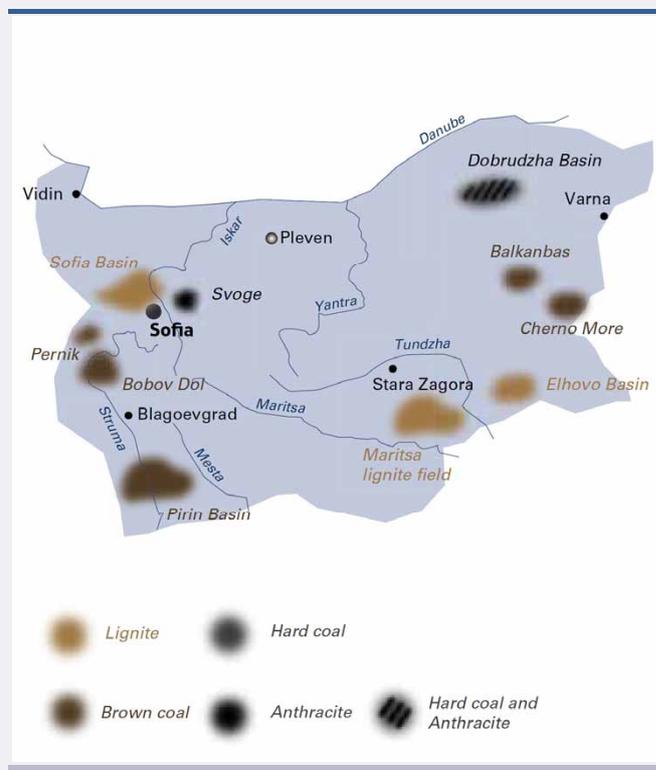
Following its *Energy Strategy to 2020*, the Bulgarian government is elaborating a new energy strategy to 2030, with a horizon to 2050. The key priorities are: guaranteeing energy security and the financial stability of companies in the energy sector; full liberalisation of the Bulgarian electricity market in line with EU legislation; selection of a prime contractor for the Belene nuclear power plant; continued gas exploration in the Black Sea and construction of related infrastructure; increasing the share of renewable energy sources in power generation; and implementing an energy efficiency programme.

In October 2019, the Council of Ministers approved a *National Climate Change Adaptation Strategy and Action Plan* for the period to 2030. This will serve as a reference document, setting a framework for action and priority directions.

Primary energy production totalled 16.8 million tonnes of coal equivalent in 2017, with lignite and brown coal having the highest share at 48.3%, followed by nuclear energy (34.6%). Renewables (16.3%), fossil gas (0.6%) and liquid fuels (0.2%) accounted for the remaining energy production. In 2012, eight years early, Bulgaria reached its 2020 target of 16% renewable energy in final energy consumption, but at a high economic and political cost.

Due to its domestic production of coal and nuclear power, Bulgaria had an import dependency in 2017 of just 39.5%, far below the EU average of 55.1%. At 32.7%, the share of coal in total primary energy supply is more than double the EU average, while the 21.7% share of nuclear power is around 70% above the EU average. Power prices are correspondingly low – among the lowest in the EU.

Coal power plants accounted for 45.9% of total electricity generation in 2017 and help to guarantee Bulgaria's energy security and economic competitiveness. Indigenous coal reserves can fuel power generation for the next sixty years.



General data		2018
Population	million	7.1
GDP	€ billion	55.2
Per capita GDP	€/person	7 800

The 1 926 MW Kozloduy nuclear power plant plays a prominent, baseload role. The ten-year lifetime extensions granted in 2017 and 2019 for units 5 and 6 are of great importance; operation could continue for thirty years. Kozloduy accounted for 34.1% of gross power generation in 2017.

The Bulgarian energy sector is important for the country's energy-intensive industries and accounts for above EU-average shares in total employment and value added. The sector contributes to the socio-economic development and welfare of the coal mining municipalities.

Large investments in new capacity, rehabilitation of old power plants and expansion of the electricity grid have been made over recent years. However, regulated consumer tariffs are insufficient to cover new investments and the CO₂ emission allowance costs borne by electricity utilities, a situation exacerbated by the high number of consumers in arrears.

Lignite

Opencast lignite mining is mainly carried out in the mines of MINI MARITSA IZTOK EAD (MMI) whose production of 28.0 million tonnes accounted for 96.6% of the country's total 29.0 million tonnes in 2018. Its mines cover an area of some 240 square kilometres, being the largest mining site in South East Europe. MMI is also the biggest employer in Bulgaria. The company supplies four power plants with its own lignite: the state-owned Maritsa East 2 thermal power plant (TPP) (1 620 MW) and the privately owned CONTOURGLOBAL Maritsa Iztok East 3 TPP (908 MW), AES Galabovo TPP (670 MW) and BRIKELL TPP (200 MW). MMI also supplies lignite to the 120 MW Maritsa 3 TPP in Dimitrograd.

As a subsidiary of BULGARIAN ENERGY HOLDING, MMI plays an important role in ensuring national energy security. In the next few years the level of lignite production by MMI will remain at 26-28 million tonnes, used exclusively for thermal power generation, whose share will remain stable. As there is no alternative to lignite in the immediate future, no significant reduction in lignite production or lignite-fired power generation is foreseen. Under the various *Energy Strategy* scenarios, a decrease in lignite-fired power generation and capacity closures are projected after 2030 or when the new nuclear power plant is commissioned.

The price of lignite mined by MMI, despite being the lowest in the EU, will most probably remain unchanged in the years ahead. This has a negative impact on the company's ability to invest. The company will rely on European investment funds for development projects, including diversification projects such as a solar PV farm on the spoil tip of a mine.

Other lignite mining companies accounted for small shares of national lignite production in 2018: STANYANTSI JSC (1.9%) and BELI BYRAG JSC (1.5%).

Brown coal

Bulgaria's brown coal deposits are mostly located in the western part of the country (Bobov Dol, Pernik and Pirin coalfields and the Katrishte deposit) and near the Black Sea (Cherno More coalfield). In 2018, brown coal production from underground and surface mines was 1.3 million tonnes.

VAGLEDOBIV BOBOV DOL EOOD mines in the Bobov Dol coalfield, being the largest deposit of brown coal in the country with reserves amounting to some 100 million tonnes. After the closure of the country's last underground mine at Bobov Dol in 2018, only coal mined at a single opencast mine is supplied to the nearby 210 MW Bobov Dol TPP and to households.

OTKRIT VAGLEDOBIV MINES EAD, another private company, owns two opencast mines in the Pernik coalfield supplying Bobov Dol TPP. BALKAN MK OOD carried out underground coal mining in the Oranovo coalfield with some 30 million tonnes of brown coal reserves.

Other small, privately owned mines are the Vitren mine located in the Katrishte deposit, with an annual capacity of

Bulgaria

Coal resources and reserves		as at 1.1.2018
Total resources brown coal	Mt	4 112
Total resources lignite	Mt	4 574
Reserves brown coal	Mt	192
Reserves lignite	Mt	2 174

Primary energy production		2018
Total primary energy production*	Mtce	16.8
Brown coal and lignite (saleable)	Mt / Mtce	30.3 / 7.2

Saleable coal quality		
Brown coal calorific value	kJ/kg	12 140-13 400
Lignite calorific value	kJ/kg	5 652-7 746
Brown coal ash content	% a.r.	<26
Lignite ash content	% a.r.	17-45
Brown coal moisture content	% a.r.	<16
Lignite moisture content	% a.r.	51-60
Brown coal sulphur content	% a.r.	<2.7
Lignite sulphur content	% a.r.	2.2-2.8

Coal imports / exports		2018
Hard coal imports	Mt	0.8

Primary energy consumption		2017
Total primary energy consumption*	Mtce	26.8
Coal consumption	Mtce	8.8

Power supply		2017
Total gross power generation	TWh	45.6
Net power imports (exports)	TWh	(5.5)
Total power consumption	TWh	30.0
Power generation from lignite	TWh	19.6
Power generation from hard coal	TWh	1.3
Lignite and brown coal power generation capacity	MW	3 558
Hard coal generation capacity	MW	175

Employment		2018
Direct in brown coal & lignite mining	thousand	10.294
Other brown coal- & lignite-related**	thousand	45.000

* 2017 data

** e.g. in power generation, equipment supply, services and R&D

around 0.1 million tonnes, and the Cherno More mine in the Black Sea coalfield near Burgas, with an annual capacity of 0.25-0.3 million tonnes. The latter closed in 2016.

Hard coal

Hard coal production is not significant (c.35 thousand tonnes) and is carried out by MINA BALKAN 2000 EAD.

Czech Republic



Since 2014, the Czech Republic has enjoyed real GDP growth of around 3% per year. Over the next few years, GDP is expected to grow at around 2%, driven almost exclusively by domestic demand. Labour shortages constrain faster growth. The Czech government aims to decouple energy consumption from economic growth.

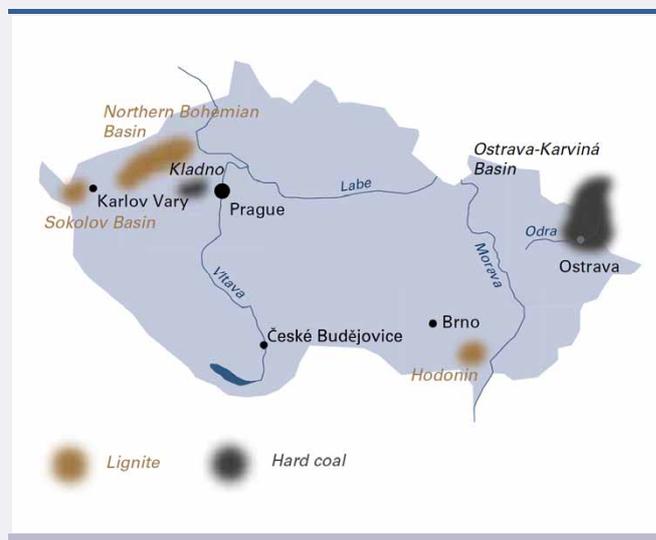
Coal is the only significant indigenous energy resource in the Czech Republic. The country's proven coal reserves have been estimated to total 705 million tonnes. Brown coal, which accounts for more than 95% of these reserves, is mainly produced in north-western Bohemia, while hard coal is mined in northern Moravia. Significant quantities of hard coal are exported to Slovakia, Poland, Austria and Hungary.

Primary energy supply, which was 61.8 million tonnes of coal equivalent (Mtce) in 2018, comprised: 36.2% coal (22.4 Mtce total of which an estimated 5.7 Mtce was hard coal and 16.4 Mtce was brown coal), 15.8% fossil gas (9.7 Mtce) and 21.6% oil (13.3 Mtce). The primary energy mix also includes nuclear energy with an 18.1% share in 2018 (11.2 Mtce), as well as biofuels and waste which together accounted for 10.2% (6.3 Mtce). Solar, hydro and wind power supplied the remaining 0.9% (0.6 Mtce).

The Czech Republic's dependence on energy imports has been quite modest to date, but is growing; 37.2% of energy demand was met by imports in 2017. However, imports are structurally imbalanced with around 97% dependence on imported oil and gas. A number of direct and indirect measures are being adopted to reduce energy import dependence, including: increased energy efficiency, the promotion of renewable energy sources which already account for more than the targeted 13% share in final energy consumption by 2020, and the efficient use of indigenous solid fuel resources, mainly brown coal.

In 2018, 49.5% of national gross electricity production of 88.0 TWh came from coal-fired power plants with a total capacity of approximately 10.0 GW, including those using coal gas. Fossil gas-fired power generation had a 4.3% share. Nuclear power plants supplied 34.0% of gross generation and 11.8% came from renewable energy sources including hydro. After rapid growth from 2009 to 2011, output from solar PV has stagnated, with 2.3 TWh in 2018 when output from wind turbines was just 0.6 TWh.

There are five coal mining companies in the Czech Republic, including OSTRAVSKO-KARVINSKÉ DOLY, the only hard coal producer, and four brown coal mining companies: SEVEROČESKÉ DOLY, the biggest producer of brown coal,



General data		2018
Population	million	10.6
GDP	€ billion	207.8
Per capita GDP	€/person	19 600

owned by ČEZ; VRŠANSKÁ UHELNÁ, with coal reserves to last until 2055; SEVERNÍ ENERGETICKÁ, with the largest brown coal reserves in the Czech Republic; and SOKOLOVSKÁ UHELNÁ, the smallest of the brown coal mining companies. All five companies are publicly listed or in private ownership. The majority state-owned utility company, ČEZ, is the largest coal consumer in the Czech Republic and the most important Czech supplier of electricity.

Hard coal

The Czech Republic has 23 million tonnes of economically recoverable hard coal reserves, with the largest deposits located in the Upper Silesian coal basin. Having an area of 6 500 square kilometres, this coal basin ranks among the largest in Europe. A major part is located in Poland, while about one sixth (1 200 square kilometres) lies in the Czech Republic where it is called the Ostrava-Karviná basin (after the city of Ostrava and the town of Karviná). Here, OSTRAVSKO-KARVINSKÉ DOLY (OKD) extracts hard coal from three deep mines: Karviná, Darkov and ČSM. A fourth mine, Paskov, stopped production in March 2017. In 2018, OKD's saleable output was 4.5 million tonnes, with a workforce of 6 895 own employees and 2 200 contractors.

The thickness of worked coal seams at Karviná mine ranges from 1.5 to 6.5 metres. Production at OKD mines is mainly longwall with shearer loaders, combined with controlled caving. The last longwall working with a plough finished in October 2019 and “room and pillar” trials have ended. Raw coal is washed in coal preparation plants at ČSM and Darkov mines and is sold as coking coal or steam coal, based on its quality parameters.

Brown coal and lignite

The Czech Republic has 682 million tonnes of economically recoverable brown coal reserves. In addition to a coal basin in North Bohemia and another basin near the town of Sokolov, there are coalfields in the south of the country, although these are not economically viable. Production of brown coal totalled 39.2 million tonnes in 2018, providing an important contribution to the country’s energy supply.

The main brown coal deposit and the largest mining area, covering 1 400 square kilometres, is the North Bohemian brown coal basin, which is located at the foothills of the Krušné hory mountains, along the border with the German state of Saxony, in the vicinity of the towns of Kadaň, Chomutov, Most, Teplice and Ústí nad Labem. The coal seams in this area lie at depths of up to 400 metres and are between 15 and 30 metres thick.

Brown coal is extracted in the central part of the North Bohemian brown coal basin by two mining companies, VRŠANSKÁ UHELNÁ (VUAS) and SEVERNÍ ENERGETICKÁ (SEAS). Both are members of the vertically integrated SEV.EN ENERGY GROUP and together employ 2 700 people for coal production out of a total group workforce of 3 140 in 2018.

SEAS exploits the country’s largest brown coal deposit at its ČSA surface mine, which holds reserves of 750 million tonnes of good quality brown coal with an energy content of up to 17 500 kJ/kg. These reserves are sufficient to support production for the next one hundred years. However, reserves within the current mining limits, which were approved in 1991, will last until 2024. A total of 3.7 million tonnes was produced in 2018.

VUAS extracts brown coal at the Vršany surface mine. Its coal reserves within existing mining limits have the longest remaining life of any in the Czech Republic. In 2013, the company entered into a fifty-year coal supply agreement with the ČEZ Počerady power station (5 × 200 MW). This long-term contract secures the future of Vršany mine through to its depletion and brings economic stability to the North Bohemian region. In 2018, VUAS extracted 7.8 million tonnes of brown coal.

The SEV.EN ENERGY GROUP also operates the 820 MW Chvaletice brown coal power plant which is undergoing an extensive modernisation programme to reduce emissions and meet stringent European environmental standards with the aim of extending its life to 2030.

Coal resources and reserves		as at 1.1.2018
Resources hard coal	Mt	1 437
Resources lignite	Mt	2 210
Reserves hard coal	Mt	23
Reserves lignite	Mt	682

Primary energy production		2018
Total primary energy production	Mtce	39.4
Hard coal (saleable output)	Mt / Mtce	4.4 / 4.0
Lignite (saleable output)	Mt / Mtce	39.2 / 16.7

Saleable coal quality		
Hard coal net calorific value	kJ/kg	25 490-32 070
Lignite net calorific value	kJ/kg	11 600-20 560
Hard coal ash content	% a.r.	4.3-18.9
Lignite ash content	% a.r.	6.0-37.8
Hard coal moisture content	% a.r.	3.5-9.9
Lignite moisture content	% a.r.	26.5-38.3
Hard coal sulphur content	% a.r.	0.42-0.43
Lignite sulphur content	% a.r.	0.78-1.44

Coal imports / exports		2018
Hard coal imports	Mt	3.8
Hard coal exports	Mt	1.9

Primary energy consumption		2018
Total primary energy consumption	Mtce	61.8
Hard coal consumption	Mtce	5.7
Lignite consumption	Mtce	16.4

Power supply		2018
Total gross power generation	TWh	88.0
Net power imports (exports)	TWh	(13.9)
Total power consumption	TWh	74.1
Power generation from hard coal	TWh	5.8
Power generation from lignite	TWh	37.7
Hard coal power generation capacity	MW	1 200
Lignite power generation capacity	MW	8 450

Employment		2018
Direct in hard coal mining	thousand	6.757
Direct in lignite mining	thousand	7.147

In 2019, SEV.EN ENERGY GROUP expanded its portfolio by acquiring two heat and power plants: a 516 MW coal- and gas-fired plant at Kladno near Prague and a 64 MW plant at the city of Zlín in eastern Moravia.

The brown coal mining company SEVEROČESKÉ DOLY (SD) based in the town of Chomutov operates in the North Bohemian brown coal basin, northwest of Prague. SD

extracts brown coal at two sites, namely the Tušimice mine and the Bílina mine. A total of 21 million tonnes was produced in 2018, giving SD a 54% share in national brown coal production.

The Tušimice brown coal mine is located between the towns of Chomutov and Kadaň and has an annual production capacity of over 11 million tonnes. After blending at the Tušimice coal preparation plant, the vast majority of the coal produced is supplied to the Tušimice and Pruněřov power stations operated by ČEZ.

The Bílina brown coal mine is located between the towns of Bílina and Duchcov. Each year, over 9 million tonnes of high-quality, low-sulphur brown coal (11 000-13 000 kJ/kg) are produced and transported to Ledvice power station, CHP plants, district heating plants, industrial users and households.

In 2018, the SD group had a total workforce of 4 841.

Located in western Bohemia, in the western part of the coalfield below the Krušné hory mountains, the brown coal basin around the town of Sokolov is mined by SOKOLOVSKÁ UHELNÁ (SU). The company operates one surface mine, the Jiří mine. In 2018, its output was 6.8 million tonnes. Brown coal from the Sokolov area is mainly used for power and heat generation, with chemical by-products from coal gasification also being important.

SU generates electricity and heat at two of its own plants: the Vřesová IGCC plant (2 × 200 MWe) and a CHP plant (5 × 270 MWt), which have a combined annual output of 3.5 TWh. Most of the heat produced is consumed by the

company itself, although some is supplied to the towns of Karlovy Vary, Nejdek, Chodov and Nová Role. The company also pursues environmental activities, notably the reclamation of land affected by surface mining, as well as waste processing and disposal. SU's operations employed a total workforce of 2 980 in 2018.

The Czech coal industry has always played and will continue to play a significant role in the national economy. In 2018, the share of coal in gross electricity production amounted to 49.5%. According to the most recent *State Energy Policy*, adopted in May 2015, the share of coal in gross electricity production should decrease to between 11% and 21% by 2040. The *State Energy Policy* will be updated in 2020, based on the recommendations of a Coal Commission established in 2019. With this gradual phasing out of coal-fired power generation, the use of fossil gas, biogas and, prospectively, synthetic methane and hydrogen will increase in the Czech Republic, according to the draft *National Energy and Climate Plan* submitted by the Czech government to the European Commission in December 2018.

To ensure the sustainable use of coal in the future, the Czech Republic is engaged in a comprehensive programme to renovate and renew coal-fired power stations in North Bohemia. The 800 MW Tušimice II power station has been renovated, reducing its CO₂ emissions significantly and extending its life to 2035. The life of the 750 MW Pruněřov II power station has also been extended following the renovation of three units, successfully reducing CO₂ emissions by 40%. Finally, the new, state-of-the-art supercritical 660 MW Ledvice power station, commissioned in 2017, has an efficiency of 42.5%. With a forty-year design life, its 140-metre high boiler house is a Czech landmark.





Germany



Germany has the fourth largest economy in the world, after the United States, China and Japan. Following a major downturn in 2009, after the global economic crisis, the German economy has grown at an average rate of 2.1% since 2010. The unemployment rate in 2018 was 3.4%. Germany accounts for almost one fifth of EU energy use.

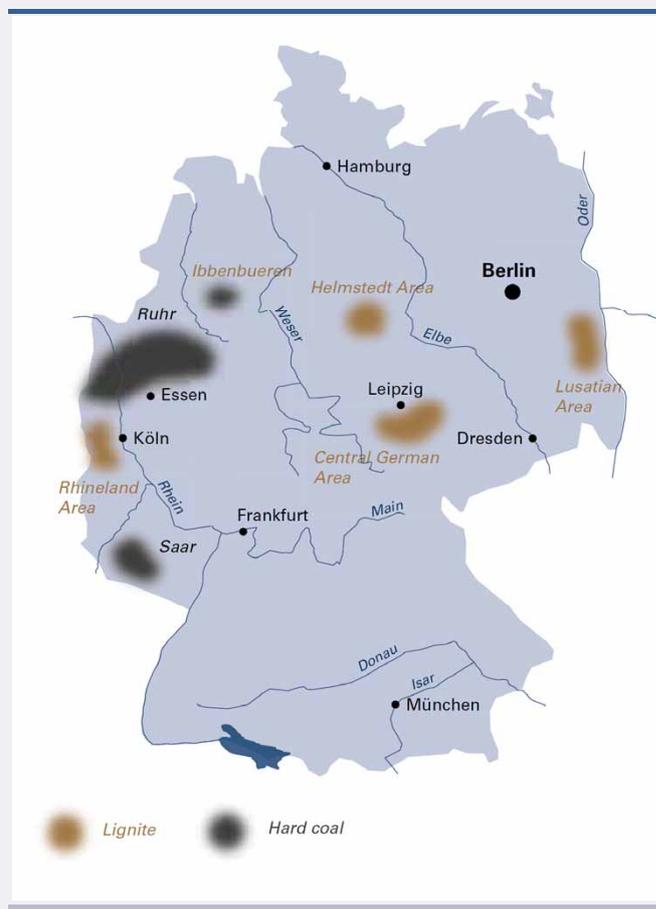
Germany has considerable reserves of lignite, making it one of the country's most important indigenous sources of energy. There are long-term prospects to mine about 4 billion tonnes of lignite reserves at existing and approved surface mines. The last two hard coal mines were closed in December 2018, following a political decision ten years earlier to end subsidised German hard coal production.

In 2018, primary energy production totalled 160.9 million tonnes of coal equivalent (Mtce). With an output of 54.0 Mtce, coal and lignite had a share of 33.6%. The mix of indigenous primary energy production can be broken down as follows: 51.4 Mtce of lignite (32.0%), 2.6 Mtce of hard coal (1.6%), 10.1 Mtce of oil and fossil gas (6.3%), 28.3 Mtce of nuclear power (17.6%) and 68.5 Mtce of renewable energy and other fuels (42.6%).

Germany's primary energy consumption amounted to 447.2 Mtce in 2018. Oil accounted for the largest share (34.0%), followed by fossil gas (23.4%), coal (22.2%), renewables (13.8%) and nuclear energy (6.3%). Within the figure for coal, hard coal accounted for 10.9% and lignite for 11.3% of total primary energy consumption. Germany is dependent on energy imports to a large extent, except in the cases of lignite and renewable energy. About 94% of hard coal supply was imported in 2018 and, since 2019, Germany has depended entirely on imported hard coal. The country's overall energy import dependence was 63.6% in 2018.

The power generation structure is characterised by a diversified energy mix. In 2018, Germany's gross power generation of 646.8 TWh was produced as follows: 35.4% from coal (of which 22.5% was from lignite and 12.9% from hard coal), 35.0% from renewable energy sources, 12.9% from fossil gas, 11.8% from nuclear and 4.1% from other sources. Thus, hard coal and lignite, along with nuclear power, are still the mainstays of the German power industry.

Since 2011, the German government and parliament have decided on a package of several new or amended energy laws and further political measures to foster change in the energy sector. This fundamental, long-term change is known as the *Energiewende* or "energy transition" to renewable energy sources and includes the phase-out of nuclear power generation in Germany by the end of 2022.



General data		2018
Population	million	82.8
GDP	€ billion	3 344.4
Per capita GDP	€/person	40 300

In November 2016, the federal government agreed a "Climate Protection Plan 2050" (*Klimaschutzplan 2050*) which sets out strategies to reduce greenhouse gas emissions by 55% by 2030 compared with 1990 and by 80% to 95% by 2050. The plan provides for specific reduction targets for each sector for 2030: 61% to 62% for the energy sector. To ensure that implementation of the plan is not uniquely detrimental to the coal-producing regions, the governing parties (CDU/CSU and SPD) decided in their 2018 coalition agreement to establish a "Growth, Structural Change and Employment" Commission".

This commission was appointed in June 2018. In late January 2019, it presented its final report which *inter alia* includes recommendations for the gradual reduction and

eventual phase out of all coal-fired power generation in Germany. According to the commission’s report, a reduction in the installed capacity of lignite and hard coal power plants, to about 15 GW each, should be made by 2022. Compared with the end of 2017, when coal capacity totalled 42.5 GW, this means a decline of almost 5 GW for lignite-fired power plants and of 7.7 GW for hard coal-fired power plants. By 2030, the installed capacity of coal-fired power plants (outside of reserves) is to be reduced to a maximum of 9 GW for lignite and 8 GW for hard coal.

In addition, the commission recommends a complete phase-out of coal-fired power generation in Germany by the end of 2038 – more than ten years earlier than planned. This coal phase-out is to be linked to a number of energy security and social policy conditions which will be verified in 2023, 2026 and 2029. Insofar as certain prerequisites are met with regard to energy-intensive industries, regional employment and economic competitiveness, the date for the final phase-out may be set earlier than 2038, but no earlier than 2035 and subject to negotiations with the power plant operators. Whether an earlier date would be possible will be examined in 2032 under a “flexibility clause”.

In implementing these recommendations, Germany will be prematurely deprived of an important source of electric power for its industrial heartland. These recommendations are, at the same time, a major intervention into the social framework and value creation of the lignite-mining districts. In fact, even without a premature, state-regulated exit from coal, power generation based on lignite in Germany would have ended by no later than 2050.

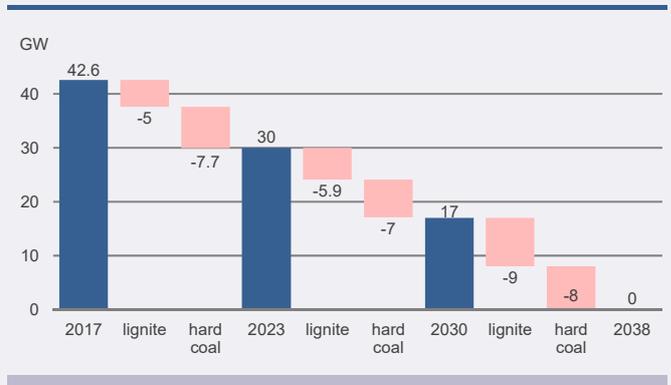
To decommission lignite-fired power plants, the “Growth, Structural Change and Employment” Commission recommends a contractual agreement with the operators. This should contain compensation payments for the operators and be linked to legal regulations on a socially acceptable phase-out. By late autumn 2019, such agreements between the lignite companies and the federal government should have been negotiated. Hard coal-fired power plant operators should receive a “voluntary premium” through tenders. A bill was presented in autumn, allowing a coal phase-out law to be passed by the end of 2019 or early in 2020. To support the structural change and transition process in the affected coal regions, another bill was presented by the federal government in late summer 2019. It provides for several measures, including state aid up to €40 billion through to 2038 for investments and projects in the affected regions.

