Czech-Austrian Winter and Summer School

Features of energy integration of the EU countries

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CONTENT

1. ABSTRACT

In the first decade of the 21st century, the problems of stable energy supply to European Union members, occupied one of the priority places in power integration policies. This is due to two reasons. On the one hand, the base of the planet's energy resources is depleted as energy consumption increases every year. On the other hand, due to politicization of energy security, there was a threat of using the energy factor to achieve political goals.

In this regard, EU members came to conclusion that at the national level it was necessary to develop a set of energy policies. They aimed at promoting power integration between EU countries and cooperation with third countries with common foreign and security policies. This paper deals with the research of European electricity market integration, which occupies a significant place in the foreign policy of EU countries with detailed consideration of Czech Republic and Austria. Moreover, it provides explanation of the history of EU power markets integration and its current situation. The paper is focused on comparison of electricity markets in above mentioned countries and other EU members. Generally, it is agreed that the future structure of the European energy market has not been yet clearly defined. Eventually, it analyzes the possible ways of power integration systems development in EU markets.

2. HISTORY OF EU POWER MARKETS INTEGRATION

Energy is one of the most vital and discussed topics of our time. The problem of energy supply occupies the top lines of the agenda of governments of many countries of the world. In recent years, integration processes have intensified within the European Union. There has been a marked increase in efforts to develop and implement a unified energy policy both within the EU and in relation to countries that are not members of this association and international organizations.

European integration is the most successful and effective project for international regional cooperation. Both energy and competition policies are important elements of the European Union. EU competition rules have been part of the Treaty since the establishment of the European Union. However, much has changed on the EU Energy Market.

In the second half of the nineties, Member States decided to gradually open these markets to competition and work towards an internal energy market. This has resulted in numerous competition issues, for example due to a historically high market concentration and a lack of possibilities for market entry due to long term contracts with customers and network operators. Important milestones have been reached to address these issues, such as the unbundling of energy distribution and supply, the introduction of the right to switch energy supplier and improvements in interconnectivity and, therewith, in market integration. Moreover, a lot has also been done to ensure that the energy supply is not only affordable and competitive, but also secure and sustainable.

The first legislative package prescribing energy market liberalisation was adopted in 1998. Over time the political attention within the EU gradually shifted from energy market liberalisation towards energy market integration, although liberalisation efforts are still ongoing in some Member States.

In the following years, these ambitions and actions were confirmed and strengthened by further Directives on the internal market for electricity and gas of 2003 (second legislative package). Since July 2004, all industrial customers have been entitled to choose gas suppliers. And in 2007 the markets became completely open to all consumers without exception. The opening of national gas markets The EU expands the legal capabilities of gas producers for a direct access to the European consumer, bypassing intermediaries, and resellers. The requirements of the second gas directive became part of the national legislation of the member countries.

The goal of the third and latest legislative package on the internal energy market was to further open up the gas and electricity markets in the European Union, to enhance investments in energy infrastructure and cross-border trade in order to reach the goals of the 'Europe 2020 Strategy' through a secure, competitive and sustainable supply of energy to the economy and the society. Many steps have been made towards the establishment of the internal energy market, however the Commission has concluded that further efforts are still required.

As a result, the energy market of today is in many ways totally different from the market 20 years ago. It is still undergoing major changes under the influence of climate change objectives and the accompanying policies. "Energy" is now a vast field, covering many different types of market participants (generators, aggregators, network operators), technologies (coal, wind, nuclear but also batteries) and business models (energy management services, energy advisory services, energy trading services). This also means that the complexity of the market has increased significantly. Compared to the historical situations, which often have been characterised by a single dominant state-owned monopolist, competition now comes in many different shapes and forms and manifests itself on markets that were non-existent 20 years ago.

3. WINTER PACKAGE

The EU is now on its way to reach its 2020 sustainability targets and has formulated new targets for 2030 The 2016 Clean Energy Package is the most recent policy initiative and encompasses measures in various energy market

The concept of the Winter Energy Package is set forth in the European Commission's "Clean Energy for All Europeans" report, released on November 30, 2016. The eight legislative proposals are an excellent starting point for expanding the capabilities energy consumers, improving energy markets, increasing shares of renewable energy and reducing energy consumption.

economy.

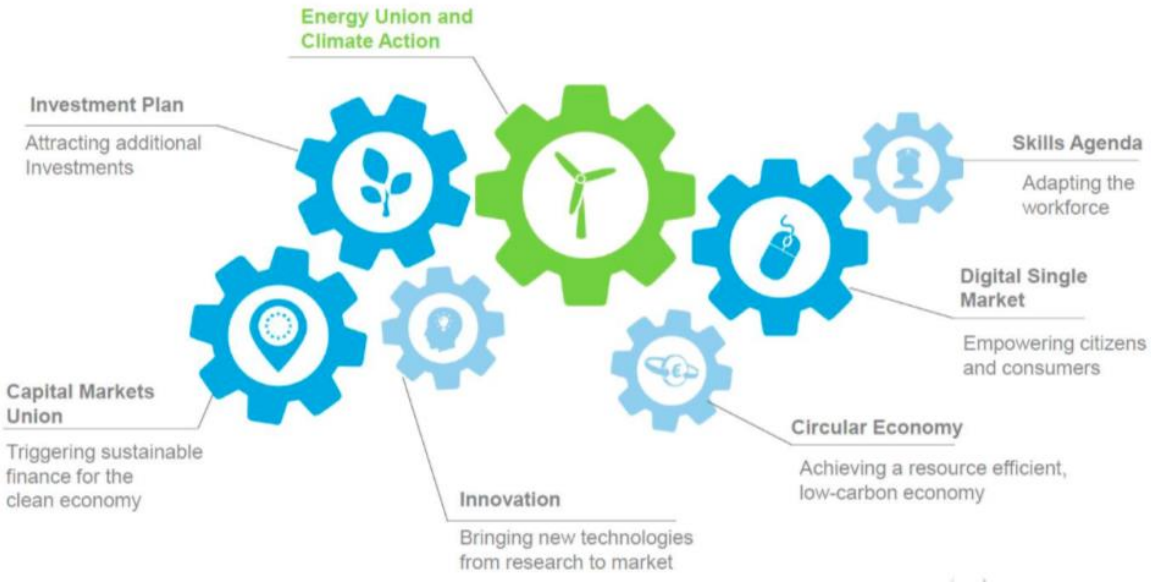


Figure 1: Modernisation of the economy – Role of the Energy Union and Climate Action

The Governance Regulation is meant to hold everything together. In particular, it aims to give credible underpinning to the commitments on climate change. It also gives legislative expression to the EU's Union-level energy and climate targets to be achieved by 2030, which are:

- binding target of at least 40% domestic reduction in economy-wide greenhouse gas emissions as compared with 1990;
- binding target of at least 27% for the share of renewable energy consumed in the EU;
- target of at least 27% for improving energy efficiency in 2030, to be revised by 2020, having in mind an EU level of 30%;
- 15% electricity interconnection target for 2030.

The Commission's "Clean Energy for All Europeans" proposals are designed to show that the clean energy transition is the growth sector of the future. Clean energies in 2015 attracted global investment of over 300 billion euros. In this case It is expected that the successful implementation of the new energy package will additionally annually attract 177 billion euros of public and private investment, starting in 2021. If the package achieves its goals, it is expected that the GDP of the EU countries will grow by 1% annually in the period 2020-2030 and create 900,000 new jobs.

The presentation of the draft directives of the European Commission launched a process of consultations on the Winter Package. Published bills caused a flurry of criticism from experts and the public. Most likely, before approval in the European Parliament and the Council of the EU, many of their provisions can significantly change.

For today, in the European Parliament, a new energy package has already elected speakers from various political forces. The positions of individual countries are not yet definitively defined. Although at the level of energy ministers of the EU countries, there is general agreement and support on the main goal of the Winter energy package - to make energy more accessible to consumers and cleaner from the ecological point of view. Full

consideration and approval of the Winter energy package, obviously, will stretch for several years.

If the Winter Energy Package is adopted, the situation on the energy market is likely to change - the share of energy cooperatives and small producers will increase. At the same time, the market will become more flexible, stable and balanced, as in the periods of peak loads, small producers can extinguish the spikes in electricity consumption, playing on stabilizing the entire power system.

The main trend of the future energy industry, as it is presented in the Winter energy package is the decentralization of generation and consumption of electricity. This trend should be treated with due attention, because it is due to the development of technology, and therefore has a global impact.

No priority was allocated among these objectives but the key one should have been reduction of GHG emissions. This priority was finally recognized when the 2030 objectives were established. The winter energy package carries the philosophy of reforming the energy market towards greater flexibility for both production and consumption of electricity. The market should provide the right incentives for both producers and investors, as well as for consumers.

In part, this means that the price of electricity for consumers should become more flexible, increase during peak consumption and fall during a period of declining demand. The consumer of electricity using new technologies will be motivated to become an active player in the market, having the opportunity not only to use, but also to generate, sell and store electricity with tangible benefits. Thus, the flexibility of supply of electricity, especially from the side of RES, will be supplemented and compensated by the flexibility of demand.

3.1 Energy efficiency

Energy efficiency is the most universally available source of energy. Putting energy efficiency first reflects the fact that the cheapest and cleanest source of energy is the energy that does not need to be produced or used. This means making sure that energy efficiency is taken into account throughout the energy system, i.e. actively managing demand so as to optimise energy consumption, reduce costs for consumers and import dependency, while treating investment in energy efficiency infrastructure as a cost-effective pathway towards a low-carbon and circular economy. This will enable retiring generation over-capacity from the market, especially fossil fuel generation.

