Exploring Contrasts in Wholesale Electricity Markets between the Czechia and Austria

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CONTENT

ABSTRACT

The wholesale electricity market is crucial for a nation's energy system, ensuring reliability and affordability through power exchange. This paper compares the Czech and Austrian markets, focusing on price dynamics, market evolution and structural characteristics. Despite geographical and demographic similarities, historical, economic and regulatory differences have led to significant disparities. Through a literature review and content analysis, this study provides a comprehensive comparison, revealing significant differences that reflect each country's unique path. The first nuance identified is that the Czech Republic is a net exporter of electricity, while Austria is a net importer. Another major difference was found in the electricity mix, with Austria relying mainly on hydropower and other renewables, while the Czechia relies mainly on nuclear power and coal. The market principles, structure, players, and pricing are almost the same, though. By explaining these dynamics, the research contributes to understanding the challenges and opportunities of energy markets in Europe towards a more energy efficient and greener future.

1. INTRODUCTION

The wholesale electricity market can be entitled the backbone of a country's energy system – it facilitates the exchange of power between producers and consumers, ensuring the reliability and affordability of electricity supply. While it might seem that energy policies of the European Union member states are harmonized, the reality is that electricity markets across member states vary thanks to unique regulatory frameworks, market structures and geographical factors. This paper is the comparative analysis of wholesale electricity markets in two European nations, the Czech Republic and Austria, mainly focused on their differences in price dynamics, market developments and structural characteristics.

At first glance, the Czech Republic and Austria are not so different countries – their area, population and geographical location are roughly the same. However, the same cannot be said about the electricity market. It is mainly due to historical and economic differences. The Czech Republic, a post-Soviet transitional economy, has undergone significant restructuring in its energy sector since the early 1990s, when it moved from a centrally planned system to a market-oriented model. On the contrary, Austria, with its well-established liberal market economy, was at the forefront of the adoption of renewable energy sources and regional integration within the European electricity market.

In conclusion, by comparing the wholesale electricity markets of the Czech Republic and Austria, this paper aims to clarify the multifaceted nature of energy market dynamics within the European context. By identifying key differences and similarities, it seeks to inform the reader about the challenges and opportunities inherent in shaping the future of energy markets in Europe. Our goal is to explore how these markets have evolved over time, understand their current workings and try make predictions on their future.

2. METHODOLOGY

Literature review and content analysis are used to achieve the objective. The latest data on laws and directives are provided by the channels of the European Commission and the Parliament or on the websites of the relevant ministry of both countries. General descriptive or statictical data on electricity can be found at Energy Regulation Authorities of Austria and Czechia or on websites such as Eurostat, OECD, IEA (International Energy Agency) or Our World in Data.

3. AUSTRIA

3.1 General overview

In 2022, Austria's gross electricity production reached 69.223 Terawatt hours (TWh), displaying an increase by 13 percent between 2000 and 2022.
Hydroelectric power plants played a significant role, contributing 56.7 percent to total electricity production. This is not a novel developement, as is indicated by Figure 2. Natural gas came second, holding 15.7 percent of electricity generation in 2022. Wind power made a notable contribution of 10.5 percent, while biofuels accounted for 5.5 percent of Austria's electricity production. Photovoltaic generation also played in important role, contributing 5.5 percent and coal, albeit less prominent, still contributed 2.8 percent in 2022. Over the past two decades, the proportion of electricity generated from hydropower and natural gas has exhibited fluctuations. In contrast, wind and solar power have experienced a consistent upward trajectory in usage from 2000 to 2022.
Twenty percent of Austria's total energy-related emissions originate from power generation, comprising 42.8 percent from natural gas, 36.5 percent from coal, 8.1 percent from oil, and 12.6 percent from other sources.

Typically, production and consumption align closely, but in 2022, there was a notable discrepancy. Net electricity imports surged to 8.705 TWh, comprising 13.8 percent of the total electricity supply for the year. This marked a significant 107 percent increase compared to 2000.