The recommendations of the commission also propose incentives for the construction of gas-fired power plants and for the increased use of combined heat and power (CHP) plants. Both are needed in order to ensure security of supply since coal-fired power plants will no longer be available. Additional investments will be needed, for example in open-cycle gas turbines or gas engines.

Until there is a large-scale storage solution for electricity, a combination of power systems will be needed to match the

ups and downs of wind and solar PV power generation and so balance supply and demand, because renewable power can be close to zero at times and low for several months.

Figure 24
Coal power plant decommissioning plan of the “Growth, Structural Change and Employment” Commission



Hard coal

In 2018, the German hard coal market amounted to 48.7 Mtce, of which 27.2 Mtce were used for power and heat generation, while 20.4 Mtce were consumed by the steel industry. The remaining 1.1 Mtce were sold to the residential heating market.

At 46.7 million tonnes, Germany was the EU’s largest hard coal importer in 2018 (32.1 million tonnes of steam coal, 12.4 million tonnes of coking coal and 2.3 million tonnes of coke). The most important sources of imported coal were Russia with a share of 41.1%, followed by the United States, Australia, Colombia, Canada and South Africa.

The German government has phased out – in a socially acceptable manner – all state aid for hard coal production. In 2018, the saleable output from Prosper-Haniel and Ibbenbüren deep mines, the last two mines of RAG DEUTSCHE STEINKOHLE (RAG), totalled 2.8 million tonnes. Both mines closed at the end of 2018. Therefore, Germany’s hard coal production has definitively ended.

Employment figures continue to fall steadily and the number of employees in the hard coal mining sector was 4 125 at the end of 2018.

The core activities of RAG are now: mine water management, repairing subsidence damage due to past coal mining, and the restructuring of former coal mining areas. The private RAG FOUNDATION, created in July 2007, is the owner of RAG and majority owner of EVONIK, a speciality chemicals company. Continuing liabilities after the phase-out of hard coal mining will be financed by the proceeds of the Foundation which also promotes education, science and culture in the mining regions.

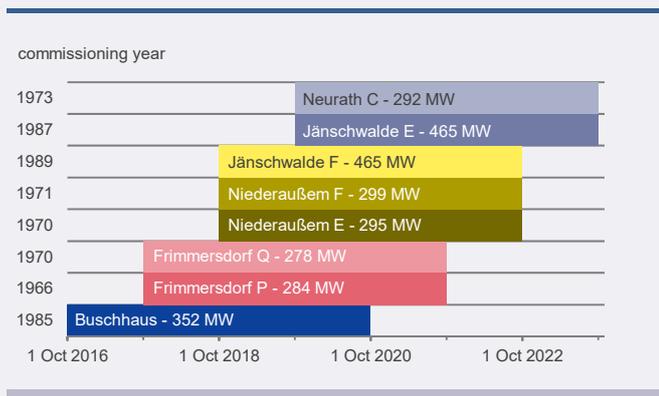
Brown coal and lignite

Lignite supply in 2018 totalled 51.1 Mtce of predominantly domestic production (lignite imports were an insignificant 35 thousand tonnes). Exports of pulverised lignite and briquettes amounted to 1.1 Mtce.

Lignite production, which totalled 166.3 million tonnes (51.4 Mtce) in 2018, was centred in three mining areas, namely the Rhenish mining area around Cologne, Aachen and Mönchengladbach, the Lusatian mining area in south-eastern Brandenburg and north-eastern Saxony, and the Central German mining area in the south-east of Saxony-Anhalt and the north-west of Saxony. In these three mining areas, lignite is exclusively extracted at opencast mines. In 2018, a total of 880 million cubic metres of overburden were moved during mining – an average overburden-to-coal ratio of 5.3 cubic metres per tonne.

Nearly 90% of lignite production is used for power generation (148.2 million tonnes in 2018), accounting for 22.5% of total power generation in Germany. On 1 July 2015, as part of the “Climate Action Programme 2020”, national political leaders, trade unions and the power plant operators jointly agreed that 2 700 MW of lignite-fired power generation capacity would be gradually transferred into a security standby reserve, starting in October 2016 and ending in October 2023. These plants will remain on standby for a period of four years after which they will be closed. These decommissionings will decrease electricity production from lignite by about 15% by 2023 and so reduce lignite demand by about 21 million tonnes, thus reducing greenhouse gas emissions by approximately 21 MtCO₂ per year.

Figure 25
Lignite-fired power plants in the security standby reserve



In the Rhineland, RWE POWER AG produced a total of 86.3 million tonnes of lignite in 2018 from its three opencast mines: Hambach, Garzweiler and Iden. Almost 90% of the lignite was consumed at the company’s own power stations, whilst some 10.3 million tonnes were used for processed products. At the end of 2018, the Rhenish mining area had a total workforce of around 10 000.

At the end of March 2018, the district government of Arnsberg approved the main operating plan for the open-pit mine Hambach, covering the 2018-2020 period. Then, in April and June 2018, the German Federation for the Environment and Nature Conservation (BUND or Friends of the Earth Germany) filed a legal complaint against the plan’s approval and initiated an expedited proceeding against the order for immediate enforcement. The Higher Administrative Court of North Rhine-Westphalia ruled on 5 October 2018 that forest clearing should not be carried out in Hambach Forest before a legally enforceable decision had been reached in the BUND case, although other mining operations could continue. No decision has been reached on the factual issue of clarifying Hambach Forest’s fauna-flora habitat status and a final decision on the case might not be available before the end of 2020. Hence, forest clearing is likely only in 2021. For RWE POWER, the interruption to forest clearance has far-reaching consequences. It is expected that the first mining bench will reach Hambach Forest by the end of 2019. At the same time, recultivation measures will be affected, because overburden will not be available. In order to avoid reaching a complete standstill, lignite mining and hence electricity production have been reduced since early 2019. Elsewhere, the “Growth, Structural Change and Employment” Commission recommends keeping Hambach Forest as it is now.

In 2018, gross electricity production at the lignite-fired power plants of the Rhenish District amounted to 72.0 TWh, from a gross installed capacity of 11 489 MW. Two 300 MW Frimmersdorf units (P and Q) were transferred into secure standby from 1 October 2017, followed by two 300 MW Niederaußem units (E and F) from 1 October 2018. A 300 MW Neurath unit (C) was transferred into secure standby by 1 October 2019.

In the Lusatian mining region, the Czech EPH-owned LAUSITZ ENERGIE BERGBAU AG (branded LEAG) extracts lignite at Jänschwalde and Welzow-Süd in Brandenburg, as well as at Nochten and Reichwalde in Saxony with a total output of 60.7 million tonnes in 2018.

Lignite sales to power plants in Lusatia totalled 56.9 million tonnes in 2018. LEAG is the main operator of lignite-fired power plants in the mining area with a total gross capacity of 7 175 MW, including Jänschwalde, Schwarze Pumpe and Boxberg power plants. In 2018, the gross power output from these plants was 53.1 TWh. At the end of 2018, LEAG had a total workforce of around 8 000.

The Central German mining area around Leipzig yielded a total lignite output of 19.2 million tonnes in 2018. The most important company in this area is MITTELDEUTSCHE BRAUNKOHLENGESELLSCHAFT mbH (MIBRAG), owned by the Czech company, EPH. It has two opencast mines at Profen in Saxony Anhalt and Schleenhain in Saxony. The company supplies lignite to its two combined heat and power plants at Deuben and Wähilitz with a total capacity of 124 MW, as well as to the larger LEAG/ENBW Lippendorf and UNIPER Schkopau power stations. With a gross capacity of 3 200 MW, these plants generated 20.3 TWh in

2018. At the end of 2018, the Central German mining area had a total workforce of 2 380.

Also in Central Germany, ROMONTA GmbH operates an open-pit lignite mine for crude montan wax production at Amsdorf in Saxony-Anhalt. Montan wax is primarily used in the plastics industry, for the manufacture of cosmetics and cleaning products, and for the hydrophobic treatment of building materials. In addition, montan wax is used as a forming wax in investment casting and as an additive to modify the performance of asphalt and bitumen. Lignite production in 2018 was 466 thousand tonnes. The wax-free fuel is used for power generation at Amsdorf.

Extraction of lignite from opencast mines changes the natural landscape, so land reclamation is an integral part of any mining project. Mining activities are only complete following the transformation of a former “industrial” opencast mine into a vibrant landscape. For more than one hundred years, nature has inspired landscape restoration projects in Germany, including indigenous flora and fauna. Projects that return land to productive use, often with a high recreational and agricultural value, are most typical.

The approved opencast mining plans take into account many issues and ensure a balance between the various interests in the lignite mining areas. Implementation of the “Growth, Structural Change and Employment” Commission’s recommendations may require changes to the existing permits, depending on the nature of the opencast mine sites. It will be a real challenge to find a new balance between the various interests, including agriculture, forestry, local authorities, water management, nature conservation and, last but not least, mining.

The German lignite industry is represented by the Deutscher Braunkohlen-Industrie-Verein e. V. (DEBRIV – the German Brown Coal Association). On behalf of DEBRIV, the German Economic Institute (IW) examined the impact of a stricter national CO₂ reduction target on the operation of the EU emissions trading system (ETS) to 2030 and beyond. IW concluded in October 2018 that electricity prices in Germany would rise as a result of the EU ETS reforms adopted earlier in 2018 and that added value and jobs in the lignite industry would be lost because of the higher cost of CO₂ emission allowances required for lignite-fired power generation.

An accelerated phase-out of coal, as has now been recommended and is being adopted by the state, will lead to an even larger reduction of added value and jobs in the lignite industry, and indirectly in upstream sectors. The national 55% reduction target for CO₂ emissions from the energy sector by 2030 (c.f. 1990) would already halve jobs in the German lignite industry by 2025. By 2030, more than two thirds of jobs would be lost. According to IW calculations, around 72 000 direct, indirect and induced jobs depend on the lignite industry, as every job in the industry is linked to almost two more jobs elsewhere in the economy.

Germany

Coal resources and reserves		as at 1.1.2019
Total resources hard coal	Mt	82 964
Total resources lignite	Mt	72 400
Reserves lignite	Mt	35 900

Primary energy production		2018
Total primary energy production	Mtce	160.9
Hard coal (saleable output)	Mt / Mtce	2.8 / 2.6
Lignite (saleable output)	Mt / Mtce	166.3 / 51.4

Saleable coal quality		
Hard coal net calorific value	kJ/kg	30 264
Lignite net calorific value	kJ/kg	7 000-11 300
Hard coal ash content	% a.r.	3.3-21.0
Lignite ash content	% a.r.	2.0-15.0
Hard coal moisture content	% a.r.	2.5-13.0
Lignite moisture content	% a.r.	47.0-61.0
Hard coal sulphur content	% a.r.	0.45-1.8
Lignite sulphur content	% a.r.	0.12-2.1

Coal imports / exports		2018
Hard coal imports	Mt	44.5
Lignite imports	Mt	0.0

Primary energy consumption		2018
Total primary energy consumption	Mtce	447.2
Hard coal consumption	Mtce	48.7
Lignite consumption	Mtce	50.4

Power supply		2018
Total gross power generation	TWh	646.8
Net power imports (exports)	TWh	(51.2)
Total final power consumption	TWh (est.)	526.9
Power generation from hard coal	TWh gross	83.2
Power generation from lignite	TWh gross	145.5
Hard coal power generation capacity	MW net	24 462
Lignite power generation capacity	MW net	*20 327

Employment		2018
Direct in hard coal mining	thousand	4.125
Direct in lignite mining	thousand	15.876
Other hard coal-related**	thousand	15.000
Other lignite-related**	thousand	4.979

* of which 1 973 MW is in a security standby reserve

** e.g. in power generation, equipment supply, services and R&D



Zollverein



Greece



Accounting in 2018 for 20.5% of the country's primary energy supply of 32.3 Mtce, lignite is Greece's most important indigenous energy resource, although the country does have modest oil and gas reserves. At 0.3 Mtce, hard coal imports accounted for 0.9% of energy supply. Oil accounted for 45.9% of total primary energy supply in 2018; Greece has a large refining industry which exports oil products. Fossil gas had an 18.2% share in primary energy supply in 2018. Electricity trade has grown steadily over the years, although the global economic crisis disrupted first imports and then exports. In 2018, electricity imports into Greece reached 8.7 TWh.

Security of supply, low extraction costs and stable prices are important reasons why lignite still maintains a significant share in the Greek energy mix. However, in September 2019, Prime Minister Kyriakos Mitsotakis pledged to phase out lignite-fired power generation by 2028.

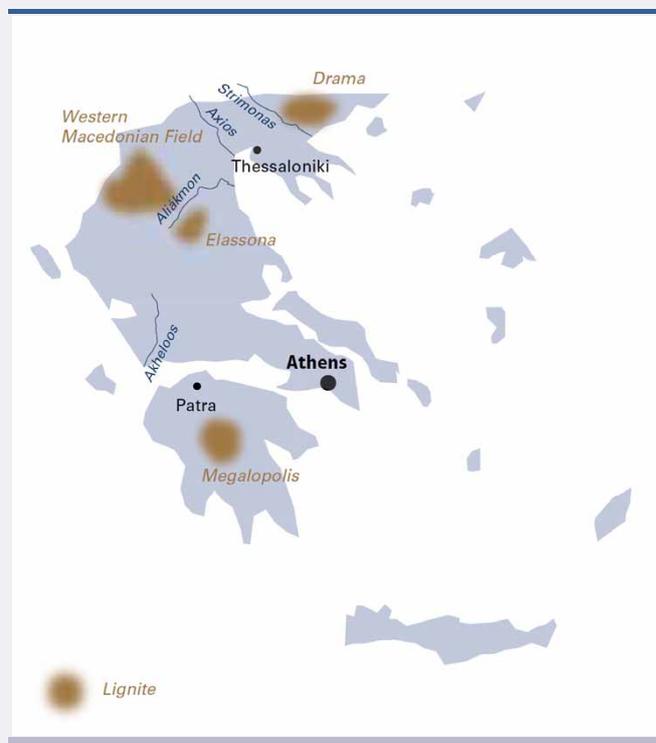
Lignite

Greece boasts lignite resources of 3.6 billion tonnes and 2.9 billion tonnes of economically workable reserves. The most important deposits are located in the north of the country at Ptolemais-Amynteon and Florina (1.6 billion tonnes) which contribute around 80% of production. Other deposits lie at Drama (900 million tonnes) and at Ellassona (170 million tonnes), as well as in the south at Megalopolis (132 million tonnes). There is also a large peat deposit of about 4 billion cubic metres at Philippi in the northern part of Greece (Eastern Macedonia). Only 30% of the total lignite reserves have been extracted to date and remaining reserves are good for over forty years at current production rates.

Lignite deposits in Greece lie at an average depth of 150 to 200 metres and typically comprise layers of lignite alternating with mineral layers.

The quality of Greek lignite can be characterised as follows: the lowest calorific values are in the areas of Megalopolis and Drama (3 770 to 5 020 kJ/kg) and Ptolemais-Amynteon (5 230 to 6 280 kJ/kg). In Florina and Ellassona the calorific value lies between 7 540 and 9 630 kJ/kg. The ash content ranges from 15.1% (Ptolemais) to 19.0% (Ellassona), and the water content from 41.0% (Ellassona) to 57.9% (Megalopolis). At less than 1%, the sulphur content is generally low.

Lignite is mined by the PUBLIC POWER CORPORATION (PPC) exclusively in opencast mines. This majority state-



General data		2018
Population	million	10.7
GDP	€ billion	184.7
Per capita GDP	€/person	17 200

owned company is the largest lignite producer in Greece and operates mines in Western Macedonia at Main Field, South Field, Kardia Field and Amynteon Field. LIGNITIKI MEGALOPOLIS SA, a 100% owned subsidiary of PPC, also operates an opencast site in the Peloponnese region of southern Greece, in the Megalopolis Field.

Bucket-wheel excavators, spreaders, tripper cars and conveyor belts are used to mine and transport lignite at these sites. PPC currently operates forty-three bucket-wheel excavators and twenty-two spreaders, together with more than 300 kilometres of belt conveyors. Hydraulic excavators and heavy trucks are used to remove the hard overburden formations found at some mines.

In 2018, lignite production amounted to 36.5 million tonnes, mostly mined by PPC, with 27.2 million tonnes extracted by the company at the West Macedonia Lignite Centre (WMLC) and 7.4 million tonnes at the Megalopolis Lignite Centre (MLC). The few privately operated mines in the West

Macedonia area produced a total of 1.9 million tonnes of lignite.

In 2018, WMLC operations removed a total of 143.7 million cubic metres of overburden and interburden, corresponding to an overburden-interburden-to-lignite ratio of 5.3 cubic metres per tonne. At MLC, overburden plus interburden removal was 15.8 million cubic metres, corresponding to an overburden-interburden-to-lignite ratio of 2.1:1. Although the overburden-interburden-to-lignite ratio has significantly increased in recent years, it is expected to remain stable in the future. The two mining areas, WMLC and MLC, and the head office in Athens, employed during 2018 a total permanent workforce of about 4 082.

Environmental protection is one of the major parameters defining PPC's overall strategy and its daily mining activities. In the lignite mining areas around Ptolemais-Amynteon and Megalopolis, PPC has carried out site restoration projects to create farmland, tree plantations, woodland, animal sanctuaries and crop-testing areas.

At the end of 2018, power generation plants owned by PPC and its subsidiaries accounted for 60.6% of the country's total installed capacity of 21.5 GW and include lignite- and gas-fired plants, oil-fired plants on interconnected and autonomous islands, hydro plants, wind farms and solar PV plants. There are also seven private power plants with a total capacity of 2 626 MW. PPC and its subsidiaries own six lignite-fired power plants comprising fourteen units with a total installed capacity of 4 337 MW. In 2018, lignite-fired power plants accounted for 29.2% of net power generation of 51.0 TWh. The share of gas was 27.7%, oil 9.0%, hydro 11.3%, wind 12.3%, solar 7.7%, CHP 2.2% and biofuels/waste 0.6%. The output from solar PV has been flat since 2013 when subsidies were reduced. In 2018, residential consumers paid €23/MWh in renewable subsidies to support wind and solar.

Lignite's future role in Greece will depend on changes taking place across the European energy sector, including the cost of carbon allowances under the EU emissions trading system. The significant increase in allowance prices during 2018 resulted in a reduction of the competitiveness of lignite-fired power generation. PPC faces other important challenges relating to the regulatory framework governing energy market liberalisation, including the forced divestment of lignite-fired units at its Meliti and Megalopolis power stations. Strategic priorities now include the replacement of old and inefficient plants and investment in renewable energy sources. The new 660 MW Ptolemaida V lignite-fired power plant is one priority, with construction by TERNA SA and HITACHI POWER EUROPE of this €1.4 billion project well underway.

In response to declining lignite production, the national government and the regional government of Western Macedonia are working with the World Bank, the European Commission, PPC and other stakeholders on regional development strategies to ensure a smooth transition to alternative means of wealth creation and energy supply.

Greece

Coal resources and reserves		as at 1.1.2018
Total resources lignite	Mt	6 430
Reserves lignite	Mt	2 876

Primary energy production		2018
Total primary energy production	Mtce	10.6
Lignite (saleable output)	Mt / Mtce	36.5 / 6.3

Saleable coal quality		
Lignite net calorific value	kJ/kg	3 770-9 630
Lignite ash content	% a.r.	15.1-19.0
Lignite moisture content	% a.r.	41.0-57.9
Lignite sulphur content	% a.r.	0.4-1.0

Coal imports / exports		2018
Hard coal imports	Mt	0.4

Primary energy consumption		2018
Total primary energy consumption	Mtce	32.3
Hard coal consumption	Mtce	0.3
Lignite consumption	Mtce	6.3

Power supply*		2018
Total net power generation	TWh	51.0
Net power imports (exports)	TWh	6.3
Total power consumption	TWh	57.3
Net power generation from lignite	TWh	14.9
Lignite power generation capacity	MW	4 337

Employment		2018
Direct in lignite mining	thousand	4.082
Other lignite-related**	thousand	2.012

* including small islands with independent diesel generators

** at PPC lignite-fired power plants

Hungary



Since 2013, Hungary's export-oriented economy has grown strongly; GDP grew by a healthy 5.1% in 2018. The country enjoys almost full employment with an unemployment rate of just 3.6% at the end of 2018, thanks partly to a public work scheme. Due to its sparse energy and raw material resources, Hungary is import dependent.

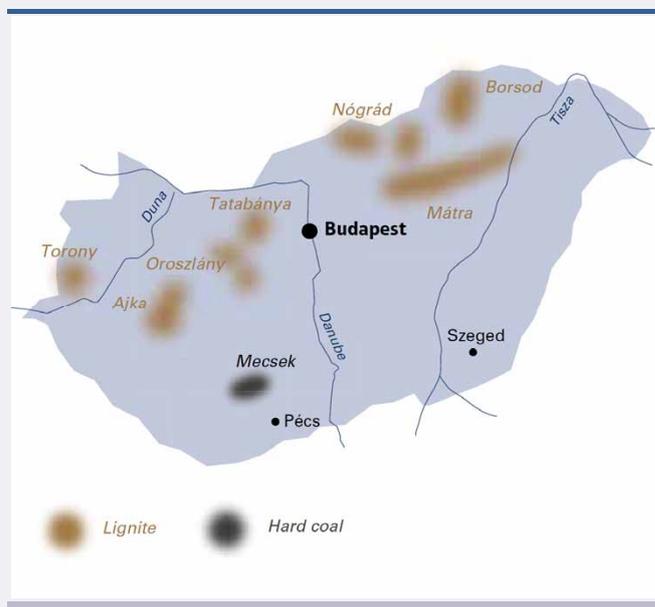
Total conventional energy resources in Hungary comprise about 10.5 billion tonnes of coal, 4.1 trillion cubic metres of fossil gas (including unconventional) and 0.8 billion cubic metres of oil (including unconventional). Lignite and brown coal reserves account for about half of Hungary's total coal resources and are the most important indigenous sources of energy currently exploited.

Hungary's primary energy consumption in 2018 amounted to 38.1 Mtce. Fossil gas had the biggest share in this total (31.3%), followed by oil (29.2%), nuclear energy (15.4%), combustible renewables and waste (10.3%) and coal (8.1%). Hungary aims to increase the share of renewable energy in gross final energy consumption to 14.65% by 2020 and 20% by 2030.

Hungary is a net importer of energy and in 2017 had an overall energy import dependency of 62.6%. In 2018, import dependencies were as follows: oil 89%, fossil gas 78% and coal 49%.

National electricity generation in 2018 totalled 31.9 TWh from an installed capacity totalling around 9.2 GW. A net 14.3 TWh of electricity was imported. Nuclear energy from Hungary's sole nuclear power plant at Paks accounted for 49.4% of gross electricity production. This state-owned plant has four reactors with a combined gross capacity of 2 000 MW. As a result of a service lifetime extension programme, the four units at Paks will operate for another fifteen to twenty years. Paks II (2 × 1 200 MW) has been approved for constructed on the same site; the new units 5 and 6 are expected to start operation in the late 2020s. Gas-fired generation also makes a major contribution to national electricity supply; it had a share of 22.7% in 2018.

Electricity produced from coal, including lignite, had a share of 15.1% in gross electricity production in 2018, generated mainly by MÁTRAI ERŐMŰ ZRT which is majority owned by OPUS GLOBAL. Renewable energy sources had a share of 11.6%, mostly biomass, followed by equal shares from wind turbines and solar PV, then biogas, municipal and industrial wastes, hydro and some geothermal. A new support scheme for renewable power generation was adopted in June 2016, with feed-in tariffs and premiums that have led to a surge in solar PV projects.



General data		2018
Population	million	9.8
GDP	€ billion	131.9
Per capita GDP	€/person	13 500

The second *National Climate Change Strategy*, approved by the Hungarian parliament in October 2018, targets a 40% reduction in greenhouse gas (GHG) emissions by 2030, compared with 1990, and a 52% to 85% reduction of gross GHG emissions by 2050. The Ministry of Innovation and Technology (MIT) is developing a new *National Energy Strategy* in which a climate-friendly electricity mix will be central to achieving these targets.

Lignite

Hungary's lignite and brown coal resources are concentrated in the regions of Transdanubia and in northern and north-eastern Hungary. In 2018, Hungary's total lignite output was 7.9 million tonnes. Almost all of this was used for heat and power generation, with only small quantities supplied elsewhere, mainly to households.

Since the closure in 2014 of the Márkushegy underground mine in western Hungary, all lignite production has been at opencast mines, principally the Visonta and Bükkábrány mines belonging to MÁTRAI ERŐMŰ ZRT (MÁTRA). The

approved mining fields of these two opencast mines have about 770 million tonnes of lignite reserves.

In 2018, MÁTRA produced 7.8 million tonnes of lignite and removed 52.1 million cubic metres of overburden. The lignite is used in the company-owned power plant at Visonta which comprises four lignite-fired units and two topping gas turbines. Lignite from the Bükkábrány mine, some 50 kilometres from the power plant, is transported by rail while a conveyor belt links the plant to the adjacent Visonta mine. Besides lignite and fossil gas, biomass is co-fired to a fuel input level of around 10%.

The MÁTRA power plant at Visonta, located 90 kilometres north-east of Budapest, has a total capacity of 966 MW (2 x 100 MW units, 1 x 220 MW unit, 2 x 232 MW units, 2 x 33 MW gas turbines and, since 2015, a 16 MW solar park which was sold in 2018). The wet flue gas desulphurisation (FGD) system commissioned in 2000 at Visonta is interesting as it is installed inside dry cooling towers and makes use of the natural draft to release flue gas high into the atmosphere. The plant is also fitted with selective, non-catalytic NO_x reduction (SNCR) to further reduce pollutant emissions. Additional wet cooling cells have been added to units 4 and 5 to create a hybrid cooling system that improves efficiency.

As part of its development strategy, MÁTRA has created an industrial park at Visonta with many activities related to the power plant, such as block manufacture using bottom ash and fly ash, plasterboard production using gypsum from the FGD system and biomass fuel processing. A new 60 MW solar PV farm is proposed for the overburden deposit at the Bükkábrány mine. Looking to the future, MÁTRA has plans for a 450 MW gas-fired CCGT, a 100 MW biomass plant, a 31.5 MW refuse-derived fuel plant and 50 MW of battery storage, as well as bigger solar farms totalling 200 MW and a solar panel factory at Visonta and Halmajugra. In the Mátra mountains, a site has been identified for a 600 MW pumped storage scheme which can proceed if there is a market demand and political support. Plans also exist for a new 500 MW lignite-fired unit with 42% efficiency. The future trajectory of the Visonta site will depend on decisions taken by the Hungarian government and local authorities, as well as the many other stakeholders involved, all within the framework of the EU's evolving climate and energy policy.

Hard coal

At the end of 2014, trial coal mining operations began in the Mecsek region. In 2018, PANNON HŐERŐMŰ ZRT extracted some quantities of coal from its Pécs-Vasas opencast mine in the region. This coal is officially classified as lignite due to its low calorific value.