Buildings account for 40% of total energy consumption in the EU and 75% of them have poor energy efficiency. Energy efficiency in buildings suffers from underinvestment and numerous barriers. While buildings are regularly maintained or improved, energy saving investments are often ignored because they face a competition for small capital, a lack of trustworthy information, lack of skilled workers or doubts on the possible benefits.

At today's rate of renovating around 1% of buildings each year, it would take a century to upgrade the building stock to modern, near-zero energy levels.Clean energy buildings are about much more than saving energy: they increase living comfort and quality of life, have the potential to integrate renewable energy sources, storage, digital technologies and to link buildings with the transport system. Investment in a clean energy building stock can lead the transition to a low-carbon economy.

Energy saving can also have a positive impact on public budgets, as about one billion euro is spent annually on energy in such public buildings. However, rules for public

sector investments and for statistical processing of assets renovation should be transparent and clear in order to facilitate energy efficiency investment in public assets. To accelerate energy savings and the penetration of renewables into the building sector, the Commission considers that Member States should nance a €10 billion fund dedicated to existing buildings renovation.

Nevertheless, the multitude of stakeholders (owner, lender, advisers, local subsidy providers, national subsidy providers) makes energy effciency improvements in existing buildings a complex issue and progress up to now has been slow. It could be possible to reach that ambitious target if major efforts are made in buildings and transportation. Similarly, development of electric vehicles is expected to reduce energy consumption in the transport sector, which still accounts for 30% of all consumed energy.

3.2 Renewable energy

The existing Renewable Energy Directive (RED) sets out the binding national targets for each Member State to achieve a specified proportion of its energy consumption to be obtained from renewable energy sources (RES). The revised RED starts from a slightly different point, since EU leaders decided in 2014 to move away from legally binding national RES targets imposed at EU level but to set a goal of achieving at least 27% of energy from RES across the EU by 2030. The starting point of the revised RED, therefore, is that “Member States shall collectively ensure” that the 27% target is achieved by 2030, whilst, individually, ensuring that they continue to obtain at least as high a proportion of final energy from RES as they were obliged to achieve by 2020. Growth in renewable energy should be driven by the most innovative technologies that deliver substantial greenhouse gas savings.

According to the Winter Energy Package the main sources of energy will be wind and sun. Europe still is the global leader in wind energy. 43% of all wind turbines installed in the world are produced by a few major European manufacturers.

At the same time, energy production should be maximally decentralized. Markets will have to provide an opportunity for short-term electricity trading to display a varied supply of electricity generated by renewable energy sources. The share of RES in heating and cooling systems should also increase. Bioenergetics should play a big role. Progress will also be observed in the supply of new biofuels for transport, and the process of further electrification of transport will accelerate. It brings employment and economic development in rural areas, replaces fossil fuels and contributes to energy security.

On the one hand, the EU has made significant progress in stimulating and developing RES. However, now, to become a global leader in this field, it is necessary to ensure its effective integration into the common market without distorting market incentives.

3.3 Energy consumption

Consumers are at the centre of the Energy Union. Energy is a critical good, absolutely essential for full participation in modern society. The clean energy transition also needs to be fair for those sectors, regions or vulnerable parts of society affected by the energy transition.

The Commission proposes to reform the energy market to empower consumers and enable them to be more in control of their choices when it comes to energy. For businesses, this translates into greater competitiveness. For citizens, it means better information, possibilities to become more active on the energy market and be more in control of their energy costs.

The first step in the direction of putting consumers at the centre of the Energy Union is to provide them with better information about their energy consumption and their costs. The proposals will entitle consumers to smart meters, clear bills and easier switching conditions.

The cost of energy impacts on our choice of energy mix, our household spending, and on Europe's competitiveness. With import dependency at 74%, the EU continues to be exposed to volatile globally-set fossil fuel prices. Wholesale electricity prices are at their lowest for 12 years and gas prices have fallen 50% since 2013 and oil prices by almost 60% since 2014. Price differences have diminished compared to other world economies.

For household end-user prices, the trends are different. Falling energy prices have been countered by rising network costs and governments' taxes and levies as energy is a frequently used tax base for sorely needed government revenues. Retail electricity prices have risen about 3% a year since 2008 and retail gas prices by 2%. As a consequence, energy costs have risen slightly, to almost 6% of household expenditure.

One of the important elements of the new energy policy in Europe are energy cooperatives - associations of citizens, enterprises and organizations, whose purpose is, as a rule, the implementation of various local projects in the field of renewable energy. Most often, such associations focus their efforts on the decentralized, ecological and independent of companies and concerns production of energy.

According to the Winter Energy Package, energy cooperatives will benefit from a full-fledged connection to the electricity grid on an equal footing with other market participants. They will be able to more effectively sell the generated electricity to consumers in different regions on transparent terms and in the required quantities. Such a policy will play into the hands of the consumer, protecting it, and allowing it to fully control its energy consumption and supply.

At the same time, consumers who produce electricity from RES for their own needs will be able to sell surplus electricity without losing their rights as consumers. An individual can supply up to 10 MW, and a legal entity can supply up to 500 MW without acquiring the status of a supplier.

4. AUSTRIA

4.1 General Information

Austria, officially the Republic of Austria, is a federal republic and a landlocked country of over 8.8 million people in Central Europe

It is bordered by the Czech and Germany to the north, Hungary and Slovakia to the east, Slovenia and Italy to the south, and Switzerland and Liechtenstein to the west. The territory of Austria covers 83,879 km2 (32,386 sq mi). The terrain is highly mountainous, lying within the Alps, and its highest point is 3,798 m (12,461 ft). Today,

Austria is a parliamentary representative democracy comprising nine federal states. The capital and largest city, with a population exceeding 1.8 million, is Vienna. Austria is consistently ranked as one of the richest countries in the world by per capita GDP terms. The country has developed a high standard of living and has been a member of the United Nations since 1955, joined the European Union in 1995, and is a founder of the OECD (Organisation for Economic Co-operation and Development). Austria also signed the Schengen Agreement in 1995, and adopted the euro currency in 1999.

Figure 2: Map of Austria

4.2 Infrastructure:

Austria currently produces more than half of its electricity by hydropower. Together with other renewable energy sources such as wind, solar and biomass power plants, the electricity supply from renewable energy amounts to 62.89% of total use in Austria, with the rest being produced by gas and oil power plants (Figure 3).

In 1972, the country began construction of a nuclear-powered electricity-generation station at Zwentendorf on the River Danube, following a unanimous vote in parliament. However, in 1978, a referendum voted approximately 50.5% against nuclear power, 49.5% for, and parliament subsequently unanimously passed a law forbidding the use of nuclear power to generate electricity although the nuclear power plant was already finished.

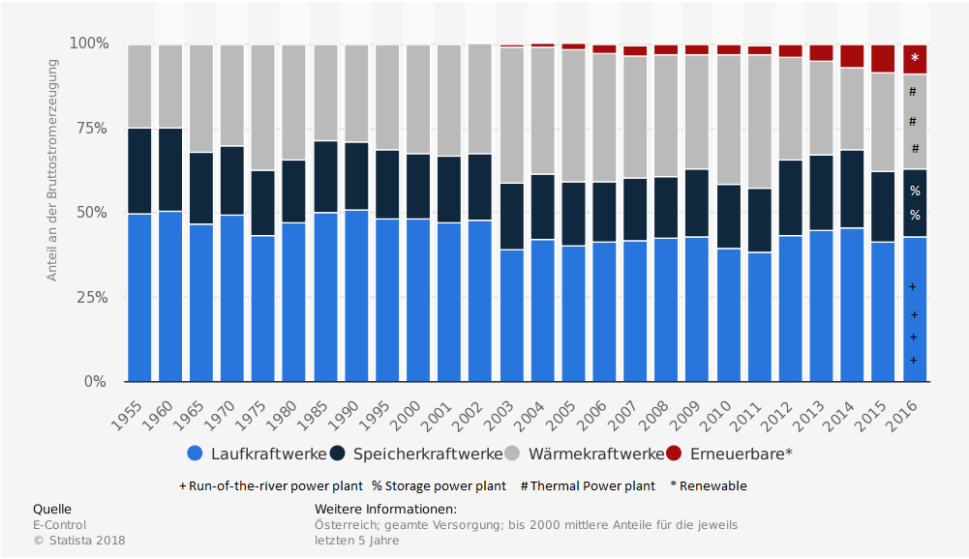


Figure 3: Share of energy sources in electric production in Austria 1955-2016

In figure.4 more details about the share of each source of energy in year 2016 has been shown. (From left: run-of-the-river power plant 23.9 GWh, strorage power plant 13 GWh, natural gas power plant 8GWh, smal run-of-the-river power plant 5.3GWh, Wind 5.2GWh, Biogenic fuel 3.1 GWh, Black coal 2 Gwh, coal derivatives 1.9 GWh, other biogenic fuel .99 GWh, natural gas derivatives 0.95 GWh, Photovoltaice 0.66 GWh, small storage power plant 0.57 GWh, other 0.33 GWh)