In 2022, per capita electricity consumption reached 8.249 Megawatt hours (MWh), indicating a 17 percent rise compared to the year 2000. Significant portions of consumed electricity are being utilized by industry (43 percent), private households (31.5 percent), commercial and public services (18.4 percent), and transport (5 percent). [1]

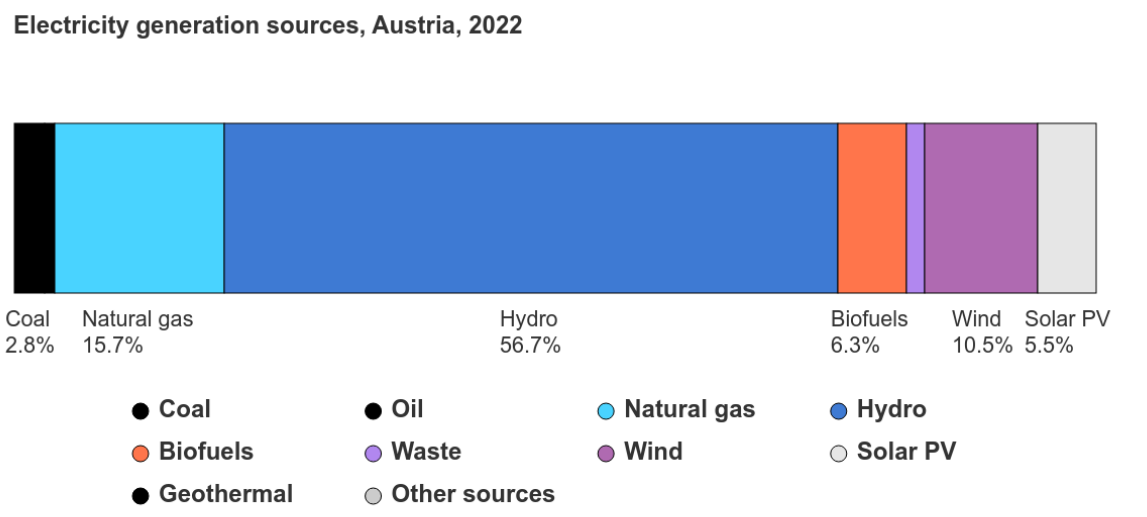


Figure 1: Source: https://www.iea.org/countries/austria/electricity

[1] https://www.iea.org/countries/austria/electricity

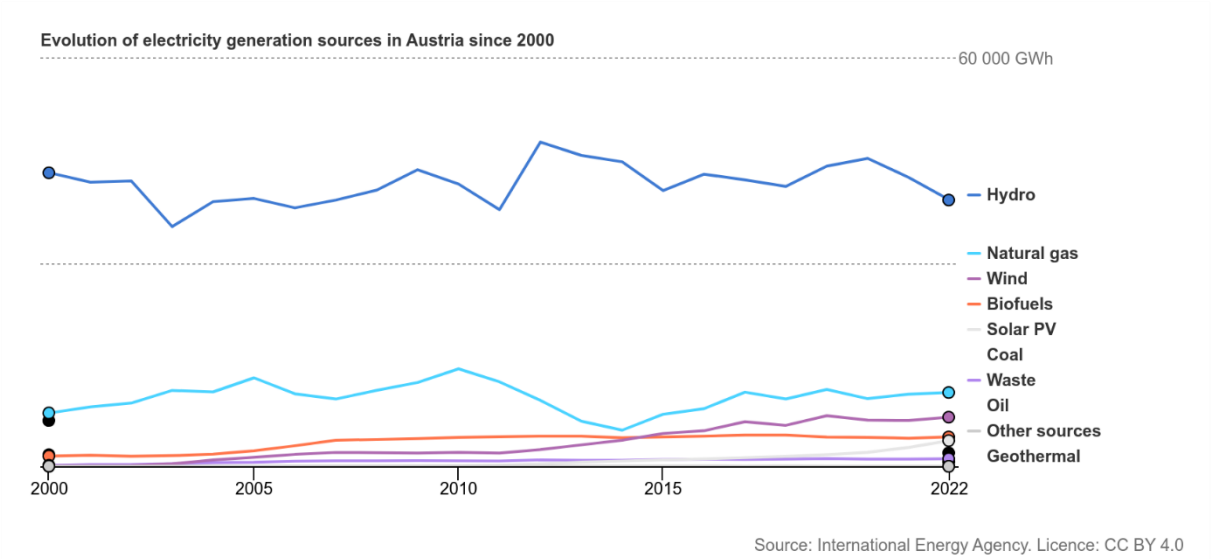


Figure 2: Source: https://www.iea.org/countries/austria/electricity

3.2 Wholesale electricity market

3.2.1. Basic principles

The electricity market in Austria is operated within a framework that consists of EU legislation, federal and provincial Austrian rules, decisions made by the regulatory authority E-Control Austria and the Market Rules.

When the Austrian electricity market was fully liberalised in 2001, a great number of technical and organisatorical changes were introduced. Presently, the liberalised Austrian electricity market adheres to the following basic principles:

- Grid operation is distinct from competitive activities like generation, wholesale, and retail.
- Distribution system operators (DSOs) are chiefly responsible for ensuring secure grid operation, metering, and managing grid user data.
- Transmission system operators (TSOs), besides managing transmission grids, also act as control area managers (CAMs). In this role, they maintain balance between electricity injection and withdrawal.
- Balance groups were introduced, allowing consumers, generators, suppliers, and wholesalers to trade with each other. Membership in a balance group is required for those interacting with the grid in any capacity.
- Each grid user (consumer or producer) enters contracts with both the grid operator and their chosen supplier or trader.
- Electric energy feed-in and off-take are forecasted, cleared, and settled in 15-minute intervals. However, smaller users (e.g., households and small enterprises) are typically metered annually using standardized load profiles.

3.2.2. Market participants

The opening of energy markets brought new roles and changed the responsibilities of existing players.

The energy market is comprised by several market players, such as:

Control area manager: To be able to technically control the flow of energy in the European power grid and keep the frequency within permissible limits, the European transmission network has been divided into control areas. Control area operators are responsible for power-frequency control in their control area, with tasks being shared internationally. The control area operator (the Austrian Power Grid AG)

- maintains the grid frequency within a specified range and ensures compliance with agreed-upon power exchanges between control areas;
- plans, procures, and activates the required control reserves from control reserve providers and settles with them;
- transmits to the balancing group coordinator the quantities of control energy and the costs of control reserves and bills them to the balancing group coordinator.

Balancing group coordinator: The Balancing Group Coordinator operates the settlement office for the allocation of balancing energy via clearing. The Balancing Group Coordinator (the APCS Power Clearing and Settlement AG)

- receives from the Control Area Operator the quantities and costs of control reserve;
- calculates for each balancing group the difference between generation and procurement as well as consumption and sale of electricity based on the actual values measured by the grid operators and the trading schedules (balancing energy);
- assigns individual balancing energy to the balancing group responsible and bills them accordingly.

Balancing Group Managers: A balancing group is a collection of metering points and/or traders forming a virtual group where balancing between generation and consumption takes place. Every supplier (for customers with energy supply contracts and associated metering points), control reserve provider, and trader is obligated to join a balancing group. Balancing group managers represent the balancing groups to other market participants. The responsibilities of balancing group managers include:

- Creating schedules for their balancing groups; they collect forecasts for generation and consumption from relevant members of their balancing groups as well as trading schedules.
- Sending intra-control area schedules to the balancing group coordinator and cross-control area schedules to the control area operator.
- Receiving settlement of balancing energy from the balancing group coordinator and settling this with suppliers.