Hungary

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	4 821
Total resources lignite	Mt	5 687
Reserves hard coal	Mt	4 157
Reserves lignite	Mt	4 241

Primary energy production		2018
Total primary energy production	Mtce	15.8
Hard coal (saleable output)	Mt / Mtce	0.002 / 0.0
Lignite (saleable output)	Mt / Mtce	7.9 / 1.8

Saleable coal quality		
Hard coal net calorific value	kJ/kg	17 549
Lignite net calorific value	kJ/kg	6 742
Lignite ash content	% a.r.	23.0
Lignite moisture content	% a.r.	47.4
Lignite sulphur content	% a.r.	1.2

Coal imports / exports		2018
Hard coal imports	Mt	1.5

Primary energy consumption		2018
Total primary energy consumption	Mtce	38.1
Hard coal consumption	Mtce	1.5
Lignite consumption	Mtce	1.8

Power supply		2018
Total gross power generation	TWh	31.9
Net power imports (exports)	TWh	14.3
Total power consumption	TWh	43.3
Power generation from lignite	TWh	4.5
Lignite power generation capacity	MW	783

Employment		2018
Direct in lignite-mining	thousand	1.400
Other lignite-related*	thousand	0.800

* i.e. in power generation at MÁTRA power plant





Poland



The Polish economy has grown every year since 1992 by an average annual rate of 4.2%. In 2018, GDP growth was 5.2% and, on a purchasing power parity basis, *per capita* GDP is now three quarters of the European Union average. Unemployment has fallen steadily over recent years, to 3.9% in 2018 or around half the EU average. Poland's population has been stable over the last thirty years; recent emigration has been largely balanced by immigration from Ukraine.

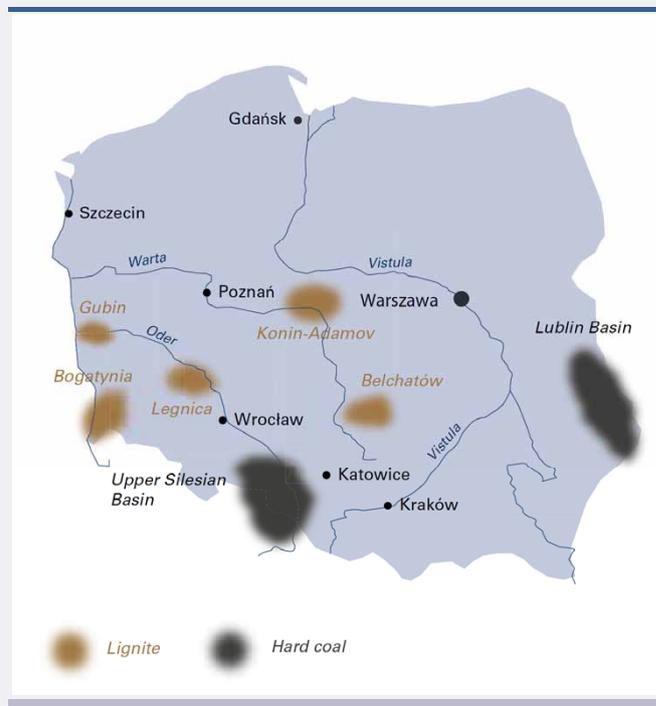
Coal is of strategic importance to the Polish economy. Compared with other EU member states, Poland has much larger reserves and makes good use of hard coal and lignite for electricity production with a 78.3% share in 2018 (133.0 TWh). Hard coal reserves total 22.3 billion tonnes, located mostly in the Upper Silesian and Lublin coal basins, while lignite reserves amount to 1.0 billion tonnes with a further 23.3 billion tonnes of resources.

At 38.3%, Poland's energy import dependency was well below the EU average of 55.1% in 2017. The country's total primary energy supply in 2018 was dominated by coal (47.1%), with oil (28.2%) and gas (15.2%) also taking significant shares, followed by biofuels and waste (7.7%), wind (1.0%) and hydro (0.2%).

In 2018, total gross power generation was 169.9 TWh. Polish electricity exports have declined since 2015 such that net imports reached 5.7 TWh in 2018. 83.6 TWh or almost half (49.2%) of Polish electricity production was generated at hard coal-fired power plants or from coal gases at coking works and steel plants. 49.3 TWh were generated at lignite-fired power plants, a 29.0% share. Power generated from wind grew to 12.8 TWh (7.6%); solar accounted for 0.2%. Fossil gas (7.4%), biofuels and waste (4.0%), hydro (1.2%) and oil (1.1%) were the other sources of electricity in 2018. In total, renewable energy sources had a 12.6% share.

Poland is currently building 4.3 GW of new coal-fired power generation capacity: TAURON Jaworzno III (910 MW), PGE Opole units 5 and 6 (2 x 900 MW), ENERGA Ostrołęka C (1 000 MW) and the 490 MW lignite-fired unit 11 at the PGE Turów power station. According to the government, these will be the last coal power plants to be built in Poland. With an otherwise ageing fleet and stricter EU emission standards, these new plants will replace older ones. Output from coal and lignite plants will thus remain relatively stable through to 2030 when they are expected to deliver at least 113 TWh according to the *Energy Policy of Poland to 2040* published in November 2019.

Poland has no nuclear power generation, but plans to construct a nuclear power plant, with the first unit at Żarnowiec or Kopalino in 2033.



General data		2018
Population	million	38.0
GDP	€ billion	496.4
Per capita GDP	€/person	12 900

Hard coal

Exploitable hard coal reserves are located in Upper Silesia and in the Lublin basin in the east of Poland, with the Upper Silesian coalfield accounting for 78.9% of the total. The coal reserves in this region contain some 400 coal seams with thicknesses of 0.8 metres to 3.0 metres. About half of these seams are economically workable. 71.6% of the reserves are steam coal, 27.0% coking coal, while other coal types account for the remaining 1.4%. All hard coal is deep mined at an average working depth of approximately 600 metres, with some over 1 000 metres. Mining is fully mechanised, with over 90% of coal produced by longwall systems.

Since the beginning of the 1990s, the Polish mining industry has been going through a process of transformation. Hard coal production decreased from 177.4 million tonnes in 1989 to 63.4 million tonnes in 2018. Over the same period, employment in the Polish hard coal mining sector decreased from 407 000 to 82 843 employees at the end of 2018.

Despite the significant reduction of mining capacity over almost three decades, Poland remains by far the largest hard coal producer in Europe. The largest coal mining company, POLSKA GRUPA GÓRNICZA (PGG – Polish Mining Group) was established in May 2016 when the mines of its predecessor, KOMPANIA WĘGLOWA (KW), were transferred to this newly formed group. Then, on 1 April 2017, the mines previously owned by KATOWICKI HOLDING WĘGLOWY (KHW) were integrated into PGG. Other leading coal mining companies are JASTRZĘBSKA SPÓŁKA WĘGLOWA (JSW) and LUBELSKI WĘGIEL „BOGDANKA” (LW „Bogdanka”). JSW is the EU’s largest coking coal producer, with an output of 10.3 million tonnes of coking coal and 4.7 million tonnes of steam coal in 2018.

Following its earlier privatisation in 2009, a majority (65%) of the shares in LW „Bogdanka” were acquired in 2015 by ENEA, a Polish power utility company. In 2011, JSW was privatised and listed on the Warsaw Stock Exchange, although the state retains a majority shareholding. Other, smaller coal hard coal producers include: TAURON WYDOBYCIE with three mines; PG SILESIA mine which the Czech group EPH acquired from KW in 2010, restarting coal production in 2012; WĘGLOKOKS KRAJ with Bobrek-Piekary mine; SILTECH mine; and EKO-PLUS mine.

In 2018, steam coal output of 51.3 million tonnes accounted for the majority (87.8%) of hard coal production. Coking coal production reached 12.1 million tonnes, mainly by JSW.

Unprofitable mines or units of integrated mines have been transferred to SPÓŁKA RESTRUKTURYZACII KOPALŃ (SRK – Mines Restructuring Company) for their eventual closure. In 2018, there were fourteen mines or units of mines managed by this restructuring company.

The Polish hard coal mining industry works to ensure the sector’s profitability. This entails new investment in modernisation, matching production volumes to market demand, reducing costs and increasing productivity. Structural changes to the industry are already showing promise and the decision in November 2016 of the European Commission to allow state aid for the closure by 2018 of uncompetitive units allowed the process to continue with the co-operation of investors and trade unions, while alleviating the social and environmental impacts of closing uncompetitive coal mines in line with EU state aid rules. The Commission concluded that this support would not unduly distort competition. More recently, on 8 February 2018, the Commission issued its decision extending until the end of 2023 the possibility of granting state aid for the further restructuring of the Polish hard coal mining sector.

Coal exporters and importers have an efficient infrastructure at their disposal in Poland, with cross-border rail links to neighbouring countries and to the Baltic Sea ports of Gdańsk, Szczecin-Świnoujście and Gdynia. Among these terminals, Gdańsk and Świnoujście can load Capesize vessels. Hard coal exports from Poland totalled 3.9 million tonnes in 2018. Most of the shipments were transported overland to neighbouring EU member states, namely the

Czech Republic, Slovakia, Austria and Germany, while small volumes were transhipped via the Baltic ports. In 2018, WĘGLOKOKS traded almost 4 million tonnes of coal, of which 1.3 million tonnes were exported.

In 2018, hard coal imports reached a record 19.7 million tonnes, including 3.5 million tonnes of coking coal, and were dominated by deliveries from Russia (13.5 million tonnes or 68.5%). Smaller quantities came from the USA (1.5 million tonnes), Australia (1.5 million tonnes), Colombia (1.4 million tonnes), Mozambique, Kazakhstan and the Czech Republic.

Irrespective of the large volume of coal imports in 2018, Poland aims to meet its demand for steam coal for power generation from domestic resources. Indigenous coal will be the foundation of Poland’s energy mix and a key element of its energy security. The forecast *increase* in power demand will be covered by sources other than conventional coal-fired power plants. So while the *share* of coal in the power generation mix will decline to approximately 60% in 2030, the *volume* of coal used by the power sector will remain stable.

In order to improve the combustion and gasification of coal through the use of modern technologies, a Clean Coal Technology Centre (CCTW) has been established in Katowice, co-financed with EU funds and co-managed by GŁÓWNY INSTYTUT GÓRNICTWA (GIG – Central Mining Institute) and INSTYTUT CHEMICZNEJ PRZERÓBKI WĘGLA (IChPW – Institute of Chemical Processing of Coal). Poland also has a well-developed and technically advanced mining machinery and equipment industry. Together with the research institutes and technology centres KOMAG, EMAG and GIG, machinery and equipment suppliers work with the Polish hard coal industry to develop and modernise mining.

Lignite

Poland exploits its lignite deposits exclusively at surface mines. Two are located in central Poland and a third lies in the south-west of the country. In 2018, lignite production was 58.6 million tonnes, 99% of which was used by mine-mouth power plants which generated 49.3 TWh of electricity or 29.0% of Poland’s total gross power generation.

The Bełchatów lignite basin, situated in the central part of Poland, incorporates two lignite fields: Bełchatów and Szczerców. In 2018, the Bełchatów mine produced 44.3 million tonnes of lignite or 75.5% of total lignite production in Poland. Mining this lignite required the removal of some 132.7 million cubic metres of overburden, which equates to an overburden-to-lignite ratio of 3.3 cubic metres per tonne. The depth of mining operations in the Bełchatów field is about 300 metres and the average calorific value of the fuel is 8 070 kJ/kg. Bełchatów mine is expected to remain in operation until 2040. The lignite output is supplied entirely to a mine-mouth power station owned by PGE GiEK, with a capacity of 5 298 MW. Electricity produced at this power station covers about 20% of domestic power consumption. Built mainly between 1981 and 1988, it

generates the cheapest electricity in Poland. A new 858 MW unit was put into service in 2011.

In the Turoszów lignite basin, located in the south-west of Poland, reserves are estimated at 290 million tonnes (77.3 Mtce). In 2018, Turów mine produced 6.5 million tonnes of lignite with a calorific value of 9 500 kJ/kg to supply the 1 498 MW PGE GiEK Turów mine-mouth power station. In 2018, some 22.6 million cubic metres of overburden were removed, giving a stripping ratio of 4.0 cubic metres per tonne. Turów mine is expected to be in operation until 2045.

The Bełchatów and Turów lignite mines, as well as the four adjacent power plants, belong to PGE Górnictwo i Energetyka Konwencjonalna (PGE GiEK), one of the six companies in the majority state-owned Polish utility POLSKA GRUPA ENERGETYCZNA (PGE Capital Group). Headquartered in Bełchatów, PGE GiEK has operations in four voivodships. It is a leader in the Polish lignite mining sector with a market share of approximately 87%. It is also the biggest electricity producer in Poland, satisfying over 36% of domestic power demand in some months of the year.

The Pałnów-Adamów-Konin (PAK) lignite basin, located in central Poland between Warsaw and Poznań, has been producing lignite for over fifty years and now generates approximately 8.5% of Poland's electricity needs. There are two active mining sites: Konin and Adamów, belonging to ZESPÓŁ ELEKTROWNI PAŁNÓW-ADAMÓW-KONIN (ZE PAK Group) which was listed on the Warsaw stock exchange in October 2012. The mines and power plants are operated by two subsidiary companies.

PAK KWB Konin SA has three mines: Józwin IIB, Drzewce and Tomisławice which together produced 6.8 million tonnes of lignite in 2018, requiring the removal of 50.7 million cubic metres of overburden (a stripping ratio of 7.4 cubic metres per tonne). Working depths are between 25 metres and 80 metres. The extracted fuel has an average calorific value of 9 220 kJ/kg and is supplied to three mine-mouth power plants: Pałnów I with an installed capacity of 1 244 MW, Pałnów II (474 MW) and Konin (583 MW). Lignite production at Konin is planned through to 2030, although only the Tomisławice surface mine will be working after 2020.

PAK KWB Adamów SA operated three surface mines, namely Adamów, Władysławów and Koźmin. Following the completion of mining and mine decommissioning, only the Adamów mine remains. Its output has been reduced as this mine also nears completion, scheduled for 2020. In 2018, lignite production of 0.8 million tonnes was supplied to the 600 MW ZE PAK Adamów power station. 5.6 million cubic metres of overburden were removed, which implies a stripping ratio of 7.0 cubic metres per tonne.

The average productivity at Poland's lignite mines was 6 800 tonnes per man-year in 2018 and employment totalled 8 583 people. Poland's lignite mining areas can maintain their annual output at current levels of around 60 million tonnes; lignite is expected to play a stable and important role in Poland's energy supply until at least 2030. Beyond

Poland

Coal resources and reserves*		as at 1.1.2019
Resources hard coal	Mt	61 436
Resources lignite	Mt	23 315
Reserves hard coal	Mt	22.307
Reserves lignite	Mt	1 047

Primary energy production		2018
Total primary energy production	Mtce	88.3
Hard coal (saleable output)	Mt / Mtce	63.4 / 51.7
Lignite (saleable output)	Mt / Mtce	58.6 / 16.6

Saleable coal quality		
Hard coal net calorific value	kJ/kg	21 000-28 000
Lignite net calorific value	kJ/kg	7 400-10 300
Hard coal ash content	% a.r.	8.0-30.0
Lignite ash content	% a.r.	6.0-12.0
Hard coal moisture content	% a.r.	6.5-11.0
Lignite moisture content	% a.r.	50.0-60.0
Hard coal sulphur content	% a.r.	0.4-1.2
Lignite sulphur content	% a.r.	0.2-1.1

Coal imports / exports		2018
Hard coal imports	Mt	19.7
Hard coal exports	Mt	3.9
Lignite imports	Mt	0.2

Primary energy consumption		2018
Total primary energy consumption	Mtce	150.7
Hard coal consumption	Mtce	63.5
Lignite consumption	Mtce	16.6

Power supply		2018
Total gross power generation	TWh	169.9
Net power imports (exports)	TWh	5.7
Total final power consumption	TWh (est.)	138.1
Power generation from hard coal	TWh gross	83.6
Power generation from lignite	TWh gross	49.3
Hard coal power generation capacity	MW net	19 195
Lignite power generation capacity	MW net	8 049

Employment		2018
Direct in hard coal mining	thousand	82.843
Direct in lignite mining	thousand	8.583

* Source: Państwowy Instytut Geologiczny (Polish Geological Institute) as at 31 December 2018

then, the Złoczew deposit has 611 million tonnes of exploitable reserves while the Ościsłowo deposit has 50 million tonnes and both are considered prospective by the government in its strategic forecast to 2040. The much larger Gubin deposit of 1 624 million tonnes is seen as a backup energy resource, if required.



Romania



Romania enjoyed solid economic growth of 4.1% in 2018 and a low unemployment rate of 4.2%, thanks mainly to its manufacturing sector. The country has significant energy resources, including coal, fossil gas and oil. Over three quarters of the country's total primary energy supply is met from indigenous resources, well above the EU average of 45%. Coal and lignite account for 16.2% of energy supply, this being slightly above the EU average.

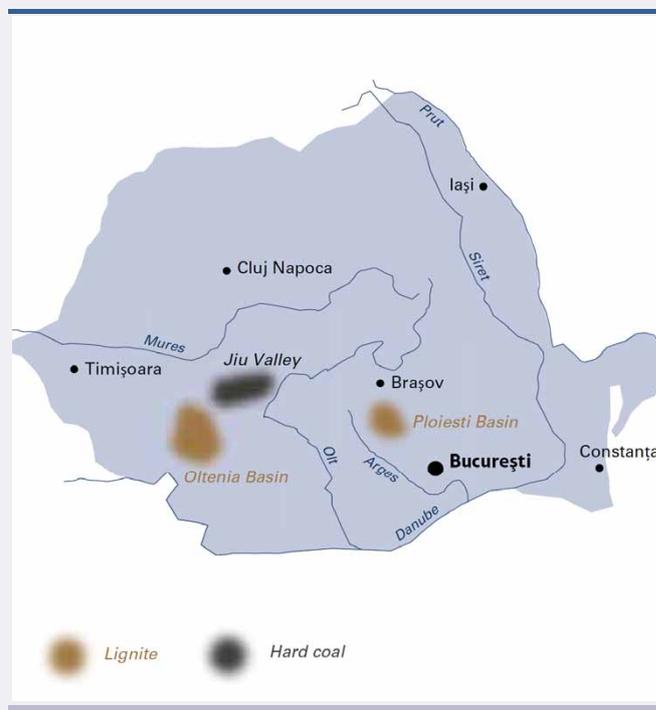
Hard coal resources are estimated at 2 446 million tonnes of which 11 million tonnes might be economically recoverable. Proven reserves of lignite total 280 million tonnes, within 9 640 million tonnes of resources. Of these, 95% lie in the Oltenia mining basin where more than 80% can be surface mined. The remaining lignite deposits have low economic potential and so extraction in most other areas has stopped. The country has a long coal mining tradition, stretching back over 150 years. Romania's entire hard coal and lignite output is used for heat and power generation.

The total net capacity of installed generation was 19 766 MW in 2018: coal 4 373 MW (22.1%), fossil gas / fuel oil 3 404 MW (17.2%), hydro 6 329 MW (32.0%), nuclear 1 300 MW (6.6%) and renewables 4 360 MW (22.1%), mostly wind turbines and solar PV. Peak demand in 2018 was 8 920 MW on 27 February, indicating a generation overcapacity and thus the opportunity for electricity exports.

In 2017, gross electricity production in Romania was 64.3 TWh: 26.2% from coal, 23.1% from hydro, 17.9% from nuclear, 16.6% from fossil gas and 15.2% renewables. Net electricity exports were 2.9 TWh in 2017 and 2.5 TWh in 2018. Exports have collapsed in 2019 and imports rose, making Romania a net importer; the additional cost of allowances under the EU emissions trading system (ETS) has made non-EU power generation more competitive.

Romania's first commercial nuclear reactor began operating in 1996 and a second CANDU reactor was commissioned in May 2007, thus completing two of the five reactors whose construction began in the 1980s and bringing the total gross capacity at the Cernavodă nuclear power plant to 1 413 MW. The completion of two further 720 MW reactors is planned by SOCIETATEA NATIONALA NUCLEARELECTRICA (SNN). It is a government priority to progress these reactors.

Romania has established an energy policy framework which is in line with EU law, regulating the production of gas, coal, lignite, oil and nuclear energy, as well as power plant modernisation. Indeed, by 2030, Romania plans to replace those older power plants reaching the end of their lives with new, high-efficiency, low-emission power plants.



General data		2018
Population	million	19.5
GDP	€ billion	202.9
Per capita GDP	€/person	10 400

The Romanian government published its *Energy Strategy 2019-2030* in November 2018, including a perspective to 2050. A priority of the strategy is to maintain the current level of diversity of indigenous energy sources. To that end, the government will stimulate investment in oil, fossil gas and lignite exploitation. Romania is also considering the development of a national gas transmission system along the Bulgaria-Romania-Hungary-Austria (BRUA) corridor and the development, on Romanian territory, of the Southern Transmission Corridor for Black Sea gas.

Lignite

COMPLEXUL ENERGETIC OLTENIA (CEO) or Oltenia Energy Complex is Romania's largest producer of coal-based energy with an installed gross capacity of 3 240 MW. The company is responsible for 99% of national lignite production. Its mines and power plants provide direct jobs for 13 000 people.

Lignite mining offers Romania a competitive advantage with the use of modern technologies and skilled labour to provide low-cost, base-load electricity. Reserves of lignite are concentrated in a relatively small area of 250 square kilometres where lignite is mined in twelve opencast pits licensed for another fifty years. These reserves provide a long-term, secure supply for the adjacent Turceni (1 320 MW) and Rovinari (990 MW) power plants. Further to the south lie the 300 MW Craiova and 630 MW Işalniţa power plants, also lignite-fired.

Since January 2017, the price of CO₂ emission allowances under the EU emissions trading system (ETS) has imposed an unbearable financial burden on CEO. In 2018, the company reported a loss of around €230 million, mainly due to its obligation to acquire CO₂ allowances. These now account for half of its total operating costs, so more than fuel and labour costs combined. The company has been forced to take out loans for the purchase of allowances. This is clearly an unsustainable economic situation for a country which depends on electricity from lignite-fired power plants.

Negotiations between CEO and CHINA HUADIAN ENGINEERING COMPANY to develop a new 600 MW lignite-fired unit that will replace some existing older units are currently ongoing.

Hard coal

The COMPLEXUL ENERGETIC HUNEDOARA (CEH) or Hunedoara Energy Complex is a state-owned electricity and heat producer headquartered at Petroşani in the Southern Carpathians. It owns and operates four underground hard coal mines in the Jiu Valley (Lonea, Livezeni, Vulcan and Lupeni) and two coal-fired power plants, as well as the Prestserv mines rescue station. The company accounts for less than 2% of Romanian electricity generation, with a gross capacity of 1 225 MW and 3 022 employees in 2018.

The main consumers of hard coal are CEH's two thermal power plants at Paroşeni (150 MW) and Mintia-Deva (1 075 MW). Indigenous hard coal production has the advantage of ensuring a long-term supply for these power plants. However, hard coal mining in Romania faces complex geological conditions, making profitable mining difficult. Petrila mine closed in 2015, followed in 2017 by Paroşeni and Uricani mines.

In April 2018, the Romanian government adopted an emergency ordinance requiring CEH to provide 400 MW of system services over the two-year period to 2020 under a Service of General Economic Interest (SGEI) exemption.

In November 2018, the European Commission found that CEH had received around €60 million of incompatible state aid through four repayable public loans. These had funded the temporary rescue aid approved in April 2015 by the European Commission (C(2015) 2652) with a view to securing the company's long-term economic viability according to Council Decision 787/2010/EU.

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	2 446
Total resources lignite	Mt	9 920
Reserves hard coal	Mt	11
Reserves lignite	Mt	280

Primary energy production		2018
Total primary energy production*	Mtce	36.4
Hard coal (saleable output)	Mt / Mtce	0.7 / 0.4
Lignite (saleable output)	Mt / Mtce	23.5 / 5.6

Saleable coal quality		
Hard coal net calorific value	kJ/kg	14 200-15 900
Lignite net calorific value	kJ/kg	7 200-8 200
Hard coal ash content	% a.r.	37-44
Lignite ash content	% a.r.	30-36
Hard coal moisture content	% a.r.	5.0-7.4
Lignite moisture content	% a.r.	40-43
Hard coal sulphur content	% a.r.	0.5-1.8
Lignite sulphur content	% a.r.	1.0-1.5

Coal imports / exports		2018
Coal imports	Mt	0.9
Coal exports	Mt	0.0

Primary energy consumption		2017
Total primary energy consumption	Mtce	47.6
Hard coal consumption	Mtce	1.2
Lignite consumption	Mtce	5.6

Power supply		2017
Total gross power generation	TWh	64.3
Net power imports (exports)	TWh	(2.9)
Total power supply	TWh	56.0
Power generation from hard coal	TWh	1.2
Power generation from lignite	TWh	15.6
Hard coal power generation capacity	MW gross	1 225
Lignite power generation capacity	MW gross	3 240

Employment		2018
Direct in hard coal mining	thousand	3.022
Direct in lignite mining and generation	thousand	13.000

* 2017 data

At the end of October 2019 and in the absence of any viable restructuring plan, CEH again filed for insolvency, having reported losses of €56 million for the first half year and total debts of over €0.5 billion.

Serbia



At the heart of the Balkans, Serbia is well located for services and trade: the Morava Valley is the easiest land route from Europe to Turkey and beyond. Economic growth in 2018 was a healthy 4.3% and annual GDP *per capita* stood at €12 300 on a purchasing power parity basis.

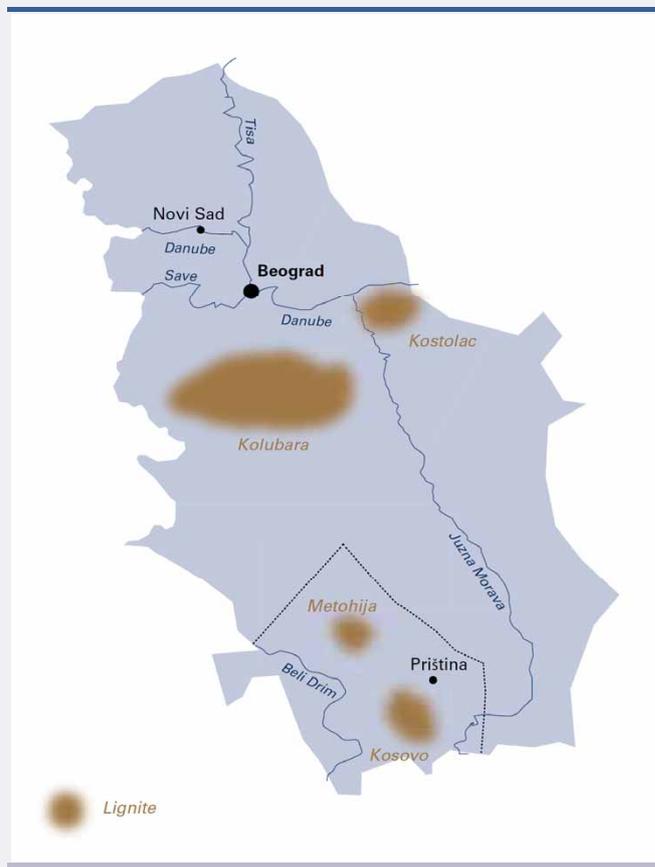
Serbia has very substantial lignite resources which are easily accessible for exploitation. Its lignite reserves are estimated to be over 7 billion tonnes; in Europe, only Germany and Turkey have larger reserves. Serbia relies on lignite and small quantities of imported coal for one half of its total primary energy supply. For electricity generation, the share of lignite was 71.0% in 2018 with hydro (26.3%) accounting for most of the remainder, while fossil gas (0.5%) and wind (0.3%) made only very small contributions. According to the Serbian energy strategy, coal will remain the country's main source of energy.