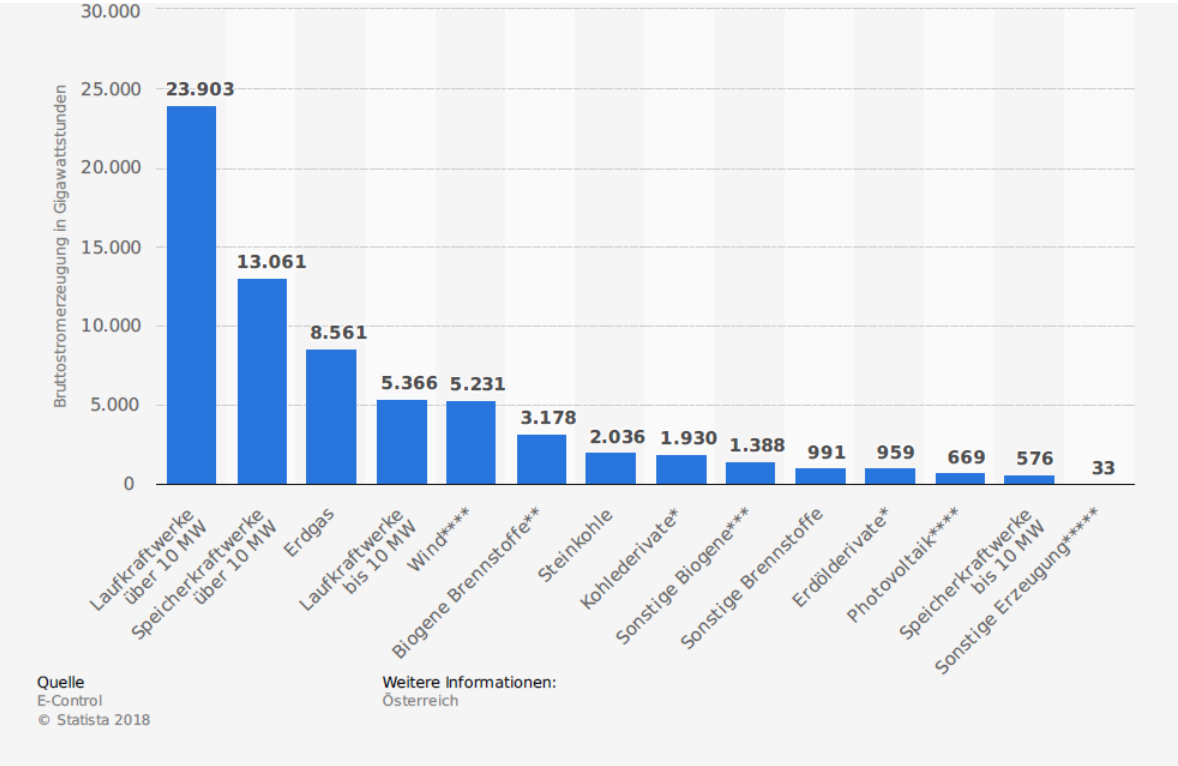


Figure 4: Share of energy sources in electric production in Austria 2016

4.3 Energy supply and demand In Austria

Austria is one of only five countries in the EU that already fulfils the 2020 target of covering at least 20% of their primary energy supply from renewables. In 2005, 21.3% of Austria's TPES (Total Primary Energy Supply) was covered by renewables. The primary domestic energy resources in Austria are large-scale hydro for electricity generation, biomass for electricity and heat production, as well as domestic resources of oil and gas. Oil is the most important single energy carrier in Austria's TPES, contributing 42% in 2005. There have been no significant shifts in Austria's breakdown of TPES since 1990, with the exception of a reduction in coal use, which has been replaced by a mix of gas and biomass. (see figure 5) (Mtoe: Million tonnes of oil equivalent)

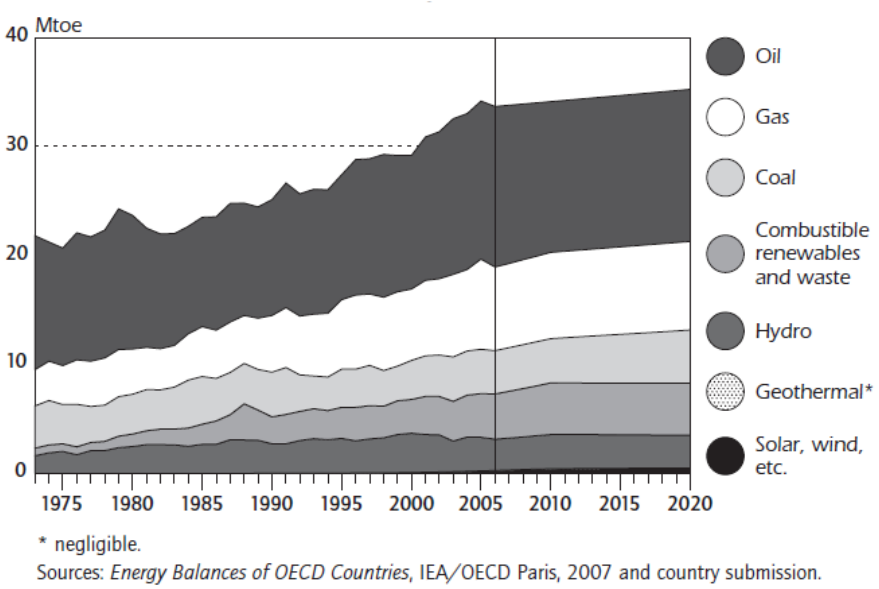


Figure 5: Total primary energy supply in Austria 1973-2020

Austria is producing 40% of its energy needs domestically (see Figure 6). Regarding fossil fuels, almost 7% of oil and 17% of natural gas required in Austria were produced domestically in 2005, but this production is declining rapidly. In the same year, domestic renewables contributed over 63% to electricity generation. Renewables also directly contributed over 10% to industrial energy demand and 19% to energy demand in the Other Sectors such as services, agriculture, government/military and the residential sectors, a very high contribution by comparison to other IEA member countries. The Austrian government is planning to build on this foundation by increasing the share of renewables in all sectors of energy supply.

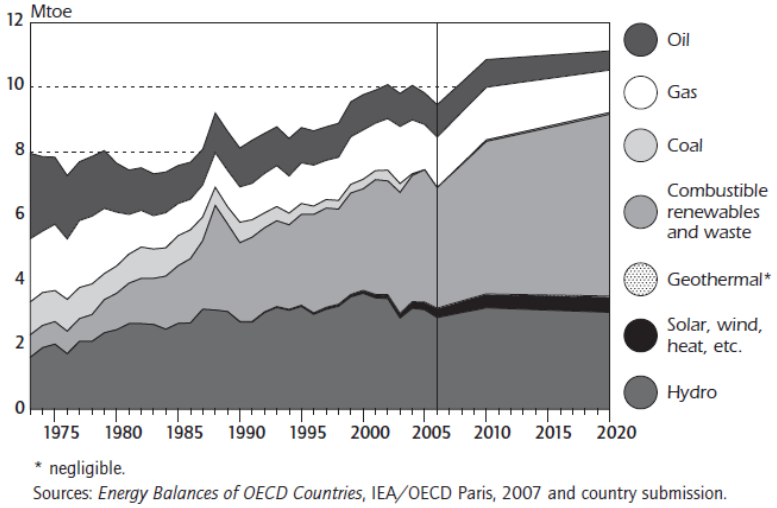


Figure 6: Energy Production by Source in Austria, 1973 to 2020

4.4 Energy Policy in Austria

Austria's energy policy is simultaneously conducted at two levels, the federal and the joint federal/state levels. The federal Constitution allocates responsibilities either to the federal level or to the joint federal and state level (see Table 1). Energy policy is formulated and implemented in close co-operation with the social partner organizations, which represent important groups of society (employers, employees, agriculture), and in dialogue with non-governmental organisations (NGOs) and the public.

Division of Energy Policy Responsibilities in Austria

Federal	*Joint*
Taxation	Supply of electricity, gas and heat
Statistics	Energy conservation
Metering	Subsidies (*e.g.* for renewables)
Emergency supply	Prohibition of nuclear power

Source: Country submission.

Table 1: Division of Energy Policy Responsibilities in Austria

Austria's energy policy strives to achieve four distinct objectives, by fostering energy supply system that assures:

- Security of supply,
- Cost-efficiency and competitiveness,
- Environmental compatibility,
- Social acceptance of the energy supplies system.

The Austrian government views these energy policy goals to be fully in line with those outlined by the EU. In order to achieve these objectives, the federal government's strategy is to promote the rational use of energy through improvements in energy efficiency, and the use of renewable sources of energy. This strategy is complemented by a range of government activities in various areas of energy policy, with the aim, among others, to increase the liberalization of the energy markets, and the diversification of energy sources and suppliers.

4.5 Gas Working towards an internal electricity market

The electricity sector in Austria and neighbouring regions is undergoing two simultaneous major developments. On the one hand, the national electricity markets and systems in the European Union are moving towards integration into an EU-wide single electricity market. This is expected to improve security of electricity supply and yield cost efficiencies. At the same time, large increases in variable renewable energy supply, driven by EU renewable energy targets, heighten the need for new, more flexible ways to operate interconnected electricity systems.

The EU-wide electricity market integration is a gradual process. At this stage, Austria's electricity market needs to be developed in a regional, cross-border context. The country should increase cross-border network capacity and extend market coupling. The transmission system operator (TSO) and the regulator should continue to co-operate with and co-ordinate their actions with other national regulators and TSOs of its neighbours and the related EU-level bodies.