The 100% state-owned ELEKTROPRIVREDA SRBIJE (EPS) or Electric Power Industry of Serbia is a vertically integrated utility company with two subsidiaries: EPS Distribution LLC Belgrade and EPS Trading LLC Ljubljana. EPS has eight divisions for electricity and coal production, including electricity supply which is the company's main activity. The production, processing and transport of coal, electricity generation and distribution, including distribution system operator, renewable energy production, and the raising of steam and hot water in cogeneration plants are all performed by EPS. Since June 1999, EPS has not been able to operate its facilities in Kosovo and Metohija.

With 29 153 employees, excluding workers from Kosovo, and about 3.5 million consumers, EPS is the largest company in Serbia. The installed capacity of EPS power plants totals 7 401 MW: lignite-fired power plants 4 079 MW; gas- and oil-fired combined heat and power plants 336 MWe / 505 MWth; and hydro power plants 2 986 MW.

Investment in new renewable energy sources is growing. In May 2019, the 158 MW Čibuk 1 wind farm became operational, 60 kilometres from Belgrade. This was followed, in August 2019, by the commissioning of the 104.5 MW Kovačica wind farm, located 70 kilometres from the capital and partly financed by the European Bank for Reconstruction and Development. In the Kostolac lignite basin, another project is nearing completion: the 66 MW Kostolac wind farm, a €100 million investment partly financed by the German KfW Bank.

In order to increase the efficiency of the power sector through market mechanisms, the Serbian government has gradually introduced competition since adoption of the Law on Energy in 2004. Opening of the electricity market will continue until it is fully opened in line with the country's ratification of the Energy Community Treaty.



General data		2018
Population	million	7.0
GDP	€ billion	42.9
Per capita GDP	€/person	6 100

Lignite

Production of lignite, with an average calorific value of 7 850 kJ/kg, takes place at open-pit and underground mines in the Kolubara and Kostolac coal basins.

The 600 square kilometre Kolubara coal basin is located in the western part of Šumadija, between Rudovci to the east, Koceljeva to the west, Stepojevac to the north and Slovac to the south. There, Field B/C, Field D, Tamnava-West Field and Field G open-pit mines account for around 75% of Serbian lignite production. Lignite is supplied by rail to the Kolubara thermal power plant (TPP) at Veliki Crljeni, TPP Nikola Tesla A and B at Obrenovac about 40 kilometres from the mines, and TPP Morava at Svilajnac. Together, these

three thermal power plants comprise fourteen units with a total capacity of 3 141 MW. Lignite from all four open-pit mines is processed in coal preparation plants at Vreoci and the Tamnava-West Field mine.

In the Kolubara coal basin, preparatory works are in progress to develop open-pit mine Field E, with 400 million tonnes of lignite reserves, as a replacement for Field D. The mine's planned annual output is 12 million tonnes. Field G open pit mine extension was opened in 2017 with 36.5 million tonnes of good quality lignite reserves. In 2019, the new open-pit Radljevo mine with 350 million tonnes of lignite reserves was officially opened after many months of overburden removal. The mine's annual output will be 13 million tonnes of lignite. The relocation of infrastructure to serve these new mines in the Kolubara basin was completed early in 2019.

Lignite mined in the Kostolac basin, from the 50 square kilometre Drmno coal deposit in the eastern part of the basin, accounts for the remaining 25% of Serbian lignite production and is supplied to the TPP Kostolac A and B power plant (310 MW and 700 MW).

In 2018, EPS extracted 38.0 million tonnes of lignite in the Kolubara and Kostolac basins, with overburden-to-production ratios of 2.5 cubic metres per tonne in Kolubara and 4.5 cubic metres per tonne in Kostolac. In addition, EPS purchased coal from underground mines operated by state-owned PEU "Resavica". The closure of two of these mines was announced in 2018.

In December 2014, a loan agreement was signed by the Serbian government with the EXIM BANK OF CHINA for a \$715.6 million project to build a new 350 MW unit (B3) at TPP Kostolac and to extend the annual capacity of Drmno mine from 9 million tonnes to 12 million tonnes of lignite. Construction is in progress and the new unit is planned to be operational by the end of 2021. Unit B3 of TPP Kostolac will help stabilise Serbia's energy system while respecting European Union environmental standards.

Environmental protection is a business priority for EPS, this being in line with the Serbian government's policy to join the European Union and the country's commitments under the Energy Community Treaty. Since 2015, EPS has harmonised the operation of its facilities with the EU *acquis*.

From 2016 to 2019, EPS has invested about €320 million in production modernisation and environmental protection projects, particularly at its thermal power plants where flue gas desulphurisation, electrostatic filters, ash and slag transport, and wastewater treatment projects have been completed. By the end of 2025, EPS plans to have invested more than €850 million in its facilities in order to improve efficiency and environmental protection. About €650 million will be invested in air pollution control equipment to further reduce emissions of sulphur dioxide, oxides of nitrogen and fine particulates.

Serbia

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	855
Total resources lignite	Mt	20 186
Reserves hard coal	Mt	402
Reserves lignite	Mt	7 112

Primary energy production		2018
Total primary energy production*	Mtce	15.0
Lignite (saleable output)	Mt / Mtce	38.0 / 9.8

Saleable coal quality		
Hard coal net calorific value	kJ/kg	12 000-18 000
Lignite net calorific value	kJ/kg	7 500-8 200
Hard coal ash content	% a.r.	12.0-35.0
Lignite ash content	% a.r.	14.0-18.0
Hard coal moisture content	% a.r.	45.0-54.0
Lignite moisture content	% a.r.	48.0-52.0
Hard coal sulphur content	% a.r.	0.9-3.8
Lignite sulphur content	% a.r.	0.4-0.9

Coal imports / exports		2018
Hard coal imports	Mt	0.1
Lignite imports	Mt	0.5

Primary energy consumption		2017
Total primary energy consumption	Mtce	22.3
Hard coal consumption	Mtce	0.1
Lignite consumption	Mtce	10.5

Power supply		2018
Total gross power generation	TWh	39.6
Net power imports (exports)	TWh	0.6
Total power consumption	TWh	40.2
Power generation from lignite	TWh	28.1
Lignite power generation capacity	MW	5 314

Employment		2018
Direct in underground coal mining	thousand	3.500
Direct in lignite mining and power	thousand	14.850

* 2017 data

Slovakia



After quickly recovering from the global economic crisis, the Slovak economy has grown strongly, by 4.1% in 2018.

The Slovak Republic does not have any significant exploitable fossil energy reserves. While the extraction of crude oil and fossil gas accounts for less than 2% of overall energy supply, there is quite a large potential for gas storage. In recent years, there has been a public debate on the exploitation of a uranium deposit at Kurišková.

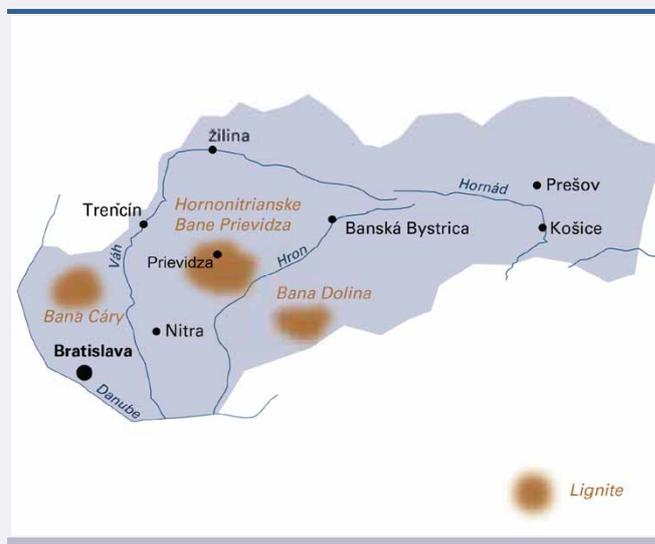
At 54.7% in 2018, nuclear power has the largest share in electricity generation, followed by hydro (14.4% excluding pumped hydro). Hard coal, including coke oven gas, accounted for an estimated 5.5% of generation, lignite accounted for a further 5.7% of generation, while fossil gas (7.0%) and oil (1.5%) accounted for smaller shares. The remainder came from biofuels and waste (5.7%) and, since 2011, a steady share from solar PV (2.3%).

In the south-east of the country, the coal-fired Elektráreň Vojany I (EVO I) power plant's 4 × 110 MW units are designed to use imported semi-anthracitic hard coal, coming now from Russia and Poland.

Two gas-fired power stations are in operation: the 350 MW Malženice CCGT commissioned in 2011 near the town of Trnava, 60 kilometres from Bratislava, and the 4 × 110 MW Vojany II or EVO II which was commissioned in 1973-74 as an oil-fired boiler plant, but converted to gas soon after.

Given the need for long-term, low-carbon strategies under the Paris Agreement, the Slovak Republic is preparing, in co-operation with the World Bank, a low-carbon development strategy to 2050. The national energy policy, approved in November 2014, signals measures to reduce end-user electricity prices, including the phasing out of tariffs for renewable electricity by 2020. The policy is to focus on the use of renewable energy sources for heat, electricity and transport, and encourage heat and power co-generation.

Overall, the energy mix under the national energy policy is well-balanced, with support for indigenous lignite and renewables. Given the high share of nuclear in its power generation mix, Slovakia's dependency on imported energy sources in 2017 (64.8%) is only slightly above the EU average, despite an almost total dependency on imported oil and gas.



General data		2018
Population	million	5.4
GDP	€ billion	90.2
Per capita GDP	€/person	16 600

Lignite

Lignite resources are estimated at just over one billion tonnes. Exploitable lignite reserves, including brown coal, are calculated at 135 million tonnes. There is an insignificant hard coal deposit in the eastern part of Slovakia, which is not exploitable.

In 2018, 1.5 million tonnes of lignite were produced. Lignite is extracted by one company at three underground mines located in the central and western parts of Slovakia. More than 90% of the total lignite production was used for electricity generation and district heating.

HORNONITRIANSKE BANE PRIEVIDZA (HBP) is a private coal mining company with a history of over one hundred years. Seated in the town of Prievidza, HBP extracts lignite at the Cigeľ-Handlová and Nováky deposits located in the Horná Nitra region in central Slovakia and at the Čary deposit located in western Slovakia. In the past, there were

three independent collieries in operation in Horna Nitra – Cigeľ, Handlová and Nováky – which were integrated into HBP. Cigeľ colliery was closed in October 2017. The depth of the worked coal seams ranges from 150 metres to 450 metres.

The lignite seams have a thickness of up to 20 metres and are mostly extracted using a long-wall, top-coal caving (LTCC) method. Thin seams, of around 4 metres, are extracted with conventional longwalls. HBP also operates a mines rescue station which serves all mining districts in Slovakia. All lignite is supplied to the nearby 486 MW Nováky power plant (Elektrárň Nováky – ENO) belonging to the SLOVENSKÉ ELEKTRÁRNE COMPANY which is 50% owned by ENEL of Italy and 50% by EPH of the Czech Republic. Nearly one third of the lignite supplied in 2018 came from mines in the Nováky deposit.

BAŇA DOLINA COMPANY, near the town of Veľký Krtíš, extracted lignite from the Modrý Kameň deposit in southern Slovakia at a depth of 150 metres. Lignite was supplied to the ENO power station. The mine was closed in May 2015.

The BAŇA ČÁRY COMPANY, near the town of Holíč in western Slovakia, extracts around 170 thousand tonnes of lignite each year from a working depth of 180 metres. The mine plans to expand its annual production to reach 350 thousand to 500 thousand tonnes.

BANSKÁ MECHANIZÁCIA A ELEKTRIFIKÁCIA NOVÁKY (BME) is a modern mining equipment supplier owned by HBP that designs and manufactures high-pressure hydraulic roof supports suitable for LTCC mining. BME also produces other mining and construction machinery, as well as equipment for the transport sector.

Together with SLOVENSKÉ ELEKTRÁRNE and ENEL, HBP is actively engaged with modernising the coal-fired ENO power plant at Nováky. In May 2015, work began on a de-NO_x system for two of the 110 MW blocks at the plant. The flue gas desulphurisation and particulate filtration systems were also renewed. HBP also has an interest in research and works with universities on various projects mostly on the non-energetic use of Čary lignite and on the accumulated water in surface swamps and wetlands found in surface depressions.

Slovakia

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	19
Total resources lignite	Mt	1 073
Reserves hard coal	Mt	0
Reserves lignite	Mt	135

Primary energy production		2018
Total primary energy production	Mtce	9.0
Lignite (saleable output)	Mt / Mtce	1.5 / 0.5

Saleable coal quality		
Lignite net calorific value	kJ/kg	10 450
Lignite ash content	% a.r.	<25
Lignite moisture content	% a.r.	<35
Lignite sulphur content	% a.r.	<2.5

Coal imports / exports		2018
Hard coal imports	Mt	3.8
Lignite imports	Mt	0.6

Primary energy consumption		2018
Total primary energy consumption	Mtce	24.7
Lignite consumption	Mtce	0.8

Power supply		2018
Total gross power generation	TWh	27.2
Net power imports (exports)	TWh	3.8
Total power consumption	TWh	31.0
Power generation from hard coal	TWh	1.5
Power generation from lignite	TWh	1.4
Hard coal power generation capacity	MW	440
Lignite power generation capacity	MW	486

Employment		2018
Direct in lignite mining	thousand	2.000
Other lignite-related*	thousand	0.430

* e.g. in power generation, equipment supply, services and R&D





Slovenia



Since its foundation in 1991, the Republic of Slovenia has enjoyed steady economic growth. After a period of strong growth since 2014, the economy slowed in 2019. The country's primary energy consumption increased by 40% between 2000 and 2008, reaching a peak of 11.1 Mtce. In 2018, consumption was 9.8 Mtce.

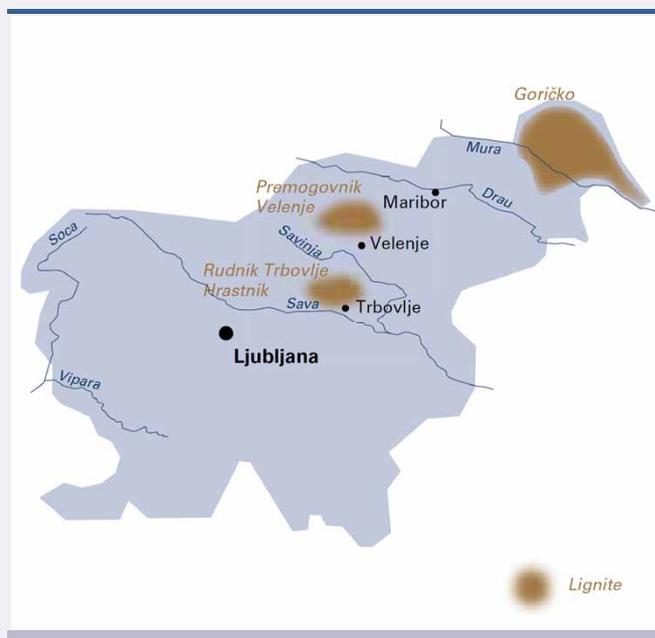
Resources of lignite and brown coal in Slovenia are estimated to be 1 256 million tonnes, lying at Velenje (358 million tonnes), Zasavje (68 million tonnes) and Goričko (830 million tonnes), with mineable reserves accounting for 109 million tonnes. Approximately 47% of the country's primary energy requirements are met by imports. Indigenous lignite production accounted for approximately 13.1% of primary energy supply in 2018, with imported coal bringing coal's total share to 16.3%. Oil had a share of 34.3%, nuclear 21.7%, biofuels and waste 10.2%, fossil gas 10.5%, hydro 5.8% and the remaining 1.2% came from renewable energy sources.

The key elements of Slovenian energy policy are closely aligned with the priorities of the European Union, such as a national plan for renewables and a plan to improve energy efficiency. In the area of climate policy, Slovenia adopted a strategic framework for climate change adaptation in December 2016. In the long term, coal and lignite are expected to be partially replaced by renewable energy sources and coal imports will reduce. PREMOGOVIK VELENJE will continue its lignite production until 2054 under currently valid plans as lignite is needed in the currently well-balanced energy mix for security of supply reasons.

At 35.9% in 2018, nuclear power accounted for the largest share of electricity generation in Slovenia, followed by hydro (29.2%) and coal and lignite (28.7%). Other sources had rather small shares, for example: fossil gas (2.9%), biofuels and waste (1.7%) and solar (1.6%).

Lignite

Only one lignite deposit is exploited in Slovenia, at Velenje in the north of the country. In 2018, 3.2 million tonnes of lignite were produced. Velenje mine is the only coal mine in Slovenia and all of its lignite output is used at the nearby Šoštanj power plant. Operated by PREMOGOVIK VELENJE and employing a unique mining method, it is one of the largest and most modern underground mines in Europe. The mine is located in the Šaleška dolina valley and boasts one of the thickest-known lignite seams in the world, at more than 160 metres.



General data		2018
Population	million	2.1
GDP	€ billion	45.8
Per capita GDP	€/person	22 100

The company's long-term strategy is to operate the mine until 2054, as it is likely to remain Slovenia's only exploitable energy resource. The Velenje coal mine belongs to the state-owned HOLDING SLOVENSKE ELEKTRARNE (HSE) who also owns the 1 029 MW Šoštanj (TEŠ) thermal power plant as well as hydro power plants.

Imported coal is mostly used at ENERGETIKA LJUBLJANA's Termoelektrarna Toplarna Ljubljana (TE-TOL) heat and power plant in Ljubljana. The company covers over 74% of the capital's household demand for gas and heat.

Taking into consideration the increasing demand for electricity, the risks of energy import dependence and the abundant coal reserves at Velenje, HSE commissioned a new 600 MW unit at Šoštanj thermal power plant in 2015. Unit 6 uses the best available techniques (BAT) to achieve an efficiency of more than 43% and deliver CO₂ emission reductions of 35%, as older units are replaced. The new unit has had a significant economic and environmental impact in Slovenia by ensuring stable electricity prices and lower emissions.

PREMOGOVNIK VELENJE is a technologically well-developed and strongly integrated company with over 144 years in lignite mining. In 2007, the company received a special award from the Slovenian Chamber of Engineers for its innovative approach to mining engineering.

The “Velenje mining method” is performed by top caving hanging seams. The very first long-wall faces appeared in 1947, quickly followed by the extensive introduction of long-wall faces in 1952. The basic approach is to extend the lignite extraction area above the protected area at the face. The “Velenje mining method” has been proven to be the most effective method for extracting thick coal seams. PREMOGOVNIK VELENJE continues to develop this method in order to gain even more improvements.

The knowledge and products of PREMOGOVNIK VELENJE offer excellent opportunities for co-operation with other countries, particularly where there is a need to introduce new technologies in Europe (e.g. in Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Slovakia and Turkey) and further away in the Asia-Pacific region.

PREMOGOVNIK VELENJE is also a partner in many EU-funded research and innovation projects which aim to develop clean coal technologies and safer mining solutions, as well as methods for predicting gas and rock outbursts and gas emissions from thick coal seams.

PREMOGOVNIK VELENJE has always aimed to prevent and eliminate any negative environmental impacts of its operations and has played an active role in land rehabilitation and air/water protection programmes in the Šaleška dolina valley. The company regularly monitors its environmental impacts, but the clearest testament to sustainable development is the tourist and sports resort that has been developed around the man-made lakes above the Velenje coal mine.

The energy transition brings new challenges in Slovenia and elsewhere. As recognised in the “Clean energy for all Europeans” package of legislation tabled in November 2016, a just transition should be ensured in those regions affected by structural change brought about by any reductions in coal mining or coal-fired power generation. There is no clear decision for a coal phase-out in Slovenia, but the question will certainly be addressed as emission reduction targets are set in upcoming strategic documents to be adopted by the government in 2020, including a new *Energy Concept for Slovenia*. In any event, Slovenia and PREMOGOVNIK VELENJE are actively involved in the Coal Regions in Transition Platform initiative of the European Commission as all stakeholders strive to address the challenges of the future energy transition.

Coal resources and reserves as at 1.1.2019

Total resources lignite	Mt	1 256
Reserves lignite	Mt	109

Primary energy production 2018

Total primary energy production	Mtce	5.0
Lignite (saleable output)	Mt / Mtce	3.2 / 1.3

Saleable coal quality

Lignite net calorific value	kJ/kg	10 650
Lignite ash content	% a.r.	16
Lignite moisture content	% a.r.	35
Lignite sulphur content	% a.r.	1.6

Coal imports / exports 2018

Hard coal imports	Mt	0.4
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Primary energy consumption 2018

Total primary energy consumption	Mtce	9.8
Lignite consumption	Mtce	1.3

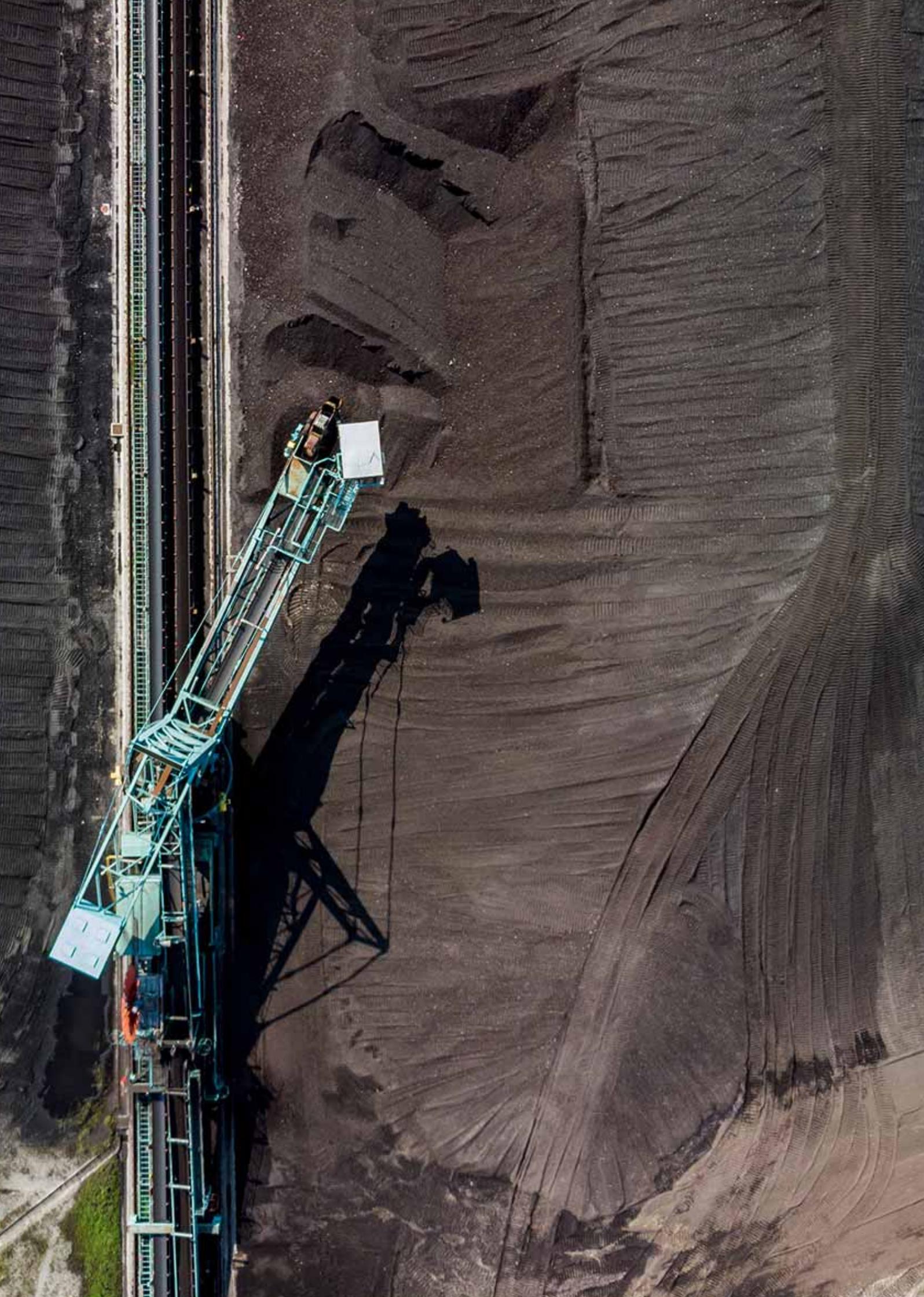
Power supply 2018

Total gross power generation	TWh	16.3
Net power imports (exports)	TWh	(0.5)
Total power consumption	TWh	13.8
Power generation from lignite	TWh net	3.8
Lignite power generation capacity	MW	1 029

Employment 2018

Direct in lignite mining	thousand	1.252
Other lignite-related*	thousand	2.371

* e.g. in power generation, equipment supply, services and R&D





Spain



Following the global economic crisis, Spain's economy has been growing since 2014; annual growth was 2.6% in 2018. The unemployment rate remains very high at around 15%.

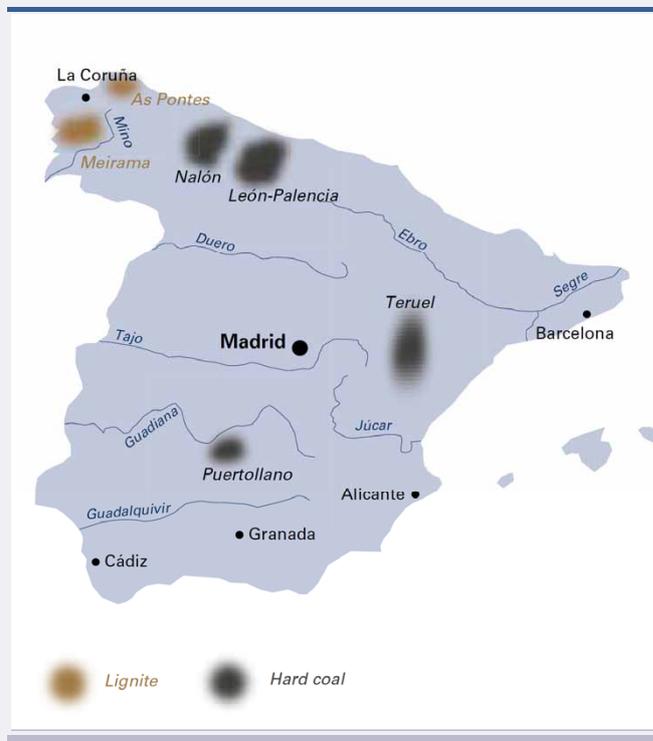
The country is highly dependent on imported oil and fossil gas. It had an overall import dependence of 73.9% in 2017, well above the EU average of 55.1%. This places a burden on the Spanish economy by increasing its trade deficit and foreign indebtedness. Spain's primary energy production was 48.6 Mtce in 2018, notably nuclear – just 2.3% came from indigenous coal production.

The only significant conventional energy resource that Spain possesses is coal, totalling 4 550 million tonnes, including accessible reserves of 1 187 million tonnes. In 2018, coal met 7.8% of the country's energy demand: 2.5 million tonnes of domestic production and 15.8 million tonnes of imported coal. Oil, fossil gas and nuclear are the other principal energy sources, with wind and solar providing 5.9% of total primary energy supply. However, after a decade of growth, wind and solar power have been in *decline* since their 2013 peak.

Electricity produced in 2018 came mainly from conventional sources: nuclear power with 55.6 TWh gross (20.3%), followed by fossil gas 57.1 TWh (20.8%), wind 50.8 TWh (18.6%), hard coal 39.3 TWh (14.4%) and hydro which had a good year with 36.8 TWh (13.4%). Solar, wind and other renewable energy sources accounted for 38.6% of electricity generation in 2018. Indigenous coal fuelled around 2% of generation.