While transmission grids are becoming more interconnected across national borders, the push for grid integration of large variable generating capacity from wind and solar, both in Austria and neighbouring countries, implies a need for changes in cross-border electricity systems. For smoother electricity system functioning, re-dispatch measures should be co-ordinated and congestion management improved. Pricing of transmission use should also be discussed in a regional context. These measures are clearly needed since Austria is already affected by loop flows originating in Germany, which also cause significant congestion at the Czech/Austrian border. Also, the establishment of New investments in transmission and distribution grids are required as are smarter systems for managing supply and demand. Permitting processes need to become more efficient. The permitting procedures related to infrastructure projects should be streamlined on a federal and provincial level, and the procedures should also ensure transparency and early involvement of civil society. Meanwhile, new investments in

pumped storage facilities are under way. Austria deserves to be commended for developing smart grids for electricity distribution.

Around 40% of Austria's energy needs are produced locally, and the country relies on imports of fossil fuels in order to meet its energy demand. Total energy production was 12.8 Mtoe in 2012, largely made up of biofuels and waste (47.6%), hydro (29.4%) and natural gas (12.2%). Austria also produces oil, wind, solar and geothermal at a smaller scale. Depleting fossil fuel reserves have led to a decline in the production of natural gas growth in biofuels and waste, wind and solar has been remarkable, resulting in an overall increase of 30.2% in energy production since 2002. The share of domestic production in TPES increased from 32.3% in 2002 to 38.6% in 2012.

4.6 Gas Sector

1. Natural Gas

Austria produces both oil and gas domestically, with production accounting for approximately 7% of domestic consumption in 2005 in the case of oil, and 17% of natural gas consumption in the same year. Oil and gas are produced from 767 wells in Austria. Proven reserves of oil including natural gas liquids (NGL) are estimated at approximately 11 Mtoe by the Federal Geological Institute. At current production rates, this equals around 11-12 years of production. The proven reserves of natural gas are estimated to be about 32 billion cubic metres (bcm). Proven gas reserves are equivalent to approximately 16 years of production.

Natural gas supply in Austria was 7.4 million tonnes of oil-equivalent (Mtoe) or 9 billion cubic metres (bcm) in 2012, accounting for 22% of the country's total primary energy supply (TPES). Natural gas accounts for 14% of Austria's electricity production, and 18% of the final energy consumption of households.

The government projects natural gas to continue to play an important role in Austria's energy mix and its share of TPES to remain at about 23% in 2020. Domestic production is likely to remain stable in coming years, covering about 18% of the country's consumption. Proven domestic reserves are slowly declining, and are likely to be close to depleted by 2030.

2. Shale Gas

According to estimates from OMV, Austria holds about 300 bcm of recoverable shale gas resources – enough to cover domestic production during at least 20 years. A project to drill two wells north of Vienna recently failed because of public protest.

3. Import and Export of Gas

Austria is highly dependent on gas imports as domestic production meets only around 20% of demand. Thus, around 80% of the gas consumed in the country is imported. almost all gas supply is sourced from Russia from a single supplier, Gazprom, and a single supply route, via Ukraine and Slovakia. In 2012, imports for domestic consumption were 14.2 bcm, which is 105% higher than in 2002. Gas imports have been steadily increasing for decades, as the infrastructure and gas markets have expanded in the region.

Austria is also a significant transit country for natural gas. It is well-located along gas routes from Russia to Italy and southern Germany, and its transit capacity helps secure the energy supply of its neighbours. Also, according to E-Control, the regulator, total gas imports amounted to 43.6 bcm in 2012, so transit volumes were some three times larger than domestic consumption.

4. Pipe lines

Austria is an important transit country for gas to Germany, France and Italy. The total length of the gas pipeline network in Austria is 38 293 km, of which 2 876 km are transmission pipelines and 35 417 km are distribution pipelines. Austria's gas grid is directly connected to the ones in Germany, Italy and Hungary through the Baumgarten hub where a number of pipelines converge.

5. Gas Storage

Austria has significant storage capacities, primarily from depleted natural gas fields, which were redeveloped on a commercial basis. Total storage capacity accounts for about 80% of 2012 natural gas consumption. During peaks of demand in the early winter, storage withdrawal can account for up to 60% of demand.

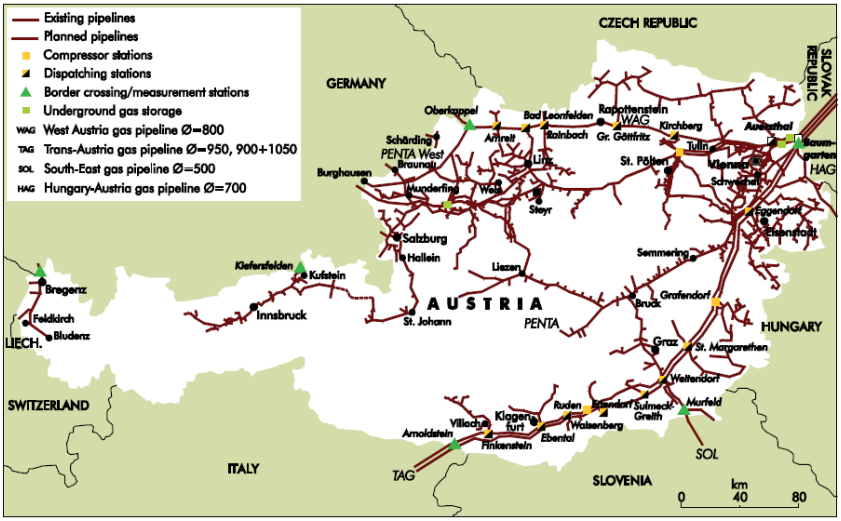


Figure 7: Austria Natural gas infrastructure

4.7 Coal Sector

Austria's coal supply was 4.6 million tonnes (Mt) or 3.3 million tonnes of oil-equivalent (Mtoe) in 2012. Coal represents nearly 10% of total primary energy supply (TPES) and 9.1% of electricity generation. Austria has no indigenous production of coal, despite existing reserves of lignite (brown coal): 333 Mt at the end of 2011, according to the government. In 2012, hard coal imports totalled 3.6 Mt, sourced from the Czech Republic 40.4%, the Unites States 33.4%, Poland 24.6%, Colombia 1% and other countries 0.6%. More specifically, steam coal imports came from the Czech Republic (44.8%), the United States (31.6%), Poland (16.8%), Germany (4.6%) and Colombia (1.9%), with additional smaller volumes from Canada and Ukraine. Coking coal, in turn, is imported from the Czech Republic (34% of the total), the United States (also 34%) and Poland (32%). Austria also imported 1.2 Mt of coke-oven coke, mainly from Poland and Hungary.

4.8 Oil Sector

Oil remains the primary energy source in Austria, representing about 34% of the country's total primary energy supply (TPES), on par with many of its OECD peers. Oil products, in turn, are mainly imported from the neighbouring countries. In 2012, Germany supplied Austria with 46.7% of the total, while the Slovak Republic accounted for 19.5%, Hungary for 8.6%, Italy for 8.3% and the Czech Republic for 7.6%.

4.9 Electricity Sector

Hydro is the main source of electricity in Austria and accounts for 63.7% of total generation. Around 24% of electricity is generated from fossil fuels. Natural gas accounts for 14.1%, coal 9.1%, biofuels and waste 7.9%, wind 3.6%, oil 1.1%, solar 0.5% of electricity generation.

Supplier switching

The Austrian electricity market was fully liberalised in 2001, allowing electricity suppliers to set their prices and consumers to freely choose their supplier. Each consumer can shop around for the cheapest offer and freely choose an electricity supplier.

Regional interconnections

Austria is well interconnected, and the western part of the Austrian electricity system is completely integrated into the German system. However, more investments in interconnections with Italy, Slovenia and Switzerland are required. Austria is also linked to the Central Eastern European (CEE) market area, but integration remains limited by congested interconnections and insufficient market coupling arrangements. Interconnections on Austria's eastern borders are increasingly strained because of unscheduled loop flows from renewable energy generation in Northern Germany coming through the Eastern European network, particularly at the highly congested Austrian/Czech border. Plans have been elaborated for further integration of the region's electricity markets.

	Into Austria (MW)	From Austria (MW)	Imports from (GWh)	Exports to (GWh)
Germany	1 400	1 600	13 707	3 979
Switzerland	1 200	1 200	102	7 362
Italy	220	n/a	11	1 074
Slovenia	450	450	400	2 386
Hungary	500	400	698	1 629
Czech Republic	600	200	10 054	86

Source: E-Control.