Spain has one of the most dynamic electricity markets in Europe. There is fierce competition between coal-fired and fossil gas-fired power generation for the market that remains after nuclear, hydro and must-run renewables have supplied. Hydro output can vary significantly from one year to the next and, with a system capacity margin of over 150%, there is plenty of room for switching between sources.

Spain plans to be a carbon-neutral country by 2050. In its draft *National Energy and Climate Plan 2021-2030*, submitted to the European Commission in February 2019, the government expects coal power plants to cease operation by 2030 at the latest, driven out of the market by the high cost of CO₂ allowances under the EU emissions trading system. Of the fifteen coal-fired power plants operational in 2019, only six are expected to continue after 2021 and coal consumption could halve by 2025. By 2030, the government wants to more than double wind power capacity and increase solar PV capacity eight fold.



General data		2018
Population	million	46.9
GDP	€ billion	1 202.2
Per capita GDP	€/person	25 700

Hard coal

Hard coal deposits in the north-west Principality of Asturias are located in the Nalón Valley and are of a low calorific value. Nevertheless, in the past they were Spain's biggest source of coal. Today, high extraction costs have led to the gradual closure of mines and only one remains: the San Nicolás underground coal mine located in the Lleros de Abajo valley near Mieres which produces up to 200 thousand tonnes each year for heating plants and the nearby 15 MWe La Pereda experimental power plant. Over 1 000 people are employed by HUNOSA at these operations. The deposits at León-Palencia are also of a low calorific value, although some anthracite seams are present. Coal in the Astur-Leonesa basin north of La Robla in the region of Castilla y León, where anthracite was mined by HULLERA VASCO-LEONESA and CARBONAR, has a high calorific value (5 500 kcal/kg or 23 000 kJ/kg) and low volatile matter.

The hard coal basin at Puertollano in the Ciudad Real province south of Madrid has good reserves. The province of Teruel in the Aragon region boasts the largest sub-bituminous hard coal reserves in Spain. The high sulphur content of this coal (4% to 6%) made it less attractive for use at power plants in the past.

In May 2016, the European Commission announced that the Spanish government's plan of October 2013 to grant €2.13 billion for the orderly closure of twenty-six coal mines by 2018 was in line with EU rules on state aid, in particular Council Decision 2010/787/EU (case SA.34332).

By the end of 2018, all Spanish coal producers had closed their mining operations: BIERZO ALTO, CARBONES ARLANZA, CARBONAR, CARBONES DEL PUERTO, CÍA GRAL MINERA DE TERUEL, CÍA ASTUR LEONESA, ENDESA, ENCASUR, HIJOS DE BALDOMERO GARCÍA, HULLERA VASCO-LEONESA, MINERA CATALANO ARAGONESA, UNIÓN MINERA DEL NORTE and HULLERA DEL NORTE. Subsidies paid in 2018, effectively the last year of production, totalled €210 000 or just €0.085 per tonne. Following several bankruptcies, only four companies will continue in 2019, carrying out restoration work at former mines.

Even those coal mining companies that remained viable without subsidy were forced to close by 31 December 2018, because under EU law continued mining would have required the repayment of *past* state aid received since 2011 – an impossible demand that led to thousands of job losses. Negotiations with the Spanish government for a just and orderly transition of the coal sector were disrupted by a change of government in June 2018 and, by mid-September, it was clear that mine closures were inevitable.

On 24 October 2018, a framework agreement was signed for the “Just Transition from Coal Mining and Sustainable Development of Mining Regions 2019-2027”. Following proposals by trade unions (FICA-UGT, CCOO and USO), this agreement is favourable for mineworkers, although subcontractors were excluded. In contrast, representations by coal mining companies, who wanted flexibility on the repayment of past state aid, led nowhere. To secure workers' rights, the agreement was signed by CARBUNIÓN on behalf of the mining companies. It foresees:

- restructuring of the coal sector within the framework of Council Decision 2010/787/EU;
- economic development of the coal mining regions;
- flexibility for companies who wish to continue mining coal beyond 2018; and
- mitigating the impacts of job losses and mine closures.

The government will therefore grant support for redundancy payments and early retirements, exceptional mine closure costs, mitigation of environmental impacts, land restoration, and state aid totalling €250 million over the 2019-2023 period for new or expanding businesses, as well as local infrastructure.

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	4 231
Total resources lignite	Mt	319
Reserves hard coal	Mt	868
Reserves lignite	Mt	319

Primary energy production		2018
Total primary energy production	Mtce	48.6
Hard coal (saleable output)	Mt / Mtce	2.5 / 1.4

Saleable coal quality		
Hard coal net calorific value	kJ/kg	18 231
Hard coal ash content	% a.r.	34.6
Hard coal moisture content	% a.r.	13.2
Hard coal sulphur content	% a.r.	2.5

Coal imports / exports		2018
Hard coal imports	Mt	15.8

Primary energy consumption		2018
Total primary energy consumption	Mtce	177.4
Hard coal consumption	Mtce	13.9

Power supply		2018
Total gross power generation	TWh	273.8
Net power imports (exports)	TWh	(11.1)
Total power consumption	TWh	284.9
Power generation from hard coal	TWh	39.3
Hard coal power generation capacity	MW	9 562

Employment		2018
Direct in hard coal mining	thousand	1.549

The FUNDACIÓN CIUDAD DE LA ENERGÍA (CIUDEN) is the leading public developer of CO₂ capture, transport and geological storage in Spain. CIUDEN also has a prominent role in the just transition of coal mining regions, acting as co-ordinator for economic development initiatives and viable projects to create employment, in addition to bringing its own technical capacity.

Lignite

At the end of 2007, Spain's last lignite mines located in Galicia on the north-west side of the Iberian Peninsula were closed. Lignite reserves of 319 million tonnes remain.

Turkey



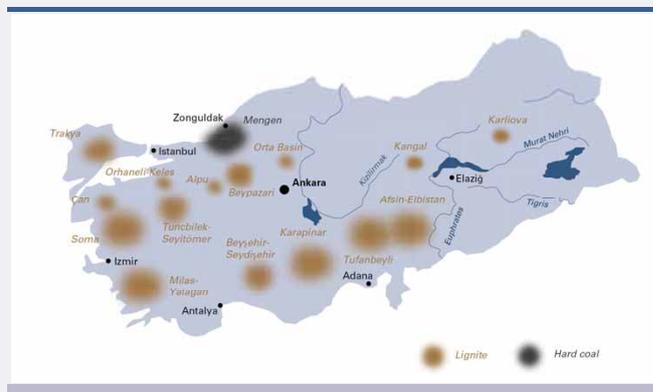
Turkey, benefitting from easy access to the European Union single market and with a population close to Germany's, enjoyed GDP growth averaging 5% per year from 2000 until 2018 when the economy began to contract following a sharp fall in the value of the Turkish lira. Privatisation has created a buoyant energy sector. The Ministry of Energy and Natural Resources (MENR) is responsible for the preparation and implementation of energy policies, plans and programmes in co-ordination with its affiliated institutions and other public and private entities. It has statutory duties covering coal mines, power stations and the electricity grid.

Total primary energy supply was 208.4 Mtce in 2018. With *per-capita* energy use in Turkey still comparatively low at 1.8 tonnes of oil equivalent (compared with an EU-average of 3.2 toe), energy demand is expected to grow.

Turkey's energy resources are almost exclusively in the form of coal, with only limited oil and gas resources. Indigenous production and coal imports met 29.7% of total primary energy supply in 2018 – the first time that coal has had the highest share. At 28.2%, fossil gas had a lower share in the energy mix, 99% imported. Oil accounted for 28.8% of energy supply, 93% imported. Overall, the country had an import dependency of 72% in 2018.

The General Directorate of Mineral Research and Exploration (MTA) has an extensive exploratory drilling programme – 1.0 million metres in 2017 and more in 2018. At the start of 2018, hard coal reserves stood at 551 million tonnes, with a further 10 975 million tonnes of lignite reserves. From these, the Turkish coal sector produced 1.1 million tonnes of hard coal and 85.2 million tonnes of lignite in 2018, this being 44.5% of total primary energy production and used mostly for power generation. Coal imports have grown steadily over the last forty years and stood at 38.3 million tonnes in 2018, again used mostly for power generation.

Turkish coal-fired power plants had an installed capacity of 19.7 GW at the end of 2018 (22.2% of total capacity). Hard coal-fired power plants' capacity was 9 600 MW (10.8%) and the capacity using domestic lignite was 10 100 MW (11.4%). Turkey has embarked on an ambitious programme to build new power plants, some with the latest supercritical and circulating fluidised bed (CFB) boiler technologies to burn mainly lignite and imported coal. The second unit at AKSA ENERJI's 270 MW Bolu-Göynük plant started operation in 2016, while ENERJISA ENERJI completed its 450 MW Tufanbeyli CFB plant in Adana province. Two new 700 MW supercritical units at EREN ENERJI's 2 790 MW ZETES power station were also completed in 2016 at Zonguldak, running on imported coal.



General data

2018

Population	million	80.8
GDP	€ billion	652.5
Per capita GDP	€/person	8 000

In 2017, the 1 320 MW Cenal power plant owned by CENAL ELEKTRİK was commissioned and, in 2018, the Çan-2 lignite power station was commissioned by ODAŞ GROUP at Çanakkale on the Aegean coast, site also of the 1 600 MW İÇDAŞ Bekirli power station. HİDRO-GEN ENERJİ's 510 MW Soma Kolin CFB power plant was commissioned in 2019 and construction started on EMBA ELEKTRİK's 1 320 MW Hunutlu coal power plant in Adana province which the owners in joint venture with SHANGHAI ELECTRIC POWER expect to commission in 2021. All new power plants must comply with the EU Large Combustion Plants Directive (2001/80/EC).

Turkey is also planning and constructing new coal plants to be fired by local lignite from mines in Thrace, Eskişehir, Afyonkarahisar, Kahramanmaraş, Bartın and other provinces. The planned "C" expansion of the Afşin-Elbistan power complex would make this the largest in the world. However, in 2012, the 1 200 MW Gerze power plant in Sinop province was cancelled by the ANADOLU GROUP after strong local opposition and, in February 2019, the supreme court blocked HEMA ELEKTRİK's planned 1 320 MW coal plant at Amasra in Bartın province. Many other projects have been cancelled or delayed.

In 2018, 113.3 TWh (37.3%) of Turkey's gross electricity production of 303.6 TWh was generated from hard coal (22.4%) and lignite (14.9%). Of the remainder, 30.4% came from fossil gas, 19.7% from hydro, 6.5% from wind, 2.5% from solar PV, 2.3% from geothermal, with smaller contributions from biofuels, waste and oil. Turkey, through

its Vision 2023 strategy (*Hedef 2023*) that marks the 100th anniversary of the Republic, aims to increase its domestic electricity production by constructing more lignite-fired power plants and raising the shares of wind and geothermal power, setting a 30% capacity target for renewables. Construction of Turkey's first nuclear power plant, a 4 800 MW Russian-built plant at Akkuyu in the south of the country, began in April 2018, while a second 4 600 MW plant is planned with Franco-Japanese technology at Sinop in the north, and a possible third plant at İğneada near Istanbul with US-Chinese technology.

The national energy and mining policy (*Milli Enerji ve Maden Politikası*), announced in April 2017 by the Minister for Energy and Natural Resources, promotes the clean and efficient use of local coal for power generation with, for example, fifteen-year purchase guarantees, capacity mechanisms and reverse auctioned feed-in tariffs. With the hashtag *#BizimKömürümüzBizimEnerjimiz* (our coal, our energy), the ministry aims by 2023 to increase coal-fired power generation capacity from 17.3 GW to 30 GW.

Turkish coal production has grown by 1.2% per year since 1990, while coal supply has grown by 3.6% per year. This reflects steadily growing lignite production, and a rapid growth in coal imports of 7.1% per year since 1990. Coal is extracted by three state-owned enterprises – TÜRKİYE KÖMÜR İŞLETMELERİ (TKİ – Turkish Coal Enterprises), ELEKTRİK ÜRETİM (EÜAŞ – Electricity Generation Company) and TÜRKİYE TAŞKÖMÜRÜ KURUMU (TTK – Turkish Hard Coal Enterprises) – and a growing number of private companies, some under contract to the state-owned companies.

Hard coal

Turkey's main hard coal deposits are located in the Zonguldak basin, between Ereğli and Amasra on the Black Sea coast in north-western Turkey. Total hard coal resources in the basin are estimated at some 1.3 billion tonnes. The calorific value of hard coal reserves varies between 6 200 and 7 200 kcal/kg. This coal basin is the only region in Turkey where hard coal is extracted and it has a very complex geological structure which makes mechanised coal production almost impossible; hence, coal production is labour intensive and subsidised.

The state-owned TTK operates five deep mines in the Zonguldak coal basin and produced 686 thousand tonnes of saleable coal in 2018, supplying the 300 MW Catalağzı thermal power plant owned by BERKET ENERGY and other customers. Hard coal production from private mines totalled 415 thousand tonnes.

In 2018, Turkey imported 38.3 million tonnes of hard coal for thermal power plants, steel production, industry and domestic heating purposes – half from Colombia, one third from Russia, and smaller quantities from the United States (7.0%), Australia (5.3%) and South Africa (4.2%). Coal imports are expected to continue to increase in the future.

Turkey

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	1 338
Total resources lignite	Mt	16 259
Reserves hard coal	Mt	551
Reserves lignite	Mt	10 975

Primary energy production		2018
Total primary energy production	Mtce	59.0
Hard coal (saleable output)	Mt / Mtce	1.1 / 1.0
Lignite (saleable output)	Mt / Mtce	85.2 / 24.3

Saleable coal quality		
Hard coal net calorific value	kJ/kg	26 000-30 000
Lignite net calorific value	kJ/kg	8 665
Hard coal ash content	% a.r.	10.0-15.0
Lignite ash content	% a.r.	11.0-46.0
Hard coal moisture content	% a.r.	4.0-14.0
Lignite moisture content	% a.r.	6.0-55.0
Hard coal sulphur content	% a.r.	0.8-1.0
Lignite sulphur content	% a.r.	0.2-5.0

Coal imports / exports		2018
Hard coal imports	Mt	38.3

Primary energy consumption		2018
Total primary energy consumption	Mtce	208.4
Hard coal consumption	Mtce	37.0
Lignite consumption	Mtce	24.3

Power supply		2018
Total gross power generation	TWh	303.6
Net power imports (exports)	TWh	(0.6)
Total power consumption	est. TWh	254.3
Power generation from hard coal	TWh	68.2
Power generation from lignite	TWh	45.1
Hard coal power generation capacity	MW net	9 600
Lignite power generation capacity	MW net	10 100

Employment		2015
Direct in hard coal mining	thousand	14.251
Direct in lignite mining	thousand	37.596

Lignite

Lignite is Turkey's most important indigenous energy resource, with total resources of 16.3 billion tonnes of which 11.0 billion tonnes are considered economically recoverable. Deposits are spread across the country, the most important one being the Afşin-Elbistan lignite basin of south-eastern

Anatolia, near the city of Maraş where deposits are up to 58 metres thick and economic reserves are estimated to be around 7 billion tonnes. The Soma basin is the second-largest lignite mining area in Turkey. Other exploited deposits are located in: Muğla province with the Yeniköy lignite facility at Ören (Milas) and the South Aegean lignite facility at Yatağan; Kütahya province with the Seyitömer lignite facility at Seyitömer and the Tunçbilek mining centre at Tavşanlı; Çanakkale province with the Çan lignite facility; Bursa province with the Bursa lignite facility at Orhaneli; and Konya province with the Ilgın lignite facility. The quality of Turkish lignite is generally very poor and only around 5.1% of existing reserves have a heat content of more than 3 000 kcal/kg (12 500 kJ/kg).

The scale of Turkey's surface mining operations allows lignite to be produced at a relatively low cost, making it competitive with imported energy resources. In 2018, lignite output totalled a record 85.2 million tonnes, including from underground mines in the Soma, Tunçbilek and Beypazarı basins. Among the proposed new lignite mines in Turkey, those in Thrace, Eskişehir-Alpu and Afyon-Dinar would be underground; whereas those in Konya and Karamanmaraş would be opencast.

Privatisation of the Çayırhan coalfield was completed in 2017, beginning the process to privatise the five lignite fields at Trakya (Çerkezköy and Çatalca), Eskişehir Alpu, Kırklareli

Vize, Afyon Dinar and Konya Karapınar. In addition, four more lignite fields, including Afşin Elbistan C-D-E, will most likely be included in the privatisation programme.

In October 2018, the Ministry of Energy and Natural Resources announced that four lignite fields had been transferred from TKİ to İMBAT MADENCİLİK, FERNAS HOLDING, DEMİR EXPORT, and the construction group YAPI TEK, while three hard coalfields had been transferred from TTK to ERDEMİR MADENCİLİK, TUMAS, a subsidiary of BEREKET HOLDING, and the energy company EMSA ENERJİ.

Meanwhile, TKİ is working in collaboration with TÜBİTAK, the Turkish Scientific and Technical Research Council, and other international partners on research projects in the fields of lignite drying, coal gasification, coal-biomass combustion and liquid fuels production, some partly supported by the European Union.

Asphaltite

At Silopi near the Iraqi border, the third CFB unit of CİNER GROUP's 405 MW asphaltite-fired power plant was commissioned in 2015 by CHINA NATIONAL MACHINERY ENGINEERING CORPORATION.





Ukraine



The Ukrainian economy grew by around 3% each year from 2015 to 2018. However, the country remains poor by European standards with a *per capita* GDP that is just one quarter of the EU average on a purchasing power parity basis.

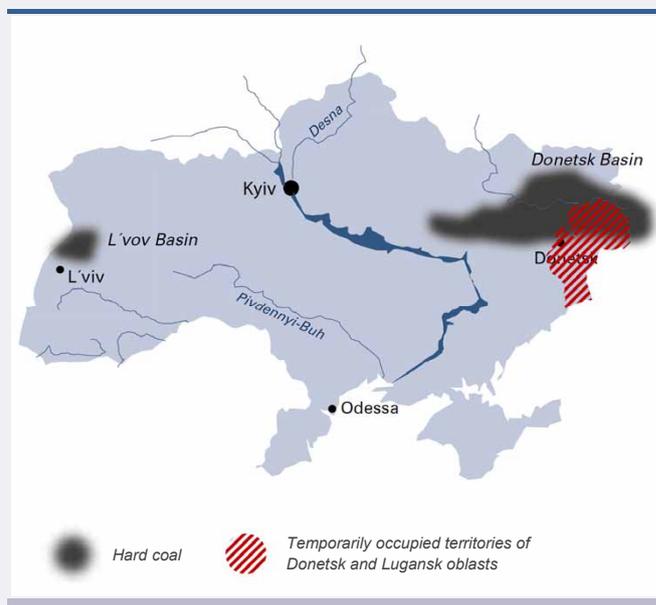
Ukraine has considerable reserves of coal and lignite, estimated at 34.4 billion tonnes in the Donetsk coal basin (by far the most significant), the Dnieper and Lviv-Volyn coal basins, as well as the Dnieper-Donetsk and Transcarpathian coal basins. It ranks seventh in the world after the United States, China, India, Russia and Australia in terms of proven coal reserves of which steam coal accounts for 70% and coking coal 30%. Exploitable reserves are competitive with imported coal.

The country also has large fossil gas reserves estimated at almost one trillion cubic metres – second only to Norway in Europe. These lie onshore, mainly in the Dnieper-Donetsk basin, offshore under the Black Sea, and as shale gas in the Donetsk and Kharkiv oblasts (Yuzivska gasfield) and in the Lviv and Ivano-Frankivsk oblasts (Olesska gasfield). Efforts to exploit these reserves were set back by the ongoing conflict in eastern Ukraine, but a new programme of deep drilling at the Machukhske gasfield in the Poltava oblast promises gas from almost 6 000 metres, adding to other conventional production which totalled 21.0 bcm in 2018.

One third (31.3%) of the country's total primary energy supply came from fossil gas in 2018, with coal (31.2%) and nuclear power (22.7%) also being important. Oil (11.4%) and renewable energy sources (3.4%), including hydro, had rather small shares in total energy supply. The *Energy Strategy of Ukraine to 2035*, adopted by the government in 2017, envisages a significant role for coal in primary energy supply: 22.0% in 2020, 16.1% in 2025 and 14.3% in 2030. The strategy aims to increase the share of renewable energy sources to 20% by 2035.

With a 29.5% share in 2018, coal is the second most important energy source for electricity generation in Ukraine after nuclear power which accounted for 54.5% of gross generation. Ukraine's fifteen nuclear reactors with a total capacity of 13.1 GW at four sites are operated by state-owned ENERGOATOM. Hydro power (7.7%) and fossil gas (6.4%) were also important in 2018, with other sources accounting for the remaining 1.9% of gross generation, mainly wind power and oil-fired power generation.

By 2025, the technical integration of the Ukrainian and continental European electricity and gas markets is planned, with cross-border transmission network capacity amounting to at least 15% of Ukraine's primary energy supply.



General data		2018
Population	million	42.2
GDP	€ billion	110.8
Per capita GDP	€/person	2 600

Hard coal

Hard coal deposits in Ukraine are characterised by their great depth – operations take place at 500 to 1 000 metres – and by thin seams of 0.8 to 1.0 metre. In 2018, coal was mined at forty-seven mines, of which forty-two produced G-grade bituminous coal. The rest produced K-grade coking coal and Zh-grade bituminous coal. Total coal production in 2018 was 26.1 million tonnes, comprising 21.6 million tonnes of steam coal and 4.6 million tonnes of coking coal.

Since spring 2014, the conflict in Donbas left Ukraine with little control over its coal-mining assets in the temporarily occupied territories of Donetsk and Luhansk oblasts where all anthracite mines are located. As of March 2017, Ukraine completely lost these assets. Production data for the lost coal mines in Donbas is not known, but some coal is likely exported via Russia and the breakaway region of Abkhazia.

The consumption of G-grade coal has grown as power plants designed for anthracite have been converted to use G-grade coal. This trend will likely continue in the future as Ukraine plans to completely replace anthracite with G-grade coal whose production is not at risk from hostilities. According to the *Energy Strategy of Ukraine to 2035*, increasing the

production of G-grade coal by 5 million tonnes would allow the complete replacement of anthracite in power generation.

Since the start of the military conflict, Ukraine has been importing steam coal for electricity production. In 2018, 5.5 million tonnes were imported: 4.1 million tonnes from Russia, 0.8 million tonnes from the United States and 0.3 million tonnes from South Africa. A further 15.9 million tonnes of coking coal were imported, bringing total coal imports in 2018 to 21.4 million tonnes.

In 2018, DTEK ENERGY, the largest private energy company in Ukraine, produced 24.1 million tonnes of coal. This was lower than previous years primarily due to the loss of T-grade and A-grade coal production from mines in the temporarily occupied territories, despite increased production of G-grade coal by the company. In Ukraine, DTEK ENERGY operates sixteen coal mines and five coal preparation plants through subsidiaries including DTEK PAVLOGRADUGOL in Dnipropetrovsk oblast and DTEK DOBROPOLYUGOL in Donetsk oblast where the company also operates the Belozerskaya mine.

Coal-fired power plants are owned and operated by three companies: DTEK ENERGY which has nine coal power plants with a total capacity of 16.3 GW, excluding Zuvivska power plant over which DTEK lost control in 2017, state-owned CENTRENERGO with three coal power plants (7.6 GW), and DONBASENERGO which operates a single 880 MW coal power plant.

The Ministry of Energy and Coal Industry of Ukraine is responsible for formulating coal policy. The main policy document for the coal industry remains government decree No. 733-r of 24 May 2017 on the "Concept for restructuring and developing the coal industry over the period to 2020". The aim of this concept is to take systematic measures to increase coal supply, raise productivity and transform the coal industry so that it is economically sustainable. At the same time, measures are planned to address the environmental and social problems in coal-mining regions and create a favourable investment climate for the privatisation of state-owned coal mines. According to the secretariat of the Cabinet of Ministers of Ukraine, there are 102 state-owned coal mines, but most are located in the temporarily occupied territories. Only thirty-three state-owned coal mines are controlled by the government and only four of these are profitable.

Coal is sold under contract between mining enterprises and consumers, and through DERZHVUGLEPOSTACH SE which was established by the government to trade coal produced at state-owned coal mines. The bulk of the saleable output from state-owned coal mines is distributed at fixed prices. Thus, loss-making mines are cross-subsidised by profitable mines, although losses are not fully covered.

In 2018, the average production cost at state-owned mines was 3 135 UAH/tonne. According to the ministry, the cost of producing 4 million tonnes of raw coal was UAH 9.4 billion, while the saleable output of 3 million tonnes was worth only

Ukraine

Coal resources and reserves		as at 1.1.2018
Total resources hard coal	Mt	81 045
Total resources lignite	Mt	7 717
Reserves hard coal	Mt	32 039
Reserves lignite	Mt	2 336

Primary energy production		2018
Total primary energy production	Mtce	128.0
Hard coal (saleable output)	Mt / Mtce	26.1 / 20.6

Saleable coal quality		
Hard coal calorific value	kJ/kg	19 250-28 500
Hard coal ash content	% a.r.	5.0-35.0
Hard coal moisture content	% a.r.	5.0-16.0
Hard coal sulphur content	% a.r.	0.8-5.0

Coal imports / exports		2018
Hard coal imports	Mt	21.4
Hard coal exports	Mt	0.1

Primary energy consumption		2018
Total primary energy consumption	Mtce	120.0
Hard coal consumption	Mtce	36.0

Power supply		2018
Total gross power generation	TWh	154.4
Net power imports (exports)	TWh	(6.1)
Total power consumption	TWh	122.1
Power generation from hard coal	TWh	47.8
Coal power generation capacity	MW	21 842

Employment		2018
Direct in hard coal mining	thousand	44.300

UAH 6.0 billion. To compensate for these losses and to pay for restructuring, state-owned coal mines receive money from the state budget. In 2019, the state budget again includes funds for coal industry restructuring: UAH 1.6 billion for the liquidation of unprofitable coal enterprises and UAH 660 million to support the construction of Novovolynskaya No.10 mine.

Private companies price coal based on supply and demand, having regard to international coal market price trends.

Lignite

During the 1990s, Ukraine produced 35 million tonnes of lignite from the Olexandria and Mokra Kalyhirka deposits in the Kirovohrad and Cherkasy oblasts, near the Dnipro River. Production in recent years has been immaterial.

United Kingdom



The United Kingdom has the second largest economy in the European Union. Following a referendum in June 2016, the country informed other member states that it would leave the Union – a process referred to as “Brexit”.

The UK is one of the largest energy consumers in Europe, third after Germany and France in the EU. It is by far the largest oil producer in the EU, accounting for two thirds of all oil production, and is also the largest producer of fossil gas. Together, the UK and the Netherlands account for two thirds of EU fossil gas production. At 36.0% in 2018, the UK’s energy import dependence is well below the EU average.