Table 2: International interconnections and electricity trade, 2011

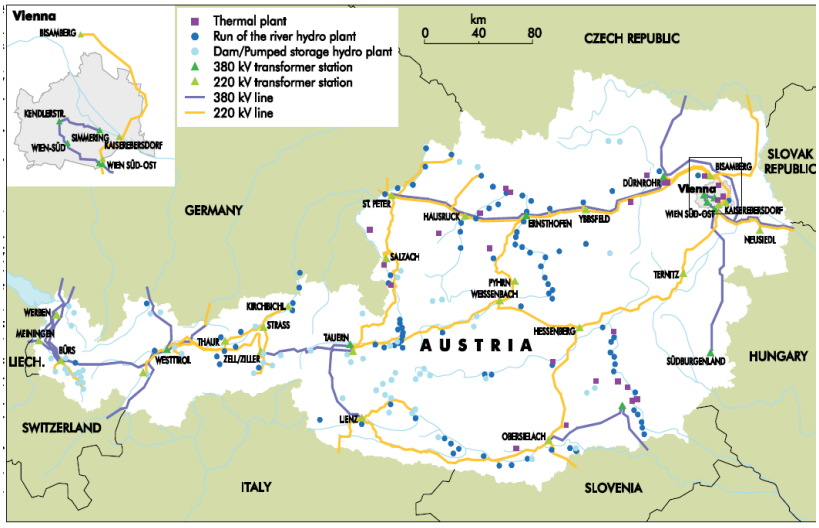


Figure 8: Map of Austria's high-voltage electricity grid

Source: APG

5. CZECH REPUBLIC

5.1 General information

The Czech Republic is located in central Europe. It includes the historical provinces of Bohemia and Moravia along with the southern tip of Silesia, which are often called Czech lands. The country borders Poland in the north and northeast, with Slovakia

in the east, with Austria in the south and with Germany in the west and north-west (Figure 9).

It has a population of 10.61 million people and is 78,866 square kilometers. Since 2000, the Czech Republic is divided into 13 regions. Prague is the capital and the largest city in the Czech Republic, which has 1.26 million inhabitants.

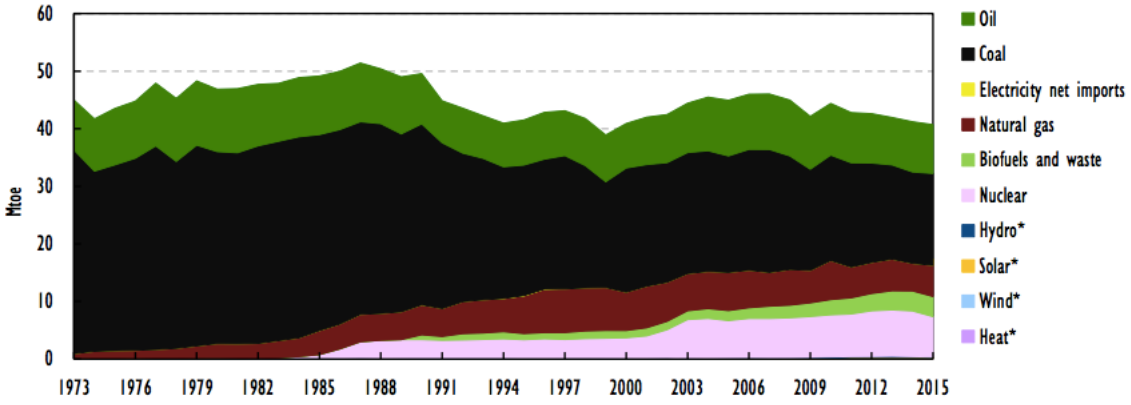
It should be noted that the Czech Republic has one of the most developed and industrialized countries in Central and Eastern Europe. Its strong industrial tradition is based on the history of Bohemia and Moravia, where 70% of industrial production is concentrated. The Czech industry focuses on metallurgy, engineering, automotive, electronics, chemistry, food and beverage production, glass, medicine, textiles and paper. Industry accounts for 41% of gross domestic product (GDP).

Figure 9:Map of Czech Republic

In 2015, the total primary energy supply in the Czech Republic (TPES) was 40.7 million tons of oil equivalent (Mtoe). Fossil fuels amounted to 30.9 million tons or 76% of TPES in 2015. This is a reduction of 17.8% from 37.6 million tons in 2005 (Figure 10).

5.2 Energy source in Czech Republic

The dominant source of energy in the Czech Republic is coal, which is 39.2% of TPES. Since 2005, the energy produced from coal has decreased by 21.1% from 20.2 million tons. According to the state energy policy (SEP), it is necessary to reduce greenhouse gas (GHG) emissions, which, together with restrictions on the extraction of brown coal as a result of territorial environmental constraints, means that the coal position as the basis of the energy system is likely to be gradually replaced by nuclear power.



Note: Data are estimated for 2015.

* Negligible.

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

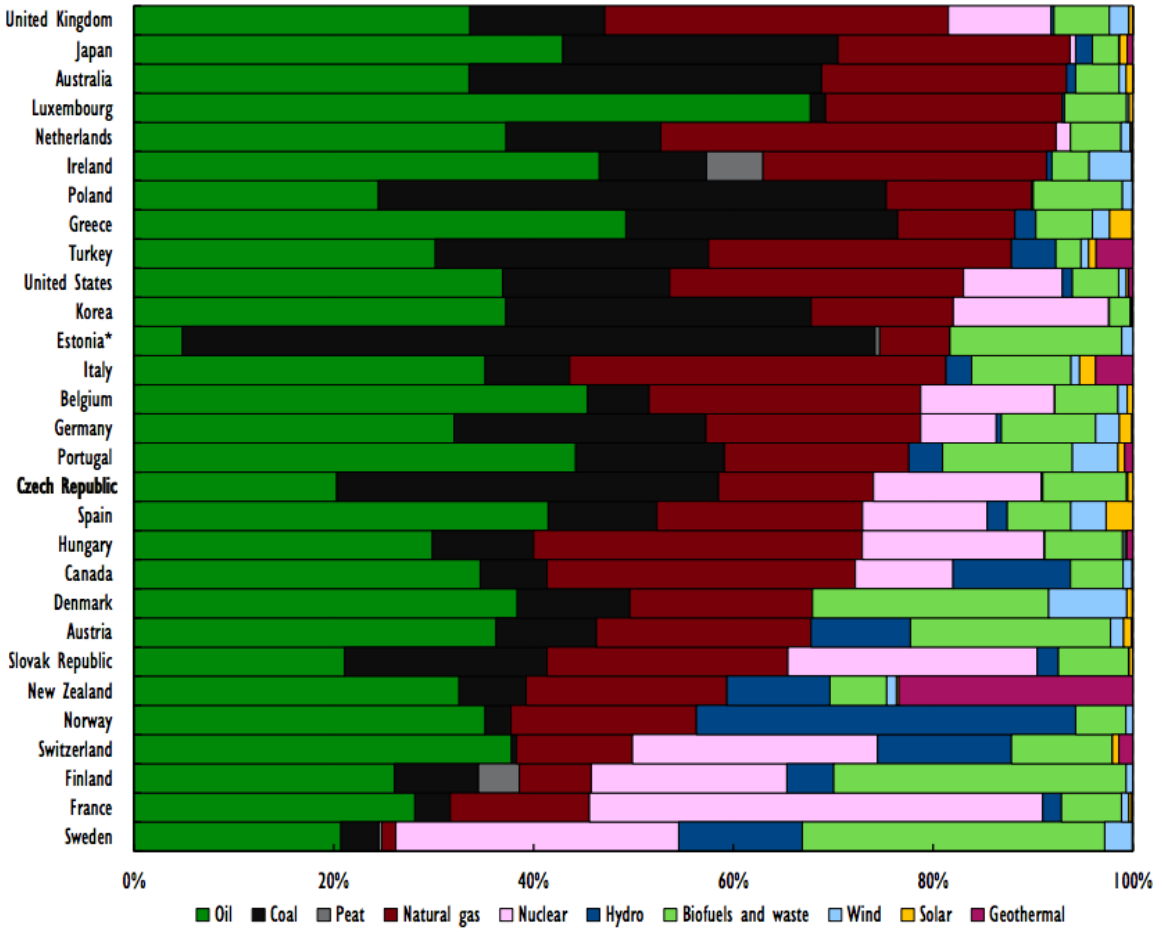
Figure 10:Total primary energy supply in the Czech Republic

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

Nuclear energy accounted for 7 Mtoe or 17.2% of TPES in 2015. This represents a moderate increase since 2005 from 6.5 Mtoe, following a surge in 2003 when the 2000 megawatt Temelín Nuclear Power Station was commissioned. By 2040, the government projects that the share of nuclear energy in TPES will reach between 25% and 33%. This is supported by the National Action Plan for the Development of Nuclear Energy (NAP NE) approved in June 2015, which ensures the future development of nuclear energy.

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

Compared with other countries, the Czech Republic is around the median level with regard to the share of fossil fuels in TPES at 76%. The share of coal ranks third-highest after Estonia and Poland, and oil and natural gas rank relatively low. With respect to the share of nuclear, the Czech Republic is the seventh-highest among the 16 countries with nuclear energy in their energy mix (Figure 11).



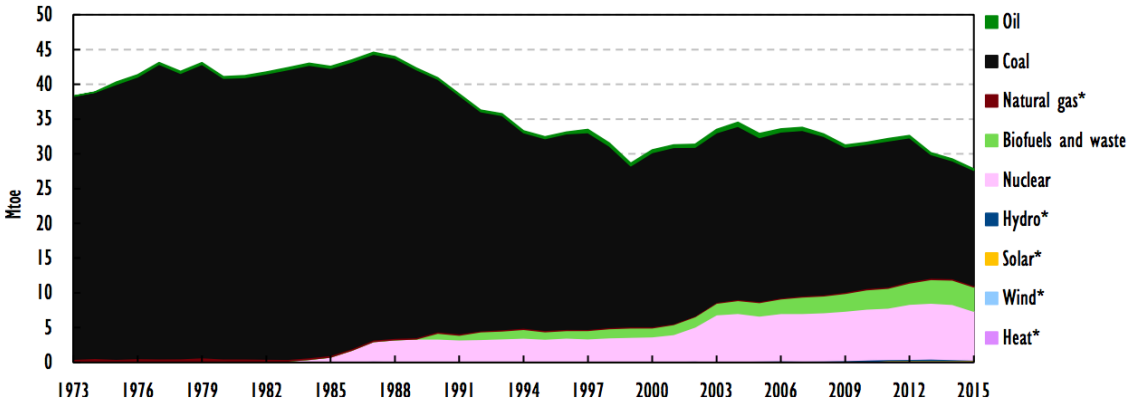
Note: Data are estimated.

* Estonia's coal represents oil shale.

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

Figure11: Comparison of total primary energy supply in countries

Around 68% of Czech energy needs are produced locally, representing 27.8 Mtoe in 2015. Domestic primary energy production was largely made up of coal (59.5%), nuclear (25.2%), and biofuels and waste energy (12.5%) (see Figure 12). Coal is the only conventional source of energy produced in large amounts; therefore, national energy security is directly related to its use. The decline in coal use over the past decade resulted in a drop in the share of domestic energy production in TPES between 2005 and 2015, offset to some extent by growth in biofuels and wastes and nuclear. The share of domestic production in TPES decreased from 76% in 2005 to 68% in 2015.



Note: Data are estimated for 2015.

* Negligible.

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

Figure 12: Energy production in the Czech Republic by source

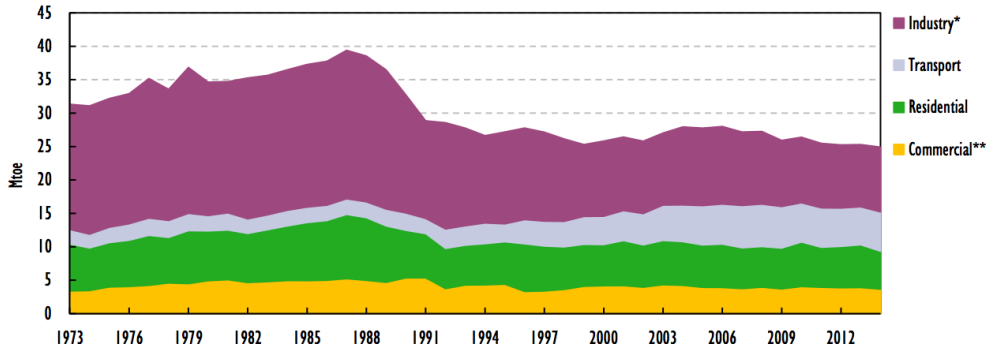
5.3 Demand

Total final consumption (TFC) of energy in the Czech Republic amounted to 24.9 Mtoe in 2014 (the latest year for which consumption data are available). TFC represented around 60.4% of TPES in 2014, with the remainder used in power generation and other energy industries (Figure 13).

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

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

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



* *Industry* includes non-energy use.

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

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

Figure13: Total final consumption in the Czech Republic by sector

5.4 Electricity prices

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

Prices for industrial users (EUR0.0761/kWh excluding taxes and levies or EUR 0.0934/kWh including taxes and levies) are also less than the EU-28 average (EUR 0.0894/kWh excluding taxes and levies or EUR 0.1496/kWh including taxes and levies).

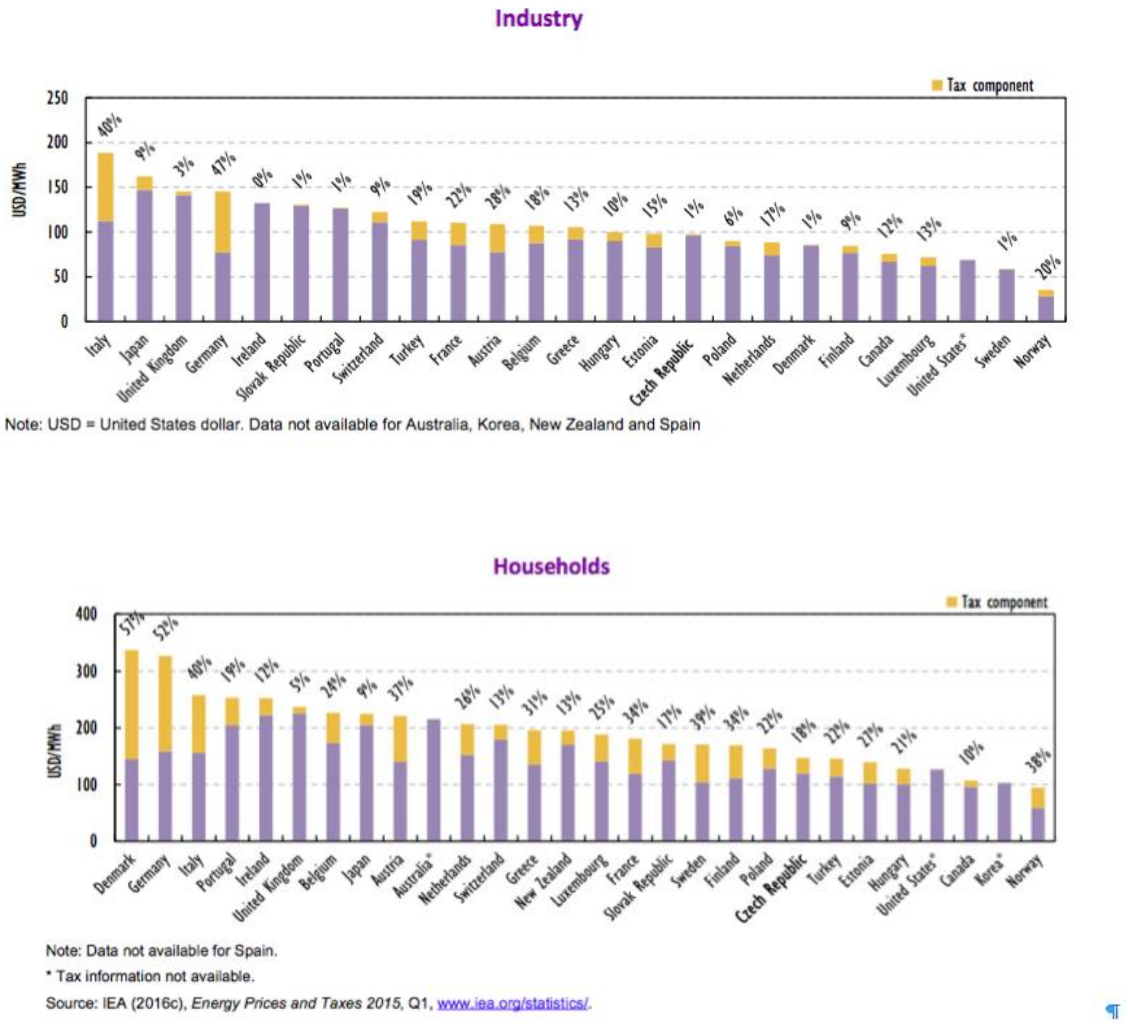


Figure 14: Electricity prices in 2015

5.5 The State Energy Policy

The State Energy Policy 2015 (SEP) is the document by which the government defines the political, legislative and administrative framework for reliable, affordable and long-term sustainable energy supply. The principal strategic objectives of the SEP are:

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

The strategic direction of the energy sector is defined by a number of targets. The Czech Republic will aim to achieve a 40% reduction in carbon dioxide (CO2) emissions by 2030 in comparison with 1990 and a further reduction in emissions in compliance with EU strategies aimed at decarbonising the economy by 2050 in accordance with the financial capacity of the country. The government also aims to increase energy savings in 2020 by 20% compared with business-as-usual with the target of achieving net final energy consumption of 1 060 petajoules (PJ) (according to the Eurostat methodology, or 1 020 PJ according to the IEA methodology) and continue increasing energy efficiency by 2040 in compliance with EU strategies with the aim of reducing energy intensity and average energy consumption per capita to below the average of the 28 EU member states (EU-28).

The country has established a target ratio of annual electricity production from domestic primary sources to the total gross amount of electricity generated of at least 80% (RES, secondary sources and waste, brown and hard coal, and nuclear fuel, assuming adequate supplies) with the target electricity generation structure (in proportion to the total gross annual amount of electricity generated) in corridors (Table 3).

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

Table 3: Relative corridors for gross electricity generation in Czech Republic State Energy Policy

The government also aims to diversify the mix of primary energy sources (in proportion to the total gross annual consumption of primary energy sources) with a target structure in corridors (Table 4).

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

Table 4: Relative corridors for primary energy sources in Czech Republic State Energy Policy

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

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

6. COMPARISON OF ELECTRICTY GENERATION IN CZ AND AT

Today, electricity and its sources have become an important issue for the economies of states. Although, there is no global consensus on the best mix of energy resources or energy policy. For this reason, we want to compare two different European cases and identify differences in electricity production in Austria and the Czech Republic and analyze energy from two different perspectives: geographic conditions and available internal resources, followed by an analysis of energy policies in both countries.

We propose several reasons for comparing the energy balance between Austria and the Czech Republic. They are both Central European countries of similar size and population. From the moment of joining the European Union, the countries comply with its conditions. Although, the EU has no right to dictate the structure of the energy balance or prohibit the use of certain resources, such as nuclear power. The government of the country should establish a responsible energy policy, and the EU can only offer its recommendations. Thus, the energy resources used in electricity production differ in Austria and the Czech Republic, having a completely different mentality. This comparison gives new views on national as well as international disputes about energy security and sustainability.