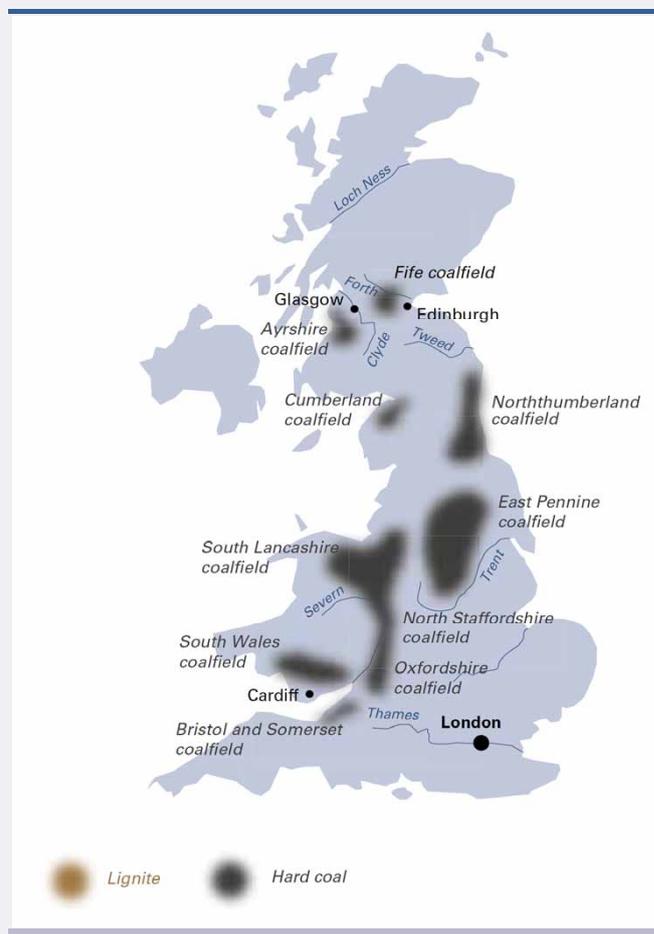
In 2018, UK primary energy production was 185.7 Mtce, with coal accounting for just 2.4 Mtce (1.3%). Total primary energy consumption was 273.5 Mtce, with fossil gas (39.2%) and oil (35.8%) having the largest shares, followed by biofuels and waste (9.1%) and nuclear (7.3%). Coal accounted for 4.4%; hydro, wind and solar totalled 3.4%.

After spending most of the previous twenty-five years as a net exporter of energy, the UK became a net importer in 2004. The gap between imports and exports has since increased and in 2011 imports of energy outstripped indigenous production for the first time. This trend looks set to continue as North Sea oil and gas reserves deplete. In 2014, the UK became a net importer of petroleum products.

Power generation in the UK is increasingly dependent on fossil gas while coal’s share has declined from 64.6% in 1990. In 2018, gross electricity supply was 332.9 TWh, dominated by gas (39.5%), renewables (33.0%) and nuclear power (19.5%). Coal saw a further rapid decline to just 17.6 TWh (5.3%), having been in the number one position as recently as 2015 when its share was 33.6%.

Following many closures of UK coal-fired power plants in recent years, mainly as a result of a carbon tax, the remaining plants in November 2019 are: RWE Aberthaw B (1 560 MW), Drax (two 660 MW units), SSE Fiddlers Ferry (1 455 MW), EPH Kilroot (560 MW), UNIPER Ratcliffe (2 000 MW) and EDF West Burton A (2 000 MW). The closures of Aberthaw and Fiddlers Ferry have been announced for March 2020. Two UK generators were granted state support to enable biomass conversions of their coal-fired power stations at Lynemouth and Drax (four units).

The UK power generation sector has little new conventional thermal capacity under construction or planned, with the main emphasis now on offshore wind. The 3 200 MW Hinkley Point C nuclear power plant, which is under construction, has been subject to repeated delays and major cost increases.



General data		2018
Population	million	66.3
GDP	€ billion	2 393.7
Per capita GDP	€/person	36 000

The UK carbon price support mechanism or carbon tax placed an additional levy on coal-fired generation from April 2013. It increased in April 2014 to £9.55 per tonne of CO₂ emitted and to £18.08 per tonne in April 2015. The levy is frozen around this level until 2021, but its trajectory thereafter is uncertain. It adds a tax of around £42 per tonne of coal to the cost of coal-fired generation, *in addition* to the cost of allowances under the EU emissions trading system (ETS) which reached €30 per tonne of CO₂ in summer 2019. A provisional £16 per tonne of CO₂ tax has been announced to replace the EU ETS in the event of a no-deal Brexit.

The UK capacity market is designed to ensure reliable generation is available to balance intermittent renewables.

Auctions are held four years ahead for the bulk of required capacity with a balancing auction one year ahead. These were suspended in late 2018, together with capacity payments, as a result of an illegality ruling by the European Court, but this issue has now been settled in the UK's favour. Clearing prices have been generally too low to bring forward the new gas-fired plants desired by government, whereas some existing coal plants have secured capacity contracts, and almost certainly would have closed otherwise. The policy intention since 2015 has been a phase-out of all coal-fired power stations by 2025.

Hard coal

The UK has identified hard coal resources of 3 910 million tonnes, although total resources could be as large as 187 billion tonnes. There are 33 million tonnes of economically recoverable reserves available at operational and permitted mines, plus a further 344 million tonnes at mines in planning. There are also about 1 000 million tonnes of lignite resources, mainly in Northern Ireland, although no lignite is mined. This significant coal resource base is, however, rendered largely irrelevant by policies designed to drive coal out of the energy mix and a hostile planning environment for surface mines.

The UK's remaining surface coal mines are located in central and northern England, South Wales and southern Scotland. Important surface mine coal producers include BANKS GROUP, CELTIC ENERGY, HARGREAVES SERVICES and MERTHYR (SOUTH WALES). The last major underground coal mine closed at the end of 2015 and the four remaining underground mines in England and Wales produced just 25 thousand tonnes in 2018. In March 2019, WEST CUMBRIA MINING was granted planning permission for Woodhouse colliery, a new coking coal drift mine with a potential output of 3 million tonnes per annum.

In 2018, hard coal supply totalled 12.7 million tonnes, with 2.6 million tonnes of indigenous production and 10.1 million tonnes of imports. Russia and the United States are the main sources, accounting for 81% of all imports. Indigenous production was almost entirely from surface mines. The UK exported 0.6 million tonnes of hard coal in 2018.

Coal consumption in 2018 was 11.9 million tonnes, of which 6.7 million tonnes were used for electricity generation, with the iron and steel industry being another large consumer. The residential heating market is now less than 0.5 million tonnes per year. Overall coal consumption has fallen by 75% since 2014, mainly as a result of government policies.

Even with the current, much smaller size of the UK coal market, indigenous production does not fulfil demand. Imports supplied virtually the whole of the coking coal market, as the UK no longer produces any significant quantities of coal suitable for use in coke ovens, a situation which would change if Woodhouse colliery opens. Nevertheless, UK steelmakers use locally produced coal for pulverised coal injection (PCI) at their blast furnaces.

United Kingdom

Coal resources and reserves as at 19.6.2019

Total resources hard coal	Mt	3 910
Total resources lignite	Mt	1 000
Reserves hard coal	Mt	377

Primary energy production 2018

Total primary energy production	Mtce	185.7
Hard coal (saleable output)	Mt / Mtce	2.6 / 2.2

Saleable coal quality

Hard coal net calorific value	kJ/kg	22 000-27 000
Hard coal ash content	% a.r.	14.0-18.0
Hard coal moisture content	% a.r.	10.0-12.0
Hard coal sulphur content	% a.r.	0.8-2.5

Coal imports / exports 2018

Hard coal imports	Mt	10.1
Hard coal exports	Mt	0.6

Primary energy consumption 2018

Total primary energy consumption	Mtce	273.5
Hard coal consumption	Mtce	12.0

Power supply 2018

Total gross power generation	TWh	332.9
Net power imports (exports)	TWh	19.1
Total power consumption	TWh	352.0
Power generation from hard coal	TWh	16.8
Hard coal power generation capacity	MW	12 300

Employment 2018

Direct in hard coal mining	thousand	647
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In early 2018, an end date for unabated coal-fired power generation (*i.e.* without CCS) of 1 October 2025 was announced by the UK government. Implementation will be via an emissions intensity limit of 450 gCO₂/kWh. This policy to phase out coal from the energy market has put pressure on the few remaining UK coal producers. The planning system also makes it extremely difficult to bring forward new mine projects, despite the demand for coal.

Total direct employment in the coal mining sector at the end of 2018 was 647 (130 at deep mines and 517 at surface mines). The industry's sole trade association is the Association of UK Coal Importers and Producers (CoallmP).





Other EU Member States and Energy Community stakeholders

Earlier chapters have reported on the key coal-producing countries of the EU and its neighbours. This chapter examines the other EU member states that all use coal to a greater or lesser extent. Also included, because of their alignment towards EU energy policy, are the contracting parties and observers to the Energy Community.

The 2005 treaty establishing the Energy Community requires contracting parties to implement important parts of the EU *acquis* on energy markets and environmental protection. It provides for the creation of a single energy market and a mechanism for the operation of networks in the South East European region which disintegrated following the conflicts of the 1990s. In 2011, the contracting parties agreed to implement the EU's third internal energy package by January 2015, although parties are not obliged to join the EU emissions trading system.

The Energy Community offers opportunities to owners of coal-fired power plants in South East Europe who will gain access to what is the world's largest electricity market. At the same time, plant owners will be required to make very substantial investments in pollution control equipment to meet stringent EU emissions legislation.

Figure 26
EU-28 Member States and Energy Community stakeholders



Source: Energy Community

** the 16 EU member states shown in bold on the map hold participant status



Armenia

Armenia is a landlocked country in the South Caucasus region, between the Black Sea and the Caspian Sea. In 2017, the majority of the country's energy supply of 4.6 million tonnes of coal equivalent was imported from Russia, including fossil gas and nuclear fuel for the 376 MW nuclear power plant at Metsamor, 30 km from the capital Yerevan. The main domestic energy source is hydroelectricity. Electricity generation of 7.8 TWh came from roughly equal shares of fossil gas, nuclear and hydro. Total hard coal resources are 317 million tonnes and small deposits of oil and gas exist, but have barely been exploited.



Austria

Austria has limited primary energy resources and is dependent on energy imports for around two thirds of its primary energy supply. Although no longer exploited, lignite resources total 333 million tonnes, lying mainly in western Styria, near Graz.

During the Monarchy, the country's energy demand was largely met with coal from Moravia and Silesia. After each world war, hard coal and lignite mining in Austria was expanded to replace production lost elsewhere; lignite output peaked at over 6 million tonnes in 1963 when hard coal output was 100 thousand tonnes. However, with increasing trade and the trend towards greater oil and fossil gas use, Austria's underground hard coal mines became less competitive and were closed during the 1960s. After more than two centuries, Austrian coal mining ended in 2006 with the re-cultivation of Oberdorf lignite mine.

Poland, the Czech Republic, the United States, Russia and Australia are the main coal exporters to Austria. In 2018, 3.5 million tonnes of coal were imported, mostly by the power and steel industries. The integrated steel works operated by VOESTALPINE at Linz has an annual crude steel production capacity of 5 million tonnes.

Electricity generation from coal was 3.6 TWh in 2018. However, on 2 August 2019 after almost thirty-three years, EVN ended coal-fired power generation at the 352 MW Dürnrrohr power plant in Lower Austria. This followed the closure in April 2015 of a 405 MW unit owned by VERBUND at the same site. A 35 MW (210 MW_{th}) waste-to-energy plant, completed in 2010, continues to operate at Dürnrrohr. At Mellach, VERBUND's 225 MWe coal-fired heat and power plant supplies the city of Graz with district heating. Some progress is being made on repurposing these coal power plant sites for hydrogen production, energy storage, renewable electricity generation and other activities.

Baltic States

The neighbouring states of Estonia, Latvia and Lithuania lie between the Baltic Sea and Russia. In 2004, these former Soviet states joined the EU and by 2015 all had joined the eurozone. To their south, the Russian enclave of Kaliningrad Oblast borders Lithuania and Poland.

Estonia, Latvia and Lithuania are poised to synchronise with the continental European electricity network in 2025, after gaining formal approval from the European Network of Transmission System Operators (ENTSO-E) in May 2019. Four DC links are already operational: LitPol, NordBalt, Estlink 1 and Estlink 2. The Baltic States will be desynchronised from the Russian IPS/UPS network, leaving Kaliningrad isolated unless DC links are built or the enclave joins the ENTSO-E system.

While no coal is produced in the Baltic States, all three countries consume modest volumes of imported coal, mostly from Russia, and offer important transit routes for Russian coal exported elsewhere.



Estonia is uniquely dependent on indigenous oil shale for its energy supply and enjoys an energy import dependency of just 4.1%, by far the lowest in the European Union. Large quantities of oil shale are used to generate competitively priced electricity at thermal power plants where it is combusted in much the same way as coal – either as a pulverised fuel in older boilers or in new circulating fluidised-bed boilers (CFBs).

Oil shale is a sedimentary rock containing up to 50% organic matter – Estonian oil shale extracted from the Baltic kukersite deposit has a heating value of 8 000-11 000 kJ/kg and 1.5% to 1.8% sulphur content. Once extracted from the ground, the rock can be either used directly as a fuel in power plants or processed into petroleum products.

Estonia's accessible oil shale reserves total approximately one billion tonnes. In 2018, 15.9 million tonnes of oil shale (4.4 Mtce) were mined by EESTI ENERGIA and VIRU KEEMIA GRUPP at underground mines and by EESTI ENERGIA, KIVIÕLI KEEMIA TÖÖSTUS and KUNDA NORDIC TSEMENT at surface mines. In underground mines, the traditional room-and-pillar mining technology is used. To improve recovery rates and reduce production losses, EESTI ENERGIA is developing a 700-metre long-wall mining face at an underground mine.

At the beginning of the century, oil shale production was trending upwards to meet growing demand for oil products produced from oil shale. In response, the Estonian government set in 2018 an annual limit for oil shale mining of 20 million tonnes.

In 2018, Estonia generated 10.7 TWh or 83% of its gross electricity supply of 12.9 TWh from oil shale and oil shale gas, a share that is expected to decrease in the future in line with government policy to increase the share of renewables. Around 75% of oil shale production is used for electricity and heat generation, notably at the EESTI ENERGIA Narva energy complex, comprising the 1 615 MW Eesti power plant and the 405 MW Balti power plant which also supplies heat to the town of Narva. Final commissioning of the adjacent 300 MW Auvere power plant was completed by GE in September 2018; it runs on oil shale, biomass, peat and oil shale gas. Four of the eight old units at the Eesti power plant were placed in standby reserve in 2019 due to the high price of allowances under the EU emissions trading system.

The environmental issues associated with oil shale exploitation are complex. With 45% incombustibles, the quantities of ash to store or recycle are large. All old pulverised-fuel boilers operate under limited lifetime derogations or have been upgraded to comply with the EU Industrial Emissions Directive. Balti 11 and Eesti 8 were repowered with CFB boilers and further units have been fitted with a novel integrated desulphurisation system, supplemented with lime injection and deNOx systems.

7 303 people are employed in the Estonian oil shale industry, of which around 3 000 are employed at mines.



Latvia transhipped 20.9 million tonnes of Russian coal exports in 2018: total coal exports from Russia to the EU in 2018 were 67.8 million tonnes. Shipments through the Baltic Coal Terminal at Ventspils were 3.6 million tonnes – lower than the terminal's annual capacity of 6.0 million tonnes as Russian ports were favoured by exporters. Ust-Luga, 120 km west of St. Petersburg, has become the largest port for coal in the region, although ice can hinder operations there as well as at St. Petersburg and Vyborg (Vysotsk) ports. Alternative routes for Russian coal exports include the ports at Tallinn (Muuga) in Estonia, Riga and Liepāja in Latvia, Klaipėda in Lithuania and Kaliningrad. Klaipėda port is strategically important as the northernmost ice-free port on the eastern coast of the Baltic Sea, with good infrastructure links to Russia. A proposal to expand the Russian Port of Primorsk to handle 25 million tonnes of coal per year would further reduce coal transshipments via the Baltic states.



The population of **Lithuania** has fallen by 17% since the country joined the European Union. Primary energy demand has thus declined to less than 10 million tonnes of coal equivalent in 2018. The country's energy mix is dominated

by imported oil and fossil gas, with only 264 thousand tonnes of imported coal in 2018.

The closure of the Ignalina nuclear power plant at the end of 2009 left a power generation gap in the Baltic region. This could have been filled by the proposed Visaginas nuclear power plant, but Lithuanians vote against this project in a 2012 referendum. Meanwhile, the 2 400 MW Ostrovets nuclear power plant, 50 kilometres from Vilnius, is under construction in Belarus, with pre-commissioning of the first unit taking place since April 2019. Commissioning of the second unit is scheduled to begin in 2020.



The **Kaliningrad** enclave is dependent on imported energy from Russia, although power is generated locally at the 900 MW gas-fired Kaliningradskaya power plant completed in 2010. To ensure power supply security, the 455 MW Pregolsky gas-fired unit was commissioned in March 2019 as the largest of four new plants with a combined capacity of 1 000 MW: the gas-fired Mayakovskaya and Talakhovskaya plants totalling 312 MW started operation in March 2018, while the coal-fired Primorsky plant should be completed by 2020. The latter will act as a backup. Gas is supplied via a single pipeline from Russia or from a new floating LNG storage and regasification unit. An underground gas-storage reservoir created in salt caverns provides additional security and will be expanded to hold 800 million cubic metres of gas. In May 2019, Kaliningrad's power grid was temporarily run in isolation to demonstrate its readiness for the future.

Although construction stopped in June 2013 of a new 2 400 MW nuclear power plant at Neman close to the Lithuanian border, it would remain a viable project if customers for its electricity could be found in Germany, Poland and the Baltic states. With three years of civil works completed, major pieces of power plant equipment delivered to the site are being kept in storage, although in 2017 the pressure vessel for unit 1 was sent to replace a damaged vessel at the Ostrovets 2 nuclear power plant in Belarus.



Belgium

In the 19th century, the Walloon coal mines of southern Belgium fuelled the country's industrial expansion. By 1917, coal mining had started in the north-east, around Limburg. National coal production peaked at 30 million tonnes in 1952 and was maintained at this level until the late 1950s. Output gradually declined as the Walloon and Limburg mines closed: Eisdien mine in 1987 and Belgium's last colliery at Heusden-Zolder in 1992. Remaining hard coal resources are estimated to be 4 100 million tonnes.

Coal imports totalled 4.1 million tonnes in 2018, coming mostly from Russia, Australia and the USA (more coal is imported into Antwerp for onward delivery to customers in other countries). Coal provides about 6% of Belgium's primary energy supply and is used mainly by the steel industry, notably by ARCELORMITTAL at Ghent. With the decommissioning of Ruien coal-fired power plant in 2013 and the conversion of other coal plants to fire biomass, coal consumption for power generation is no longer significant.

Gross electricity generation in 2018 totalled 75.0 TWh of which 28.6 TWh (38.1%) came from nuclear power stations, 23.8 TWh (31.7%) from gas-fired plants, 11.5 TWh (15.3%) from wind and solar, and 6.8 TWh (9.1%) from biomass and waste. Coal (3.1%), hydro (1.7%, mainly pumped hydro) and oil (0.2%) largely accounted for the remainder. Electricity imports have risen fivefold since 1990 to 21.6 TWh in 2018 due to capacity closures and lower power prices in France, Germany and the Netherlands. Belgium's largest power utility, ELECTRABEL – a subsidiary of ENGIE – has investments in coal-fired power plants in the Netherlands.



Cyprus

Cyprus imports small, but growing quantities of hard coal – 22 thousand tonnes in 2018 – for use mainly by VASSILIKO CEMENT WORKS. For its electricity needs, Cyprus is reliant on heavy fuel oil imports costing over 8% of its GDP. Invitations to tender for an LNG import facility were published in 2017. The Maltese government is promoting the 2 GW EuroAsia Interconnector with Israel and Greece which would further diversify energy supply. Significant gasfields in the Levantine basin are now being exploited and if political tensions in the region ease, then Cyprus could exploit the Aphrodite and Calypso gasfields.



Denmark

With the rise in its oil and gas production from the North Sea, Denmark became energy self-sufficient in 1999 and, in 2004, a net exporter of primary energy. The country is the third largest oil producer in Western Europe, after Norway and the UK. Gas production in 2018 was 4.1 billion cubic metres, less than half its 2005 peak. Oil and gas production are in decline and Denmark returned to being a net energy importer in 2013. In 2017, Denmark had the second lowest energy import dependence (11.7%) of any EU member state.

Danish energy supply has changed significantly as a result of efforts to promote renewable energy, combined heat and power (CHP) and energy efficiency. All political parties

reached an energy agreement in June 2018. This is expected to result in a greater than 100% share of renewables in electricity supply by 2030, while ensuring that at least 90% of district heating is based on energy sources other than coal, oil or gas by 2030. The government's long-term goal is for a climate-neutral Denmark by 2050.

In 2018, around 70% of gross electricity generation was from renewable sources, predominantly from wind and biomass. The relatively high use of wind turbines for electricity generation (46.3% in 2018) enhances security, but poses balancing challenges. The Danish electricity system has connections to Norway, Sweden and Germany: Denmark's net electricity imports in 2018 were 5.2 TWh or 15.4% of supply. As part of the integrated Nordic electricity market, Denmark's thermal power plants play an important role in balancing not only wind power, but also hydro power from Norway and Sweden which depends on annual precipitation.

Coal-fired power plants in Denmark have a total generation capacity of 3.7 GW; many are multi-fuelled with biomass. The majority state-owned ØRSTED runs Asnæs (827 MW), Avedøre (262 MW), Esbjerg (417 MW) and Studstrup (700 MW) power plants. Most units at these plants can burn biomass – wood pellets or straw – the result of ØRSTED's bio-conversion programme for all its coal- and gas-fired CHP units which will see coal use end by 2023. The 319 MW Amager power plant is owned by HOFOR, the city of Copenhagen's municipal heat and power company. HOFOR plans to replace its coal use in 2020 when a new biomass unit is commissioned – BIO4 has been under construction since September 2016. Fyn power plant (409 MW) includes a straw-fired boiler and a coal-fired unit, with the latter set to close by 2025. Finally, since 2015, the 410 MW Nordjylland plant has been owned by the local municipality's utility company, AALBORG FORSYNING.

Nordjyllandsværket 3 is one of the world's most efficient coal-fired power plants. Its supercritical boilers and steam turbines result in a very high electrical generation efficiency of 47% and, with heat supply, the overall efficiency can exceed 95%.

Denmark has no indigenous coal resources. In 2018, the country imported 2.8 million tonnes of coal, mostly from Russia, South Africa and Colombia. Around 95% of this coal was used for electricity and heat generation. Having peaked in 1984 at 96%, the share of coal in power generation has fallen to 21.4% in 2018 (6.4 TWh) and will be gradually phased out by 2030 under the June 2018 agreement.



Finland

With its lack of fossil fuel resources, Finland had an energy import dependency of 44.0% in 2017. Finnish energy policy thus aims to maximise energy supply diversity. One third of electricity production is from nuclear and Finland's fifth

nuclear reactor, a 1 600 MW EPR, is under construction at Olkiluoto with commercial operation by TVO scheduled for July 2020. In June 2015, TVO shareholders resolved not to proceed with plans for a second new unit at Olkiluoto. Locally produced peat (6.4 million tonnes in 2018) is used as a fuel, mainly at dedicated district heating plants and at combined heat and power (CHP) plants. Peat accounted for 4.8% of gross electricity generation in 2018.

Finland is one of the world leaders in renewable energy, especially bio-energy. Renewable energy sources provide over 40% of Finland's total primary energy supply and accounted for over 35% of power supply in 2018. Nevertheless, coal and fossil gas remain important fuels for CHP and district heating plants in Finland. Coal's share in conventional generation is falling. In 2018, gross electricity generation from coal was 6.6 TWh (9.4% of total), with an important contribution from the 565 MW Meri-Pori coal power plant at Tahkoluoto in Pori. The efficiency of heat and power production in Finland is very high; approximately one third of electricity is produced at CHP plants which operate with overall efficiencies of 80% to 90%. These plants are used widely by industry and for both district heating and cooling.

Annual coal imports to Finland were 4.0 million tonnes in 2018: 2.7 million tonnes of steam coal for energy production and 1.3 million tonnes of coking coal for the steel industry. Small quantities of coal are used by the cement industry. All coal is imported, steam coal entirely from Russia and coking coal mostly from North America.

Finland's *Integrated National Energy and Climate Plan* is based on two government reports: the *National Energy and Climate Strategy for 2030* and the *Medium-term Climate Change Plan for 2030*. The strategy accounts for Finland's special features, including its cold climate, long transport distances, extensive energy-intensive industry and domestic raw material resources, especially forest biomass. To implement the strategy, Finland has taken many measures, in particular energy-efficiency and energy-saving measures, and plans to increase the share of renewable energy in final consumption to 50% by 2030. As well as the increased share of renewable energy, the government aims to maintain the position of peat as an indigenous energy resource, but to diminish the share of fossil fuels, in particular coal. Therefore, the government has tabled legislation to ban coal use for energy from 1 May 2029, except when used as an emergency backup fuel. Many coal-fired power plants are already phasing out of coal.



France

Coal resources in France are estimated by the French geological survey (BRGM) to be 425 million tonnes of hard coal and 300 million tonnes of lignite. Hard coal mining in France ended in April 2004 with the closure of the last

operational mine, La Houve in the Lorraine region. The state-owned coal company Charbonnages de France ceased activity at the end of 2007. Today, all coal is imported.

In 2018, coal imports amounted to 13.5 million tonnes, including 4.6 million tonnes of coking coal from Australia and the United States. Coal is delivered through the ports of Dunkerque, Le Havre, Rouen, Montoir and Fos-sur-Mer, as well as via the ARA ports. Coal consumption amounted to 13.2 million tonnes in 2018, of which an estimated 3.9 million tonnes were consumed for power generation.

Gross power generation in France was 580.7 TWh in 2018, with 71.1% of this total generated at nuclear power plants. Conventional thermal power generation contributed 9.9%, hydro 11.2%, wind 4.9% and solar PV 1.8%. Coal-fired power generation accounted for 1.6% of the total while the overall share of renewables was 18.9%.

In compliance with the Large Combustion Plants Directive, the number of operational coal-fired power generation units in mainland France was reduced to five in 2015. According to the *Programmation pluriannuelle de l'énergie* published in November 2018, the French government wants to end coal-fired power generation by the end of 2021.

Today, the largest coal power plants are located adjacent to ports at Cordemais (2 × 600 MW) and Le Havre (600 MW). Both are owned by EDF which plans to close the Le Havre plant in spring 2021 and convert the Cordemais plant to biomass by spring 2022. In July 2019, UNIPER announced the sale to EPH of all its assets in France, including the 600 MW Émile-Huchet unit 6 at Saint-Avoid in Lorraine and the 600 MW Gardanne unit 5 in Provence, as well as a 150 MW unit converted to biomass known as "Provence 4 Biomasse" which was initially commissioned in 2017, but has run only intermittently since then. There are also three 100 MW coal-fired power plants in French overseas territories: one in Guadeloupe and two in Réunion. During sugar campaigns, these plants also use renewable bagasse.

The French steel industry consumes important volumes of coal – around 4.5 million tonnes for coke making and 3.0 million tonnes at integrated steel works in 2018. ARCELORMITTAL plants at Dunkerque and Fos-sur-Mer are the biggest coal consumers in this sector.



Georgia

Lying in the Caucasus region between Europe and Asia, Georgia has significant hard coal reserves of 201 million tonnes plus resources of 700 million tonnes in the Tkibuli-Shaori and Tkvarcheli deposits. The Akhhaltsikhe lignite deposit near Vale has reserves of 76 million tonnes, currently not exploited. Coal production in Georgia peaked at 3 million tonnes in 1958, but by 2000 production had collapsed to

almost zero. Following the “Rose Revolution” of 2003 and conflict with Russia in 2008, the coal industry was revitalised. In 2018, Georgia produced 219 thousand tonnes of coal from mines at Tkibuli and imported 145 thousand tonnes of coal mainly for industrial use.