In this paper, we concentrated on comparing the electricity of the Czech Republic as a net exporter of electricity and Austria as a net importer, because this is a good example of a different government strategy for renewable resources and nuclear power. The study mainly uses qualitative methods based on statistical data, energy reports and academic articles, and the results are supported by statistics.

It is well known that they are connected by the common history of the Austro-Hungarian Empire. Since then, differences in the use of fossil fuels and CO2 emissions have been evident between the two countries, as Czechoslovakia had the advantage of

an abundance of internal coal. Austria adjusted its energy policy to domestic conditions, as well as to the international situation, Czechoslovakia basically adhered to inflexible five-year plans. Coal has remained the most important energy carrier in the Czech Republic until today but in Austria it was replaced by crude oil, together with the expansion of hydropower and natural gas. Nowadays, electricity production in the Czech Republic is based mainly on coal and nuclear power. The share of renewable resources has grown significantly but it is still low compared to Austria, where we can observe an expansion of new renewable sources with declining shares of hydropower.

If we compare only the use of renewable resources, we can observe clear differences in their shares in both countries. In the past years we could see a significant change in the composition of renewable resources in the Czech Republic. The shares of hydropower, both large and small facilities, have decreased, while photovoltaics expanded rapidly during the solar power boom since 2009.

The electricity production from renewable resources changed in Austria as well, although. The share of hydropower slightly declined but it still represents the main source of renewable energy. In absolute numbers, Austria also experienced growth in photovoltaics, although it is still not a significant source of electricity and the increase is low compared to the solar boom in the Czech Republic.

Other resources, especially wind and solar power, are exploited on a different scale, although their availability is similar in both countries. Figure 15 shows the mean annual wind speed in Europe. It is clear that wind conditions in the region are mostly unfavorable, except for north-eastern Austria and northern border areas in the Czech Republic. However, the absolute amount of electricity produced by wind turbines is much higher in Austria than in the Czech Republic.

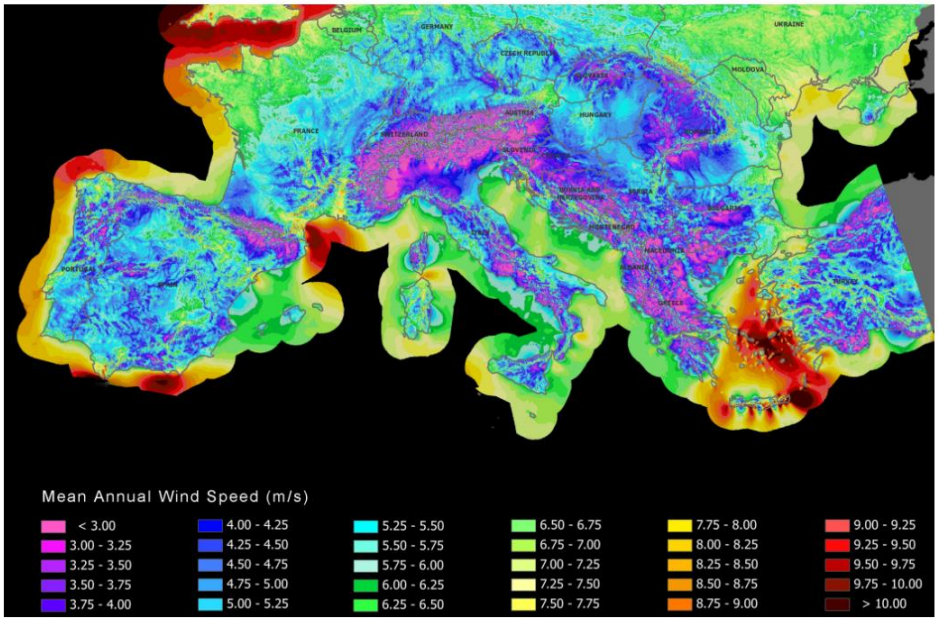


Figure15: Mean annual wind speed in Europe

Comparison of solar radiation (see Fig. 16) shows that neither the Czech Republic nor Austria are in the sunniest regions of Europe.

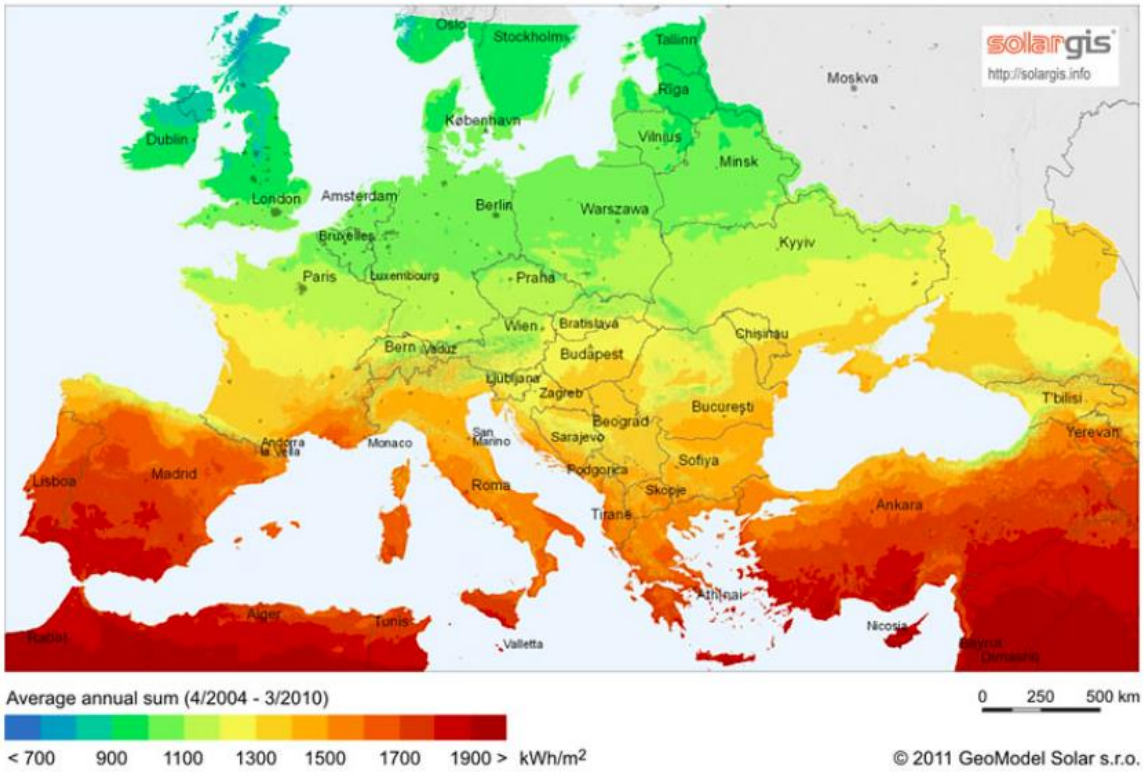


Figure16: Solar radiation in EU

However, in southern Austria, more intense solar radiation is still observed than in the Czech Republic. Despite this advantage, Austria uses photovoltaics to produce electricity to a much lesser extent, preferring to use solar panels for additional heating of water and houses. This shows the importance of policy in the field of electricity production.

6. Institutional view

To fully understand the composition of energy sources, it is necessary to compare the institutional background of Austria and the Czech Republic. However, it is important to note that the quality of institutions is different in both countries, and therefore the results of similar policy programs may differ in reality. The table 5 shows the main institutions relevant to the electricity sector in both countries. The main difference between the two countries lies in the level of production and distribution of electricity, since Austria has a much more diversified electricity supply than the Czech Republic. This is partly due to the federal structure in Austria, as many of the companies operate only in their federal state or in a particular region. Also clearly visible is the difference in the role of the Green Party, which is absent in the Czech parliament, but is well established in the Austrian political system and therefore can not influence national energy strategies.

Country	Austria	Czech Republic
Governmental level	Federal Ministry of Agriculture, Forestry, Environment and Water Management and Federal Ministry of Economy, Family and Youth	Ministry of Industry and Trade and Ministry of Environment

Green Party	20 seats in national parliament	No seats in parliament
Regulation and control	Energie-Control Austria, Federal Competition Office, Austrian Energy Agency	Energy Regulatory Office, Office for the Protection of Competition, The State Energy Inspection
Electricity generation	Verbund (40% of Austrian electricity), 59 companies generate 95% of all electricity	ČEZ (80% of Czech electricity)
Energy distribution	Around 140 companies	Around 33 companies (E.ON, PRE and ČEZ control about 75% of the distribution)
NGOs	Greenpeace, Friends of the Nature, GLOBAL 2000, Austrian Instituto of Ecology, Ökobüro (umbrella organization)	Greenpeace, Friends of the Earth Czech Republic, Mothers of South Bohemia, Green Circle (umbrella organization)

Table5: Czech and Austrian institutions relevant in energy sector

The governments of Austria and the Czech Republic often focused on different priorities and strategies in the field of energy policy. The table shows two periods before and after 2004, which is the year the Czech Republic enters the European Union, and therefore it is the beginning of a strong transformation. To facilitate the comparison of energy policy, the same period of time was chosen for Austria. It should be noted that some of the plans are in opposition (for example, nuclear energy). In addition, the arguments used in energy policy can vary significantly (as in the case of renewable energy sources, which are considered the limit of economic growth in the Czech Republic, but in Austria they are viewed as a potential source of innovation and competitiveness.

	Czech Republic	**Austria**
Before 2004	Mining reduction of uranium and coal – setting mining limits	Extended use of renewable resources
	Solving environmental problems of the past (air and water pollution)	Reduction of CO2 emissions
	Price liberalization (abolishing state subsidies on energy prices or coal industry)	Liberalization of energy market
	Privatization within energy sector	Need to stop growing energy consumption
	Opening of Temelín power plant	Opposition to nuclear power
	Restructuralization leading to reduction energy and CO2 intensity	Renewables and energy savings as an impulse for innovation and economic growth
	Kyoto Protocol (successful)	Kyoto Protocol (unsuccessful)
After 2004	Liberalization of energy market	
	Limited promotion of renewable energy sources	Expansion of renewable energy sources and energy R&D – potential for future competitiveness and economic growth □□growing

	Focus on low energy dependence and continuous electricity exports, necessary balance between green energy and economic growth	electricity imports
	Energy savings (programs for energy improvements of buildings)	Energy savings (Climate and Energy Fund)
	Expansion of nuclear power	Opposition to nuclear power
	Use of European funds (Operational Programme Environment and Operational Programme Enterprise and Innovations)	Klima:aktiv
	EU Emission Trading System	EU Emission Trading System
	Europe 2020 – setting very low targets that are easy to meet	Europe 2020 – setting high targets that often fail

Table 6: Energy policy in the Czech Republic and Austria in periods before and after 2004

7. Summary

After analyzing the two countries, it is possible to draw conclusions about the differences in resources used to generate electricity from two different perspectives: geographic and institutional.

In the case of electricity, we see that both countries prefer to use the resources available in the country: hydropower in Austria and coal in the Czech Republic. Although recently in both countries there has been a shift towards other technologies: nuclear power and renewable energy in the Czech Republic and "new" renewable resources in Austria (such as small hydropower plants, wind energy or biomass, excluding the traditional but mostly exhausted potential large hydroelectric power stations).

Most of the uranium for Czech nuclear power plants is imported from abroad. Although the country has its own internal uranium resources, they are not used for environmental and economic reasons. Therefore, it is not considered an internal source of energy. In terms of renewable resources, both countries support the continued use of biomass, which is available domestically.

Solar energy is one example of a renewable source that is not used in accordance with its availability. Countries do not have an ideal geographic location for widespread use of solar energy, but conditions in southern Austria are better than anywhere else in the region under consideration. Nevertheless, solar energy in Austria is mainly used for additional heating of water and houses, and not for electricity generation. In both countries, wind power is also used in different ways - although their share among other renewable resources is similar, wind turbines in Austria produce a higher absolute electricity volume than in the Czech Republic, although the average wind speed is comparable in both countries. This explains the existing energy balance in the production of electricity, drawing attention to the role of institutions and energy policy.

7. Market Coupling

Market integration can be promoted through market couplings. Market coupling in the European Union Internal Electricity Market (IEM) refers to the integration of two or more electricity markets from different areas through an implicit cross-border allocation

mechanism, and, from the onset of the European energy regulatory agencies, was perceived as the key instrument for the integration of EU wholesale power markets.

Instead of explicitly auctioning the cross-border transmission capacities among the market participants, market coupling makes the capacities implicitly available on the power exchanges of the various areas.

The role of the market coupling in the integration of the EU wholesale electricity markets has been prominently accentuated by the so-called Winter Energy Package of 30 November 2016. The purpose of market coupling is to maximise the economic welfare of all players. The aim of mechanism to enable the free movement of electricity between the integrated markets.

Already in 2012 the following power regions and the following power exchanges were applying market coupling: Central Western Europe (EPEX Spot (German-Austrian and France), Belpex (Belgium) and APX-ENDEX (Netherlands)), Nordic region (Nord Pool Spot (Norway, Sweden, Finland, Denmark, Estonia, Lithuania)), Central-Eastern Europe (OTE (Czech Republic and Slovakia) and HUPX (Hungary)), South Western Europe (OMIE (Spain and Portugal)) and Central-South Europe (GME (Italy) and Borzen-BSP SouthPool (Slovenia)).

In EU, the very large majority of EU Member States had their electricity markets coupled with at least one other Member State and in Central West Europe (CWE), electricity markets were deeply connected through price coupling. Coupled markets imply that power flows out of a market when prices in a neighbouring market are higher, inversely, power will be imported when domestic prices are higher.

The traded volumes can constitute a multiple of the interconnection capacity available but physical flows will be limited to the available capacity on the given interconnectors.

Market coupling is perceived as a first step towards a fully integrated market allowing short and long term trading of energy, renewable energy sources (RES), balancing services and security of supply across borders.

The two market time-frames are differentiated:

- ’single day ahead coupling'
- 'single intraday coupling'

Under market conditions, power will flow to the bidding zone which offers the highest electricity price.

7.1 Price convergence or divergence through market coupling

The analysis showed that price convergence can be a result of market coupling, however, only with a certain relationship between coal, gas and CO2 prices and a certain amount of RES feed-in. This was seen in CWE in 2011, with converging prices above 60% of the time.

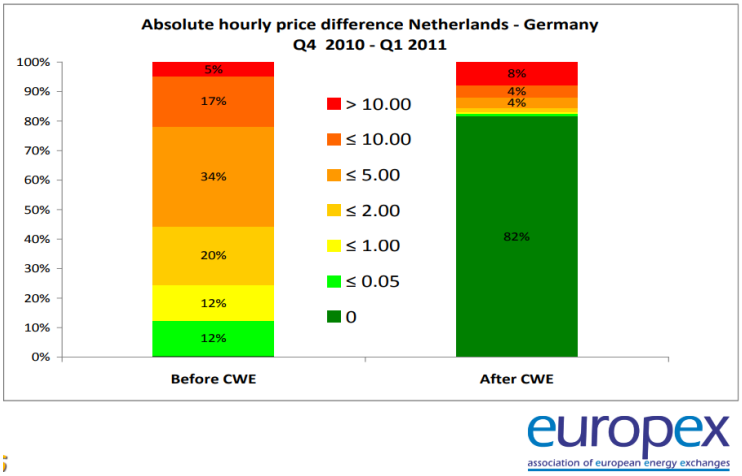


Figure 17: Price convergence through market coupling in 2011

Changing market conditions did not allow for price convergence across CWE after 2012. The analysis of fuel prices revealed that fuel price changes, resulted in price convergence or divergence. An example: As the coal price decreased and the gas price increased, gas was crowded out of the supply mix in Germany. Whereas in the Dutch market gas still plays an important role in the supply mix and influences the electricity price. Further, the analysis showed that decreasing coal prices result in a further widening of the price spread across CWE markets. Particularly, Germany benefited from the low coal prices and together with increasing solar generation during peak hours, the influence of gas vanished. Supplementary, evidence was found that the increasing share of RES in Germany also contributes to diverging prices in CWE.

Market coupling is profitable for further expansion of RES and this potential should be used as RES are an important pillar of the EU's goal to implement a lowcarbon, competitive and reliable electricity system.

Important milestones for the development of the European market coupling:

- in May 2014 Southwest Europe (SWE) joined Northwest Europe (NWE) day-ahead coupling and renamed the project to Multi-Regional Coupling (MRC), giving an important step forward towards the European Union Internal Electricity Market,
- in November 2014, the 4M Market Coupling covering Czech–Slovak–Hungarian plus Romanian market areas based also on the Price Coupling of Regions (PCR) solution, to facilitate the integration of the MRC project with the 4M project,
- on 24 February 2015, Italian borders (Italian–Austrian, Italian–French and Italian–Slovenian) have been coupled with the MRC,
- on 21 May 2015, the Central-Western European Region implemented flow-based capacity calculation (flow based market coupling - FBMC) for the first time in Europe.

7.2 Coupling of CZ, SL, HU and RO day-ahead electricity markets

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

cross- border capacity, which should enhance security of electricity supplies, improve liquidity and reduce price volatility.

7.3 Germany-Austria electricity zone

Germany and Austria share a power zone, meaning that interconnector capacity for cross-border electricity flows does not currently need to be explicitly scheduled. The zone was created in 2002 as part of a wider plan to integrate European energy markets, and is the largest cross-border power market on the Continent. However, as the amount of renewable power generated in the north of Germany has grown, the amount of power being traded between Germany and Austria has at times been twice the amount of physical capacity between the two countries, meaning excess flows spill over into the grids of neighbouring countries. Following complaints by the Polish and Czech energy regulators about the impact of Germany using their transmission systems, power transport companies will split the currently joined German and Austrian power markets from Oct. 1, 2018, regulators in both countries.

8. CONCLUSION

We conclude that the energy market has been a highly regulated market historically and will remain so in the future. The already significant role of sector-specific regulation will become even more important in the near future, given the ambitious policy objectives. Traditionally, the energy sector has been state controlled, but the Member States decided to gradually liberalise energy markets in the 1990s. Despite much progress, the liberalisation process is not completed yet. Furthermore, new developments regarding enhanced renewable energy generation and new technologies, such as smart metering, pose further challenges, but also provide new opportunities for the sector. Since the third legislative package in 2009, further market liberalisation and integration has been pursued to achieve the overarching policy objective of creating an internal energy market in the EU At the same time, ambitious renewable energy objectives have been set.

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