Coal provided 6.2% of Georgia’s total primary energy supply of 6.8 million tonnes of coal equivalent in 2017. Fossil gas is the main primary energy source (41.4%), followed by oil (27.5%), hydro (16.7%) and biomass (7.7%). Wood consumption, mainly for space heating, water heating and cooking, has led to deforestation problems. Hydro power plants are the most important source of electricity, producing 79.9% of the 11.5 TWh total in 2017. Thermal power plants fired on imported fossil gas from Russia and Azerbaijan accounted for 19.1%. Coal and wind power were insignificant, but electricity imports added 1.5 TWh to supply in 2017. There is potential to expand hydro and wind power generation for export. To this end, the 2 x 350 MW Black Sea Transmission Network HVDC link with Turkey was completed in December 2013 with support from the European Investment Bank and the German government.

SAKNAKSHIRI or Georgian Coal, a subsidiary of the GEORGIAN INDUSTRIAL GROUP (GIG), owns and operates the underground coal mines Dzidziguri and Mindeli in the city of Tkibuli, the only coal mines in Georgia. These mines supply cement works at Kaspi and Rustavi as well as the ferroalloy industry. The mines employed 1 400 workers, but mining was suspended following a fatal accident in July 2018. With GIG’s license covering more than 331 million tonnes of resources, the Tkibuli coal mining development plan envisages raising output to 550 thousand tonnes per year once safety issues have been addressed by a new owner, the STEEL INTERNATIONAL TRADE COMPANY. GIG operates a small coal-fired power plant with a capacity of 13 MW at Tkibuli.

Coming Into force in July 2016, the Association Agreement between Georgia and the European Union includes a “deep and comprehensive free trade area”. The country is also a party to the Energy Community Treaty and, in May 2019, signed a co-operation agreement with the European Network of Transmission System operators for Electricity (ENTSO-E).

In the breakaway republic of Abkhazia, the Turkish operator TAMSAS produced good quality coal at an opencast mine in the Tkvarcheli coalfield until 2018 when the exploitation of deeper parts of the 20 million-tonne reserve became uneconomic. The coal terminal at Ochamchire port has been greatly expanded over recent years to handle transshipments.



Ireland

In recent years, the Irish economy has made a strong return to growth, following the sharp economic downturn that began with the 2008 global financial crisis. Energy use has grown, but is still below pre-crisis levels.

Ireland has no indigenous coal production, although 3.9 million tonnes of peat were harvested in 2018 for energy use, accounting for 16.0% of total indigenous energy production. Coal imports totalled 1.3 million tonnes in 2018, all steam coal and mostly from Colombia. Coal and peat use have declined and together accounted for 10.3% of Ireland’s total primary energy supply in 2018 which was 19.7 million tonnes of coal equivalent. They are used mainly for power generation.

BORD NA MÓNA is the leading peat producer and distributes solid fuel products within the residential heating market in Ireland. The company’s peat briquettes are popular due to their low sulphur emissions and competitive price. BORD NA MÓNA plans to end all of its peat harvesting operations by 2027.

Since 2001, peat-fired power plants were supported by a public service obligation as, with their use of indigenous fuel, they contribute to security of electricity supply. However, this support expired in 2015 in the case of the Edenderry power plant and in 2019 in the cases of the West Offaly and Lough Ree plants. In addition, the government has set a 30% biomass dilution target for peat used as a fuel. For example, the 128 MW Edenderry power plant was designed and built to fire peat, but is now co-fired with a mixture of peat and biomass from forests and energy crops. The use of biomass commenced in 2008 and has increased steadily. In 2018, 6.8% of Irish electricity was generated from peat and 1.1% from biomass.

Ireland has one coal-fired power plant, at Moneypoint in County Clare operated by the ELECTRICITY SUPPLY BOARD (ESB). At 915 MW, it is Ireland’s largest power station, having been fully commissioned in 1987 as part of a fuel diversification strategy. Significant refurbishments have been carried out by ESB to meet environmental standards, including a €368 million investment in pollution control equipment to meet EU regulations on NO_x and SO₂. Moneypoint is expected to operate until 2025. Indeed, the Irish government’s policy is to cease using coal for electricity generation by 2025 and peat by 2030.

Fossil gas was the dominant fuel for power generation in 2018 with a 51.8% share of generation, followed by wind (27.3%) and coal (7.0%). The Corrib offshore gasfield came onstream in late 2015, adding 3.6 million tonnes of coal equivalent to Irish energy production in 2018 and reducing the country’s gas import dependency to 38.8%. Overall, Ireland had an import dependency of 63.8% in 2018, excluding aviation and marine bunkers, compared with an EU average of around 55%.

Although a single electricity market covers the Republic of Ireland and Northern Ireland, and a 500 MW interconnector links this to the UK mainland, the island market is quite isolated. With wind power generation growing strongly (22% per year since 2000), the island grid increasingly relies on conventional power plants during periods of low wind and high demand. To ensure sufficient dispatchable capacity, the first auction under a capacity remuneration mechanism (CRM) was held in December 2017.



Italy

Italy has a very low demand for coal. In 2018, coal covered only 5.8% of primary energy supply which totalled 215.6 million tonnes of coal equivalent, this being 19.2% below its 2005 peak. Emissions of CO₂ from fossil fuel use fell even more – by 31.1% since 2005 – as the Italian energy mix shifted towards fossil gas and renewable energy sources. Since 1990, Italy's greenhouse gas (GHG) emissions have fallen by almost 20%.

The only coal reserves and resources in Italy are located in the Sulcis-Iglesiente basin, in south-west Sardinia, totalling an estimated 610 million tonnes. Mining activities were stopped there in 1972, but restarted in 1997 with many environmental improvements. Saleable production in 2018 was an estimated 243 tonnes, although for economic reasons this was left underground. In accordance with EU state-aid law, CARBOSULCIS, owned by the Regional Government of Sardinia, closed Monte Sinni mine at Nuraxi Figus in December 2018. The agreed closure plan foresees work on safety and environmental restoration, renewable energy projects and research activities aimed at the industrial redevelopment of the site though to 2027.

Italian electricity production is uniquely fragile, with no solid baseload nuclear or coal power. On average, G7 countries rely on coal and nuclear for 43.8% of their power generation. In Italy, the comparable figure is just 10.5%, all from coal. This means an overdependence on fossil gas which accounted for 44.6% of gross power generation in 2018, followed by hydro (17.0%), solar (7.8%), wind (6.0%) and oil (3.7%). Biofuels, energy from waste and geothermal accounted for the balancing 10% of electricity production. After growing strongly under five *Conto Energia* schemes which ended in 2013 and other green subsidies, the share of new renewables (solar, wind and biofuels) stagnated over the five-year period to 2018 at around 20%. Net electricity imports of 43.9 TWh in 2018 met over 13% of gross electricity supply.

In a decisive June 2011 referendum, Italian voters rejected government proposals to restart a nuclear programme that was abandoned following an earlier referendum held after the 1986 Chernobyl disaster.

Italy had an overall energy import dependence of 77.0% in 2017, rising to 92.3% in the case of fossil gas. In 2018, fossil gas imports came mainly from Russia (48%), Algeria (27%) and Qatar (10%). Italy also imported 10.8 million tonnes of steam coal in 2018 and 3.3 million tonnes of coking coal, the latter including PCI coal. The main supply countries were Russia, the United States and Colombia. In October 2017, ENEL sold its 10% shareholding in PT BAYAN RESOURCES of Indonesia which produced 20.9 million tonnes of coal in 2017 and 28.9 million tonnes in 2018. Coal

imports into Italy peaked in 2008 at 25.1 million tonnes and have since fallen because of the forced closure of the 660 MW Vado Ligure coal-fired power plant owned by TIRRENO POWER, the closure of a further three coal power plants (Brindisi Nord, Genoa and "Pietro Vannucci" Bastardo in Umbria) and ongoing difficulties at the ARCELORMITTAL steel plant in Taranto.

Mainland Italy now has just six coal-fired power plants: ENEL Torrevaldaliga Nord on the coast near Rome (1 320 MW), ENEL Andrea Palladio-Fusina near Venice (960 MW), ENEL Brindisi Sud "Federico II" (2 640 MW), A2A Monfalcone (336 MW), ENEL "Eugenio Montale" at La Spezia (600 MW) and A2A Brescia (70 MW).

Following their modernisation and conversion from fuel oil to coal, Italy has some of the best-performing coal-fired power plants in Europe. The Torrevaldaliga Nord power plant attains a net efficiency of 45%, thus matching the world-leading performance of plants in Japan. It is estimated that, by 2038, all the modernisation investments at Italian coal power plants will have been fully amortised. However, Italy's coal-fired power plants are destined to reduce their output and close before then.

On 8 January 2019, the Italian government presented to the European Commission its draft Integrated National Energy and Climate Plan (PNIEC). In it, great emphasis is placed on an acceleration of decarbonisation policies and the promotion of renewable energy sources as part of an economy-wide transformation. For coal, the plan confirms what was proposed in the National Energy Strategy of 2013, *i.e.* the closure of all Italian coal-fired power plants by 2025.

To protect the competitiveness and security of the Italian power system, the planned coal phase-out is to be gradual and closely connected to power plant replacement and extension of power transmission, distribution and energy storage infrastructure. However, without nuclear and coal, and with the emphasis on more expensive renewables, Italy faces an uncompetitive power generation mix that will contribute to weaker industrial activity and higher electricity prices for households. The closure of coal plants will exclusively benefit oligopolistic gas producers, such as GAZPROM, the largest Russian company, and SONATRACH, the Algerian state-owned oil company.

Absent appropriate actions, there are serious issues with the coal phase-out plan. For example, the closure of the two coal-fired power plants on Sardinia (640 MW EPH Fiumesanto and 340 MW ENEL Sulcis "Grazia Deledda") appears to be technically impossible as they account for 70% of the island's power production. The same situation affects Italy's central-northern grid which already experiences security and adequacy problems.

Moreover, from an environmental point of view, in a world where coal will continue to be used for power generation, the coal phase-out plan will be of little climatic benefit as the CO₂ emissions from coal-fired power generation in Italy accounted for just 0.06% of global GHG emissions in 2018.



Luxembourg

In 1952, when its prosperity was based on steelmaking, the Grand Duchy of Luxembourg was chosen as the site of the European Coal and Steel Community, marking the start of the institutional development that led to the European Union. Luxembourg continues to enjoy strong economic growth, of over 2.5% per year, and a growing population.

With an energy-import dependence of 95%, Luxembourg is among the most import-dependent EU member states, after Malta and Cyprus. The country has only one major power generation site: the RWE-operated 1 300 MW pumped-storage hydro plant at Vianden. A 385 MW combined-cycle gas turbine plant at Esch-sur-Alzette operated by TWINERG was prematurely closed in 2016 for economic reasons. Luxembourg thus generates only one quarter of its electricity needs (excluding pumped hydro) and imports the rest, mainly from Germany. It is part of the DE/AT/LU bidding zone and, since October 2017, the BeDeLux interconnector between Belgium, Germany and Luxembourg has been in operation, while a new DeLux interconnector is planned.

The steel industry's conversion to electric-arc furnaces (ARCELORMITTAL steel works at Esch-Belval and Differdange) has practically eliminated Luxembourg's coal use and means the sector accounts for around 40% of total electricity demand. Coal is used today mainly for the production of cement at the CIMALUX Rumelange plant. All coal is imported – 63 thousand tonnes in 2018 – and makes only a small contribution to the country's primary energy supply. Yet, in 2017, Luxembourg had the highest *per capita* greenhouse gas emissions by far (20.2 tCO₂e/capita) of all the EU member states.



Malta

Malta has no conventional energy production and reports no coal consumption. Until 1995, coal was imported for power generation. The inefficient 90 MW Marsa and 444 MW Delimara 1 power plants, both running on heavy fuel oil, were decommissioned in 2015 and 2017 respectively. To replace them, ENEMALTA PLC built Delimara 4 – a 205 MW combined cycle gas turbine plant supplied from a floating LNG import facility. In addition, the 153 MW Delimara 3 power plant, commissioned in 2012 and comprising eight diesel engines and a steam turbine, has been converted to run on fossil gas. For security of supply reasons, four engines can also run on diesel oil. A 120-kilometre 200 MW interconnector to Sicily was commissioned in 2015.



Moldova

The Republic of Moldova does not produce coal or lignite. It imports small quantities of hard coal for use by industry and in heating plants – 142 thousand tonnes in 2018. Coal represents less than 3% of gross inland energy consumption.

Electricity is imported from Ukraine, but mostly from the 2 520 MW Kuchurgan thermal power plant located on the shores of Cuciurgan reservoir in the Transnistria region. This twelve-unit plant can run on coal, fossil gas or fuel oil. In 1990, over 4 million tonnes of coal were consumed there, but since the late 1990s the station has used virtually no coal. Although the Moldovan electricity grid is synchronised with Russia's (IPS/UPS), some units at Kuchurgan could be synchronised with Continental Europe to allow exports of electricity via Romania. Owned by MOLDAVSKAYA GRES, a subsidiary of the Russian company INTER RAO UES, the plant is in need of further refurbishment and only operated at 17.8% of its installed capacity in 2018.

The remaining supply of electricity is covered by two gas-fired combined heat and power (CHP) plants in Chisinau (64 MW + 240 MW), a 20 MW CHP plant in Balti, ten CHP plants at sugar refineries (totalling 98 MW) and two hydro power plants: the 48 MW Dubăsari plant and another 16 MW plant at Costesti.



The Netherlands

Hard coal mining dominated the South Limburg area of the Netherlands from the late 19th century to the mid-1970s. The coalfield, located in the south of the country close to the German and Belgian borders, was mainly exploited from underground mines. Coal mining in the Netherlands ended in 1974 when the private Oranje-Nassau Mine I and Julia coal mines closed. Emma mine, the last state-owned mine, was closed in 1973.

Since around 1915, lignite was extracted at opencast mines near the towns of Eyselshoven and Hoensbroek. The deposits are located on the north-west fringe of the large Rhenish lignite basin to the west of Cologne in Germany. Lignite mining ended in 1968 with the closure of the Carisborg site.

The Netherlands is home to the main ports for the transshipment of coal imports into Europe. The ports at Amsterdam and Rotterdam, along with Antwerp port in Belgium, together make up the ARA trading area for imported steam coal and coking coal in north-west Europe.



In 2018, 11.3% of the Netherlands' primary energy supply was provided by coal, all imported. The country imported 13.0 million tonnes in 2018, comprising 8.8 million tonnes of steam coal and 4.2 million tonnes of coking coal. The main supplier countries were Russia, the United States, Australia and Colombia.

Most imported coal is used for coal-fired power generation: coal had a 26.3% share of the 113.5 TWh gross electricity generation in 2018, including the use of coke oven gas and blast furnace gas at steelworks. The fleet of Dutch coal power plants is very modern and includes: UNIPER 1 070 MW Maasvlakte 3 plant in the Rotterdam area, ENGIE 800 MW Maasvlakte plant, commissioned in early 2015, and RWE 1 560 MW Eemshaven plant near Groningen. All three of these plants employ the latest supercritical steam technologies to achieve high energy efficiencies. Older coal-fired plants operate at Geertruidenberg (600 MW Amer) and Amsterdam (630 MW Hemweg 8). Some plants co-fire coal with biomass, to a greater or lesser extent. Ownership is very diverse, with ESSENT (a subsidiary of RWE), ELECTRABEL (a subsidiary of ENGIE), UNIPER and NUON (a subsidiary of VATTENFALL) being the major players in coal-fired power generation.

Under the Climate Act of 2018, the Netherlands has committed to reduce its greenhouse gas emissions by 49% by 2030 and by 95% by 2050, compared with 1990 levels. In its Climate Agreement of June 2019, the national coalition government agreed to phase out coal-fired electricity generation by 2025/2030, with the first plant to be closed by 2020 and the three modern plants at the beginning of 2030. The government will introduce a targeted carbon levy on industry, starting at €30 per tonne of CO₂ in 2021 and rising to €125-€150 per tonne in 2030, including the EU ETS allowance price, on emissions that exceed a fixed reduction path. A minimum CO₂ price for electricity production will also be introduced.

In response to these political developments, ENGIE agreed the sale in April 2019 of its Maasvlakte and other plants to RIVERSTONE HOLDINGS of the United States for an average of €85 per kilowatt (compared with Maasvlakte's investment cost of €1 500 per kilowatt in 2009). In the case of NUON, the Dutch government has ordered the company to close Hemweg 8 by the end of 2019. Meanwhile, RWE will convert its Eemshaven plant to co-fire biomass.

The Dutch government has supported CCS demonstration projects, including the ROAD project (Rotterdam Opslag en Afvang Demonstratieproject). Under the Climate Agreement, subsidies will be offered to CO₂-reducing options in industry, such as CCUS.

TATA STEEL owns the IJmuiden integrated steel works which has a crude steel annual production capacity of 7 million tonnes and consumes most of the coking and PCI coal imported by the Netherlands. A pilot project at IJmuiden to demonstrate the Hisarna iron-making process aims to reduce CO₂ emissions from steelmaking.

Norway

Norway, Europe's northernmost country, opted to stay out of the European Union by referendum in 1994, but supplies significant volumes of oil and fossil gas to the Union. In 2017, 25.3% of EU gas imports came from Norway which is the world's third largest gas exporter after Russia and Qatar. Hydro power plants supplied 95.0% of Norway's gross electricity generation in 2018 and the country is a significant net exporter of electricity: 6.9% of gross production.

In 2018, Norway produced 145 thousand tonnes of hard coal and imported 746 thousand tonnes of steam coal for use in the metallurgical industry, chemicals production and cement manufacture. 113 thousand tonnes of steam coal were exported in 2018.

Norway has access to deposits of good quality, high calorific value coal at Svalbard lying within the Arctic Circle where resources are estimated to total 90 million tonnes, with reserves of 1.0 million tonnes.

Coal mining on Spitsbergen, the largest and only permanently populated island of the Svalbard archipelago, has served multiple government goals, not all related to energy. Without continued peaceful economic activity on Spitsbergen, Norwegian sovereignty might be weakened by foreign economic activity as the Svalbard Treaty of 1920 grants rights to all thirty-nine signatories. The state-owned STORE NORSKE SPITSBERGEN KULKOMPANI (SNSK) was established in November 1916 and owns three drift mines employing 124 people: Svea Nord longwall mine located 60 kilometres south of Longyearbyen, Lunckefjell mine north-east of Svea, and Gruve 7 room-and-pillar mine in the valley of Adventdalen near Longyearbyen. There is no road connection between Longyearbyen and Svea, so all personnel transport is by plane or snowmobile in the winter. Spitsbergen's 10 MW coal-fired combined heat and power plant takes coal from Gruve 7 and a decision must be taken soon on its replacement. At NOK 3-5 billion, an underwater cable from the mainland is possible, but very expensive.

Political guidance for SNSK's operations is laid down in a government White Paper (No. 22 to the Storting, 2008-2009), establishing that SNSK and its coal mining operations are – and will remain – important for maintaining a Norwegian community in Longyearbyen on Spitsbergen.

The majority of coal production in the past was carried out in Longyearbyen. From 2000 until 2015, the principal activities of SNSK were located at Svea. In 2007, total coal production on Spitsbergen was 4.0 million tonnes. However, mining at Svea Nord and preparatory works on the new mine at Lunckefjell were put on hold by the Norwegian government in January 2015 as low coal prices had led to a difficult economic situation. Extensive cost reductions and a

significant downsizing of SNSK continued in 2016. To bring in some revenue from tourists, Gruve 3 which closed in 1996 re-opened as a museum with underground tours.

In 2017, the Norwegian government decided to permanently stop coal mining activities at Svea and Lunckefjell. The area has to be cleared and all the mining equipment is to be sold. This process will take several years and equipment will be sold as it becomes available.

In the future, the only mining will be at Gruve 7, directed by STORE NORSKE GRUVEDRIFT AS, with annual coal production of around 140 thousand tonnes.

In co-operation with SINTEF and the Arctic University of Norway, SNSK has been engaged in research projects supported by the Norwegian Research Council on alternative uses for coal and processed coal with the aim of increasing the value of Svalbard coal.

Norwegians are conscious that end-use emissions from the country's exports of oil and gas are substantial. In response, Norway has been a pioneer in the field of carbon capture and storage: at the Sleipner gasfield and at the Snøhvit LNG project. The CO₂ Technology Centre Mongstad was inaugurated in May 2012 to develop CO₂ capture technologies for both gas- and coal-fired power plants.



Portugal

Portugal has limited indigenous energy resources, leading to a 79.9% energy-import dependence in 2017. Its last coal mine, Germunde in the Castelo de Paiva region, was closed in 1994, leaving behind national reserves of 3 million tonnes. The country also has lignite resources of 66 million tonnes.

In 2018, 51.1% of Portugal's electricity production came from renewable energy sources: hydro, wind, biofuels, solar PV, geothermal and wave. Nevertheless, conventional thermal power generation remains crucial to cover those periods when wind power is not available and to balance the annual variations in hydro power production on the Iberian Peninsula. Coal-, oil- and gas-fired power generation together accounted for 48.0% of gross electricity production in 2018. Coal's share of gross production was 20.2%.

Imported coal accounted for 12.4% of total primary energy supply in 2018 with imports of 4.7 million tonnes coming from Colombia and the United States. Most of this coal was consumed at Portugal's two coal-fired power plants located at Sines (1 256 MW) and Pego (628 MW). Both are fitted with flue gas desulphurisation and selective catalytic reduction to reduce emissions of sulphur dioxide and NO_x.

Sines power plant, adjacent to a coal import terminal on the Atlantic coast, was built in the late 1980s and is owned by

ENERGIAS DE PORTUGAL (EDP). The inland Pego power plant, about 120 kilometres north-west of Lisbon, was fully commissioned in 1995 and is now owned by TRUST ENERGY, a 50%-50% joint venture between ENGIE and MARUBENI. Around 650 are employed at the two power plants and the coal port.

In November 2017, the Portuguese Government announced its commitment to retire all coal-fired power plants by 2030. Since 1 January 2018, coal used to produce electricity in Portugal has been taxed at a rate corresponding to 10% of the tax on petroleum and energy products, plus a carbon tax corresponding to 10% of the additional levy on CO₂ emissions. These rates will be increased each year to reach 100% in 2022.

South East Europe

The countries of South East Europe not covered in earlier chapters include Albania, Bosnia and Herzegovina, Croatia, Kosovo, North Macedonia and Montenegro.



Albania produces very small volumes of lignite, about 296 thousand tonnes in 2018, and imports further volumes to meet demand totalling an estimated 430 thousand tonnes at industrial and residential customers, including the Antea cement works. With total resources of 727 million tonnes, the country has the potential to support a much larger coal mining industry. During the 1980s, annual coal production of around 2.4 million tonnes came from mines in central Albania: at Valias, Manëz and Krrabë; at Mborje and Drenovë in the Korçë district; in northern Tepelenë at Memaliaj; and at Alarup to the south of Lake Ohrid.

The country produces all of its electricity at hydro plants with a total capacity of 2.1 GW. A 98 MW gas- / oil-fired thermal power plant at Vlorë is currently inoperable. Imported electricity covers around 40% of total electricity supply.

The Trans-Adriatic Pipeline (TAP), which will deliver Azeri gas via Greece and Albania to Europe, is expected to create a demand for fossil gas in Albania. Construction of the TAP is scheduled to finish in 2019, with first gas deliveries to Italy expected in 2020.



In **Bosnia and Herzegovina**, brown coal and lignite make a very large contribution to primary energy supply (62.0% in 2017). Only North Korea, South Africa, Mongolia and China have higher coal dependencies. In 2018, Bosnia and

Herzegovina produced 14.3 million tonnes of brown coal and lignite. This was mostly used to generate electricity at power plants near to coal mines: 73.0% of the country's gross electricity production was from coal in 2017. In addition, 1.5 million tonnes of imported coking coal was consumed in 2018.

At 2 264 million tonnes, Bosnia and Herzegovina's reserves of lignite are substantial. Total lignite resources are reported to be 5 274 million tonnes. The largest coal deposits are located in the north-east of the country around Tuzla in the Kreka-Banovići coal basin. Bosnian lignite typically has a lower calorific value of 9 100 kJ/kg (2 200 kcal/kg), a moisture content of 49%, an ash content of 3.8% and a high sulphur content (as-received values).

ELEKTROPRIVREDA BOSNE I HERCEGOVINE (EPBiH) is a state-owned utility company with seven subsidiary coal mining companies: Rudnici „Kreka“ (Šikulje and Dubrave opencast lignite mines and Mramor underground mine); RMU „Kakanj“ (Vrtlište opencast mine, Haljinići underground mine and Begiči-Bištrani underground mine which opened in July 2013); RMU „Zenica“ (Stara Jama, Raspočje and Stranjani underground mines); RMU „Breza“ (underground mines at Sretno and Kamenice); RMU „Đurđevik“ (Višća opencast brown coal mine and Đurđevik underground mine); and RMU „Abid Lolić“ and RU „Gračanica“ which operate opencast mines.

RMU BANOVIĆI operates two large opencast mines at Grivice and Turija, employing hydraulic shovels, draglines and 170-tonne trucks to mine a 12-metre seam. The Čubrić opencast mine was closed in 2011. Opencast mines at Banovići have an average overburden ratio of 5 cubic metres per tonne. The company also operates the partly mechanised Omazići underground coal mine. In November 2015, RMU BANOVIĆI signed an agreement with DONGFANG ELECTRIC CORPORATION of China to build a new power plant in Banovići. Financed by the INDUSTRIAL AND COMMERCIAL BANK OF CHINA, the €400 million project includes a 350 MW lignite-fired unit with a supercritical circulating fluidised bed boiler. In September 2019, IGH of Croatia, STEAG ENERGY SERVICE and SGS were selected to supervise the power plant construction project.

Coal mines situated in northeast and central Bosnia serve the Tuzla and Kakanj power plants owned and operated by EPBiH. The Gacko coal mine and power plant in the south of the country as well as the Bogutovo Selo opencast mine and Ugljevik power plant in the east are operated by the state-owned ELEKTROPRIVREDA REPUBLIKE SRPSKE (EPRS). Other mines include Kamengrad mine and the Livno and Tušnica mines which supply Ugljevik power plant, although not all are in production.

The 715 MW Tuzla power plant has three operational units and supplies heat to Tuzla and Lukavac as well as process steam to nearby industries and fly ash to the cement works at Lukavac. After the Bosnian war of 1992-95, major overhauls were completed at the plant, including boiler upgrades and the installation of new electrostatic

precipitators. The 450 MW Kakanj power plant has three units and was similarly reconstructed and modernised after the war. In addition to the generation of electricity, the power plant supplies heat to the city of Kakanj as well as ash and slag to the Kakanj cement works. New units are planned at both plants: the 450 MW Tuzla 7 and the 300 MW Kakanj 8.

In November 2017, EPBiH signed a loan agreement with the EXPORT-IMPORT BANK OF CHINA to finance the €722 million Tuzla 7 project. The new unit will replace the four oldest units at Tuzla (2 × 32 MW, 100 MW and 200 MW). When completed, Tuzla 7 will provide almost one quarter of EPBiH electricity production.

At the end of 2018, EPBiH adopted its 2019-2021 business plan in which construction of Tuzla 7 was given priority, followed later by Kakanj 8. These permitted power plants are needed to replace old units that must be phased-out due to limits imposed under EU regulations and also to provide a market for local coal.

The Gacko and Ugljevik power plants, each of 300 MW, were commissioned in 1983 and 1985 respectively. In 2019, MITSUBISHI HITACHI POWER SYSTEMS and RUDIS of Slovenia completed a FGD retrofit project at Ugljevik power plant. Under a national emission reduction plan (NERP) agreed with the Energy Community, FGD at the Gacko plant will be needed from 2023. In the future, lignite for these plants could come from new opencast mines being developed by COMSAR ENERGY at Delići, Peljave-Tobut and Baljak and by EPRS subsidiary RUDNIK i TERMOELEKTRANA (RiTE) UGLJEVIK at Ugljevik-Istok.

A new 300 MW lignite-fired power plant came online in September 2016 at Stanari in northern Bosnia and Herzegovina. The plant was built by DONGFANG ELECTRIC CORPORATION and financed by the CHINA DEVELOPMENT BANK with a €350 million loan. To supply the power plant, Stanari coal mine at Doboj, with reserves of 108 million tonnes, has increased its annual output capacity from 0.6 million tonnes to 2 million tonnes with a loan from SBERBANK of Russia. The UK-registered EFT GROUP owns the Stanari mine and power plant.



Croatia became the newest member state of the European Union on 1 July 2013. The country does not produce coal, but consumed 595 thousand tonnes of imported coal in 2018, mainly at the 335 MW Plomin I and II power plant which is 100% owned by HRVATSKA ELEKTROPRIVREDA (HEP). Coal accounted for 9% of total generation in 2017. In February 2018, HEP applied for a permit to modernise the 125 MW Plomin I unit to extend its life by 15-20 years. Plans for a third 500 MW unit at Plomin were cancelled in 2016.



Kosovo is governed by the United Nations Interim Administration Mission in Kosovo (UNMIK), following the violent conflict of 1996-99. It has very large lignite resources, totalling 10.8 billion tonnes and fourth only to Poland, Germany and Serbia in Europe. Reserves are located in the Kosova, Dukagjini, Drenica and Skenderaj basins, although mining has been limited to the Kosova basin to date. Lignite production in 2018 was 7.2 million tonnes.

For electricity, Kosovo was 93.2% dependent on lignite in 2017, with the rest coming from hydro plants and imports, including from a 32 MW hydro plant at Ujman/Gazivoda and other smaller plants.

The state-owned KORPORATA ENERGETIKE e KOSOVËS (KEK) has a monopoly position in lignite mining and electricity generation. The Kosova A (comprising five units of which the 200 MW unit A3 and 2 × 210 MW units A4 and A5 are operational) and Kosova B (2 × 339 MW units) power plants near Pristina are supplied with lignite from Sibovc Southwest mine near Obilić which opened in 2010.

In December 2014, a successful bid for the new 500 MW “Kosova e Re” thermal power plant (a.k.a. Kosovo C) was submitted by CONTOUR GLOBAL of the United States to the Kosovan Ministry of Economic Development. This €1.2 billion project will replace Kosova A and will, with the development of the Sibovc mine, create 10 000 jobs, improve the environment and end the electricity blackouts that plague the country. In May 2019, GENERAL ELECTRIC was chosen to build Kosovo C with construction expected to start late in 2019.



North Macedonia is a significant lignite producer:

5.0 million tonnes in 2018 from the Suvodol and Oslomej surface mines of state-owned ELEKTRANI NA SEVERNA MAKEDONIJA (ESM) and a number of smaller, privately owned surface mines. Coal resources are estimated at 632 million tonnes in the Pelagonija and Kicevo basins, including deposits at Suvodol, Brod-Gneotino, Zhivojno, Oslomej, Popovjani and Stragomiste. Lignite from the Mariovo basin may be exploited to fuel a proposed new 300 MW power plant at Mariovo. In March 2019, tenders were invited for a 10 MW solar PV farm at the Oslomej mine.

Most coal and lignite is used for power generation which accounted for 54.0% of gross generation in 2017, mainly at the 675 MW ESM Bitola and 125 MW ESM Oslomej power plants. The balance is used almost entirely by the steel industry, including the DOJRAN STEEL plant at Nikolic, DUFERCO MAKSTIL's integrated steel works at Skopje, and ARCELORMITTAL's steel mill, also at Skopje.



Montenegro produced and consumed 1.6 million tonnes of lignite in 2018, mostly for power generation – 1.4 TWh in 2017, this being 54.8% of gross generation. Hydro power supplied 41.1% with the remainder coming from wind and solar PV. Although not currently exploited, Montenegro has hard coal resources of 337 million tonnes.

Montenegro's 225 MW Pljevlja coal-fired power plant, commissioned in 1982 and owned by the majority state-owned company ELEKTROPRIVREDA CRNE GORE (EPCG), is supplied with brown coal (10 300 kJ/kg) from two surface mines operated by RUDNIK UGLJA PLJEVLJA employing 861, including contractors, and 100% owned by EPCG since June 2018. Under an agreement with the Energy Community on implementation of EU law, the unit may operate for 20 000 hours over the period 2018-2024. In March 2019, a contract was placed with STEAG ENERGY SERVICES of Germany to further upgrade the unit with flue gas desulphurisation and deNOx to meet the latest EU emission standards and thus extend the operational life of the plant. A heat offtake for district heating in Pljevlja is included in the upgrade. Earlier plans to construct a new unit have been put on hold and a contract with SKODA PRAHA for a new 254 MW unit was terminated at the end of 2017.

In 2014, METALFER acquired an underground coal mine at Berane which had been flooded and idle since 2005. Exploitable reserves are estimated at over 50 million tonnes of brown coal with a calorific value of 14 000-17 000 kJ/kg. In January 2015, commercial mining restarted at a depth of 200 metres, employing 140 people. Production in 2018 was 56 448 tonnes.



Sweden

There is currently no coal mining in Sweden and imported coal accounted for only 4.6% of the country's primary energy supply in 2018. Coal reserves and resources are estimated at 5 million tonnes in southern Sweden. In 2018, 540 thousand tonnes of peat were extracted.

Since the mid-1990s, coal imports have been stable at close to 3 million tonnes per year (2.7 million tonnes in 2018). Demand for high-quality coking coal from Australia and the United States comes mainly from Sweden's speciality steel industry. Limited quantities of steam coal, mostly imported from Russia, are used at cement works and at combined heat and power plants which are fuelled mainly with solid biofuels, including at the FORTUM / STOCKHOLM EXERGI Värtan plant in Stockholm. Coal was used in the pulp and paper industry, but has been replaced with biofuels.

In 2018, nuclear power accounted for 41.3% of Sweden's gross electricity production, while the share of hydro power was 38.7%. The balance was met by wind power (10.4%) and CHP plants firing mainly solid biofuels and wastes (7.5%), and fossil fuels (1.9%). Wind and biomass are generously subsidised while nuclear and fossil fuels are heavily taxed.

The role of nuclear power has long been the subject of political debate in Sweden. In June 2010, the parliament agreed that new nuclear power plants could replace old ones

at existing sites. After lengthy negotiations, this policy was restated in a cross-party framework agreement of June 2016.

A new Climate Act entered into force on 1 January 2018 with the aim of linking Sweden's annual Budget Bill with climate objectives. An independent climate policy council will hold the government to account. In June 2018, the Energy Bill adopted by parliament includes a 100% target for renewable electricity production by 2040. In response to such political developments, the owners of the Värtan CHP plant have decided to phase out coal use by 2022.

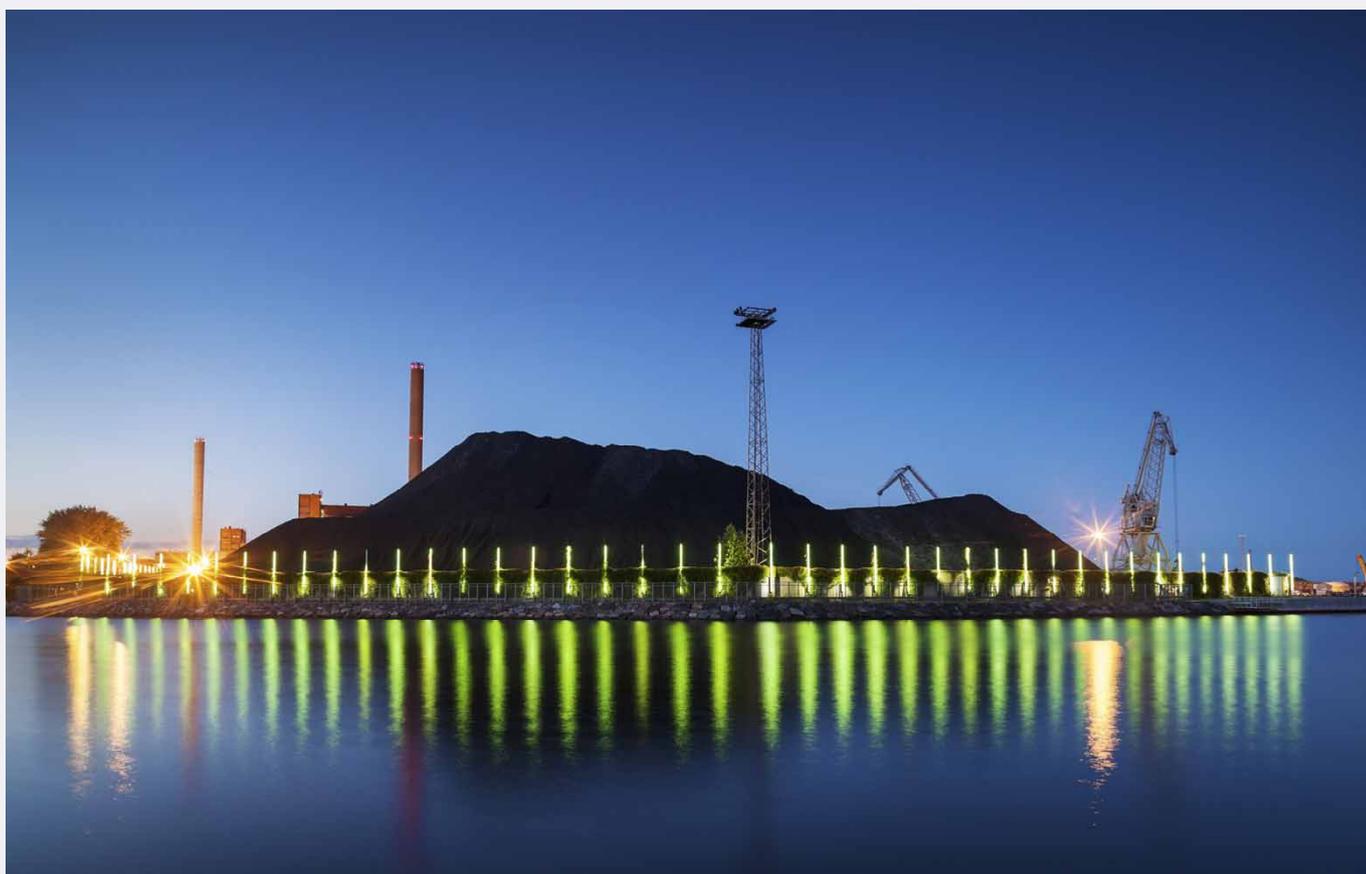


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EU statistics

Data for EU member states that use only imported coal, 2018

	Population (million)	GDP (€ billion)	Primary energy production (Mtce)	Total primary energy consumption (Mtce)	Primary coal & peat consumption (Mtce)	Gross power generation (TWh)	Gross coal power generation (TWh)	Capacity of coal-fired generation (GW)
Austria	8.8	385.7	16.7	47.2	3.9	68.6	3.6	0.6
Belgium	11.4	450.5	16.7	74.8	4.4	75.0	2.3	-
Croatia	4.1	51.5	*6.0	*12.5	0.5	*12.0	*1.4	0.3
Denmark	5.8	298.3	19.7	24.2	2.2	30.0	6.4	3.7
Finland	5.5	232.1	27.6	48.8	6.0	70.0	10.0	3.4
France	66.9	2 353.1	193.2	350.4	13.0	580.7	9.3	3.0
Ireland	4.8	324.0	6.9	19.5	2.0	30.9	4.3	0.9
Italy	60.5	1 765.4	50.4	215.6	12.2	290.6	30.5	7.8
Netherlands	17.2	774.0	52.2	102.5	11.6	113.5	29.9	4.6
Portugal	10.3	203.9	8.3	31.2	3.9	59.8	12.1	1.8
Sweden	10.1	471.2	50.1	68.4	3.1	159.3	2.0	0.3

Sources: EURACOAL members, Eurostat, IEA and ENTSO-E. See country chapters for data on coal-producing member states. * 2017 data

Coal production and imports in 2018 for the EU-28

	Hard coal production (million tonnes)	Lignite production (million tonnes)	Hard coal imports (million tonnes)
Austria			3.5
Belgium			4.1
Bulgaria		30.3	0.8
Croatia			0.5
Czech Republic	4.4	39.2	3.8
Denmark			2.8
Finland			4.0
France			13.5
Germany	2.8	166.3	44.5
Greece		36.5	0.4
Hungary		7.9	1.5
Ireland			1.3
Italy			14.1
Netherlands			13.0
Poland	63.4	58.6	19.7
Portugal			4.7
Romania	0.7	23.5	0.9
Slovakia		1.5	4.4
Slovenia		3.2	0.4
Spain	2.5		15.8
Sweden			2.7
United Kingdom	2.6		10.1
others			0.5
EU-28	76.3	367.0	167.0

Source: EURACOAL members

Power generation structure in the EU-28 in 2017

	Total gross power generation		Coal & coal products (%)	Oil (%)	Fossil gas (%)	Nuclear energy (%)	Hydro (%)	Renewables, waste & other (%)
	(TWh)	EU share (%)						
Austria	71.3	2.2	5	1	15	0	59	19
Belgium	86.1	2.6	3	<1	27	49	2	20
Bulgaria	45.6	1.4	46	1	4	34	8	7
Croatia	12.0	0.4	11	2	26	0	46	15
Cyprus	5.0	0.2	0	91	0	0	0	9
Czech Republic	86.9	2.6	51	<1	4	33	3	9
Denmark	31.0	0.9	20	1	6	0	<1	73
Estonia*	12.9	0.4	84	1	<1	0	<1	15
Finland**	67.1	2.0	14	<1	5	33	22	26
France	561.5	17.0	3	1	7	71	10	8
Germany	652.0	19.8	39	<1	13	12	4	31
Greece	55.3	1.7	34	10	31	0	7	18
Hungary	32.8	1.0	16	<1	24	49	1	11
Ireland**	30.9	0.9	19	<1	51	0	3	27
Italy	295.2	9.0	12	4	48	0	13	24
Latvia	7.5	0.2	0	0	27	0	58	14
Lithuania	3.9	0.1	0	4	15	0	30	51
Luxembourg	2.2	0.1	0	0	10	0	64	26
Malta	1.6	0.0	0	12	78	0	0	10
Netherlands	117.1	3.6	29	1	51	3	<1	16
Poland	170.4	5.2	78	1	6	0	2	13
Portugal	59.4	1.8	25	2	32	0	13	29
Romania	64.3	2.0	26	1	17	18	23	15
Slovakia	27.6	0.8	13	2	6	55	17	8
Slovenia	16.3	0.5	30	<1	3	38	25	4
Spain	275.6	8.4	17	6	23	21	8	26
Sweden**	164.3	5.0	<1	<1	<1	40	40	19
United Kingdom	338.3	10.3	7	<1	40	21	3	29
EU-28	3 294.3	100.0	22	2	20	25	10	21

* coal figure includes oil shale

** coal figure includes peat

Source: Eurostat nrg_bal_peh database, last update 25.06.2019

EURACOAL

The European Association for Coal and Lignite is the umbrella organisation of the European coal industry. Associations and companies from fifteen countries work together in EURACOAL to ensure that the interests of coal producers, importers, traders and consumers are properly served. Its twenty-seven members come from across the EU-28 and Energy Community. As the voice of coal in Brussels, EURACOAL evolved from CECISO (European Solid Fuels Association) after the expiry of the treaty establishing the European Coal and Steel Community in 2002.

EURACOAL's mission is to highlight the importance of the European coal industry to energy supply security, energy price stability, economic added value and environmental protection. EURACOAL seeks to be an active communicator, with the aim of creating an appropriate framework within which the coal industry and coal consumers can operate.

Country	Member Association / Company
Bosnia-Herzegovina	RMU "Banovići" d.d. Banovići
Bulgaria	MMI – Mini Maritsa Iztok EAD
Czech Republic	ZSDNP – Zaměstnavatelský svaz důlního a naftového průmyslu (Employers' Association of Mining and Oil Industries)
Finland	Finnish Coal Info
Germany	DEBRIV – Deutscher Braunkohlen-Industrie-Verein e.V. (German Association of Lignite Producers) DMT GmbH & Co KG GVSt – Gesamtverband Steinkohle e.V. (German Coal Association) VDKi – Verein der Kohlenimporteure e.V. (Coal Importers' Association)
Greece	CERTH/CPERI – Chemical Process and Energy Resources Institute PPC – Public Power Corporation S.A.
Hungary	Borsod-Abaúj-Zemplén County Government
Poland	GIG – Główny Instytut Górnictwa (Central Mining Institute) GIPH – Górnicza Izba Przemysłowo-Handlowa (Mining Chamber of Industry and Commerce) KOMAG Institute of Mining Technology Lubelski Węgiel „Bogdanka” S.A. PGG – Polska Grupa Górnicza S.A. (Polish Mining Group) PPWB – Porozumienie Producentów Węgla Brunatnego (Confederation of Polish Lignite Producers)
Romania	PATROMIN – Asociația Patronală Minieră din România (Mining Employers Association of Romania)
Serbia	EPS – Elektroprivreda Srbije (Electric Power Industry of Serbia)
Slovak Republic	HBP – Hornonitrianske bane Prievidza a.s.
Slovenia	Premogovnik Velenje d.o.o.
Spain	CARBUNIÓN – Federación Nacional de Empresarios de Minas de Carbón (National Coal Mining Employers' Association) Geocontrol S.A. SUBTERRA Ingeniería S.L.
Turkey	TKİ – Turkish Coal Enterprises
Ukraine	DTEK PRJSC Donetsksteel

As at 31 October 2019

Coal classification

Coal Types and Peat			Total water content (%)	Energy content a.f.* (kJ/kg)	Volatiles d.a.f.** (%)	Vitrinite reflection in oil (%)		
UNECE	USA (ASTM)	Germany (DIN)						
Peat	Peat	Torf	75	6 700				
Ortho-lignite	Lignite	Weichbraunkohle	35	16 500		0.3		
Meta-lignite		Sub-bituminous coal	Mattbraunkohle	25	19 000		0.45	
Sub-bituminous coal	High volatile bituminous coal		Glanzbraunkohle	10	25 000	45	0.65	
Bituminous coal		Medium volatile bituminous coal	Flammkohle			40	0.75	
			Gasflammkohle			35	1.0	
			Gaskohle		36 000	28	1.2	
			Fettkohle					
			Low volatile bituminous coal					
Anthracite		Semi-anthracite	Magerkohle			19	1.6	
	Anthracite	Anthrazit	3	36 000	10	2.2		

* a.f. = ash-free basis

** d.a.f. = dry, ash-free basis

UNECE: Ortho-Lignite up to 15 000 kJ/kg
 Meta-Lignite up to 20 000 kJ/kg
 Sub-bituminous Coal up to 24 000 kJ/kg
 Bituminous Coal up to 2% average vitrinite reflection

USA (ASTM): Lignite up to 19 300 kJ/kg

Source: BGR

Note: There is no separate definition of the term "brown coal" as it is synonymous with "lignite".

Glossary

a. r. – as received

As-received condition or as-received basis describes the condition of coal as received by the consumer or the laboratory analysing the coal, including moisture.

Brown coal

The terms “brown coal” and “lignite” are used interchangeably in this report. The terms are synonymous – there is no separate definition of brown coal. Where the word “coal” is used, it can refer to all types of coal.

Coal reserves

The portion of known coal resources that can be profitably mined and marketed with today’s mining techniques.

Coal resources

Coal deposits that are either proven, but at present are not economically recoverable, or not proven, but expected to be present based on geological knowledge.

Mtce

Million tonnes of coal equivalent (1 tce = 0.7 toe or 29.307 gigajoules or 7 million kcal)

Total primary energy supply

TPES refers to the direct use of primary energy (e.g. coal) prior to any conversion or transformation processes. It is equivalent to total primary energy demand or consumption.

For a glossary of terms used in energy statistics, see Eurostat’s [Statistics Explained](#) website.

Data sources and references

Data and information has been provided by EURACOAL members and national government agencies. Eurostat, IEA and World Bank databases have also been valuable sources. Other data and information has come from the following publications.

BAFA (Bundesamt für Wirtschaft und Ausfuhrkontrolle – German Federal Office of Economics and Export Control (2019), *Aufkommen und Export von Erdgas Entwicklung der Grenzübergangspreise ab 1991*, BMWi, Eschborn.

BGR (Bundesanstalt für Geowissenschaften und Rohstoffe – Federal Institute for Geosciences and Natural Resources) (2019), *Energy Study 2018 – data and developments concerning German and global energy supplies, 22*, Hannover, Germany, August.

BP (2019), *BP Statistical Review of World Energy 2019*, 68th ed., [BP plc](#), London, June.

CEER (Council of European Energy Regulators) (2018), *Status Review of Renewable Support Schemes in Europe for 2016 and 2017*, Report C18-SD-63-03, Brussels, December.

ENTSO-E (European Network of Transmission System Operators for Electricity) (2019), *Statistical Factsheet 2018*, ENTSO-E aisbl, Brussels, June.

European Commission (2011), *Impact Assessment accompanying the Energy Roadmap 2050*, Commission Staff Working Paper SEC(2011) 1565, Brussels, December.

European Commission (2016), *EU Reference Scenario 2016: energy, transport and GHG emissions trends to 2050*, European Union, Luxembourg, July.

European Commission (2018), In-Depth Analysis in Support of the Commission Communication COM(2018) 773 A *Clean Planet for All – a European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy*, Brussels, 28 November 2018 (§7.7).

European Commission DG Energy (2019), *EU Energy in Figures – statistical pocketbook 2019*, European Union, Luxembourg, September.

IEA (International Energy Agency) (2018), *CO₂ Emissions from Fuel Combustion*, OECD/IEA, Paris, October.

IEA (2019a), *World Energy Outlook 2019*, OECD/IEA, Paris.

IEA (2019b), *Coal Information 2019*, OECD/IEA, Paris.

IHS (2019), *IHS McCloskey Coal Report*, IHS Markit, London.

IPCC (Intergovernmental Panel on Climate Change) (2018), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva.

NERA Economic Consulting (2018), *Update on Energy Taxation and Subsidies in Europe: an analysis of government revenues from and support measures for fossil fuels and renewables in the EU and Norway*, for International Association of Oil and Gas Producers (IOGP), London, May.

Riley, J.C. (2005), “Estimates of Regional and Global Life Expectancy, 1800–2001”, *Population and Development Review*, vol.31, iss.3, pp.537-543, September 2005.

Zijdeman, R., F. Ribeira da Silva (2015), “Life Expectancy at Birth (Total)”, <http://hdl.handle.net/10622/LKYT53>, IISH Dataverse, V1. UN Population Division (2019). Published online at OurWorldInData.org. Retrieved from: <https://ourworldindata.org/grapher/life-expectancy>.

VDKi (2019), *Annual Report 2019 – facts and trends 2018/19*, [Verein der Kohlenimporteure e.V.](#), Berlin, September.

World Energy Council (2015), *World Energy Trilemma: priority actions on climate change and how to balance the trilemma*, [World Energy Council](#), London, May.

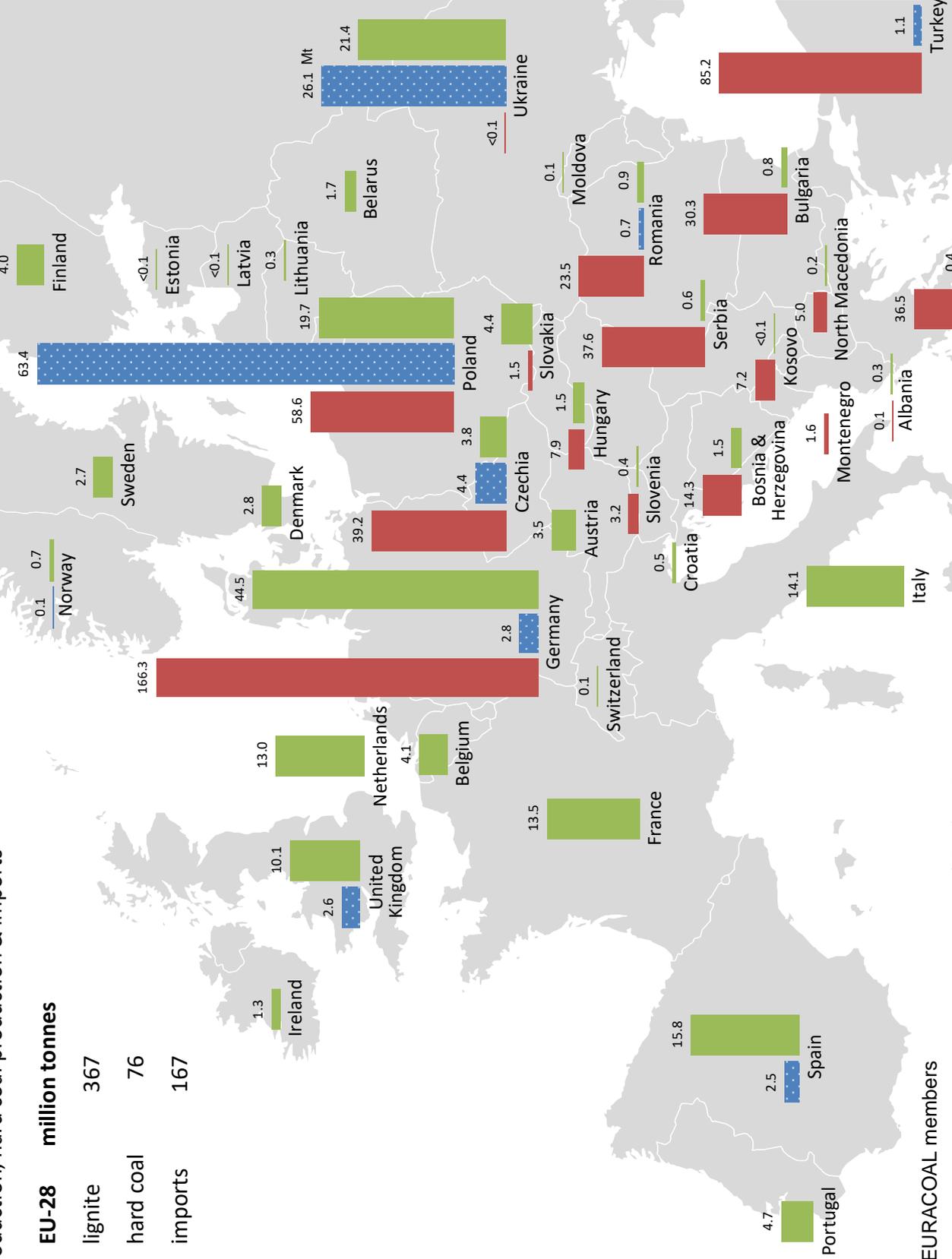
Coal in Europe 2018

lignite production, hard coal production & imports

EU-28 million tonnes

- lignite 367
- hard coal 76
- imports 167

EURACOAL



Source: EURACOAL members

Note: bars show million tonnes of coal equivalent (Mtce) while figures at top of bars show millions of physical tonnes (Mt)

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