Network Operators: Network operators provide the service of transporting (transmission system operators) or distributing (distribution system operators) electrical energy. They are required to take all necessary measures to ensure stable network operation due to technical constraints. In particular, they must guarantee the functionality of their networks through long-term investments. The transmission system operator additionally handles electricity transit. The responsibilities of network operators include:

- Establishing network contracts with their network users based on general terms and conditions and providing network access.
- Supplying their network users with electrical energy.
- Operating metering equipment, measuring electricity quantities, and assigning them to balancing groups.
- Transmitting electricity quantities per balancing group to the balancing group coordinator.
- Billing system usage fees (fees set by regulation) to their network users.

Suppliers: Suppliers supply electricity to their customers or purchase it from them. Network operators must grant all suppliers non-discriminatory access to their networks. Customers can freely choose their supplier. The responsibilities of suppliers include:

- Having energy supply contracts with their customers (producers and/or consumers).
- Conducting forecasts for the generation and consumption of their customers and providing these to the balancing group managers.
- Billing their customers for the energy generated or consumed.

Control Reserve Providers: Control reserve providers are market participants who meet all the requirements to participate in control reserve markets and offer control reserve in the control area operator's solicitations. Control reserve providers can also aggregate control reserves (aggregators) or utilize third parties who physically provide control reserves (control reserve providers). Control reserve providers can be producers or consumers (customers). The responsibilities of control reserve providers include:

- Pre-qualifying with the control area operator for one or more control reserve markets.
- Participating in solicitations for control reserve.
- Being compensated by the control area operator after successful bids or calls.

Customers: Customers are primarily end consumers who purchase electrical energy for their own use - and increasingly producers. They

- have a contract with a supplier (freely selectable) and, as network users, a contract with a network operator.
- receive invoices from suppliers for the energy consumed or generated.
- Can provide control reserve either directly or through a contract with a control reserve provider.[2]

[2] https://www.e-control.at/en/marktteilnehmer/strom/strommarkt/marktteilnehmer

3.2.3. Regulation Authority

The main energy regulatory authority is E-Control, which is in charge of regulating and monitoring both the electricity market and the gas market. Pursuant to the E-Control Act 2010 5 (Energie-Control-Gesetz 2010), the supervisory tasks of E-Control include monitoring compliance with competition rules and drawing up and publishing comparisons of electricity tariffs. E-Control also has the authority to enact regulations (in the form of "ordinances") on the functioning of the Austrian electricity market. The general terms and conditions of network operators have to be approved by E-Control.

The Austrian Energy Agency (AEA) is the Austrian energy research and policy institution in which the federal and the provincial administration and a number of important institutions and corporations (e.g. EVN, ÖBB, Wien Energie) from a variety of economic sectors cooperate. The AEA's scope of activities comprises the implementation of national and international projects and programmes, the implementation of public relations assignments and the development of strategies in the fields of, for example, energy politics, energy law, renewable energy and biomass, research and development and the development of energy-efficient buildings, devices and businesses.[3]

3.2.4. Electricity Exchange

On the Austrian energy exchange for electricity (EXAA, Energy Exchange Austria), electricity is traded on a day-ahead basis for delivery in Austria or Germany. In the absence of congestion, the wholesale market for electricity is fully coupled with Germany and forms a single price zone. Therefore electricity can also be traded at EPEX Spot situated in Paris on an Intraday and Day-Ahead basis for the Austrian/German delivery zone. Similarly, derivatives at EEX (European Energy Exchange) situated in Leipzig, such as Phelix Futures can be traded for Austria/Germany.[4]

3.2.5. Price Development

In March 2024, the average wholesale electricity price in Austria amounted to approximately 63.6 euros per megawatt-hour. In August 2022, Austria's electricity prices reached a record high, at around 489.5 euros per megawatt-hour. Between mid-2021 and mid-2022, figures soared across Europe, the consequence of an energy supply shortage which severely impacted the continent. The situation was further aggravated after Russia's invasion of Ukraine in February 2022.

[3] https://cms.law/en/int/expert-guides/cms-expert-guide-to-electricity/austria
[4] https://www.exaa.at/en/

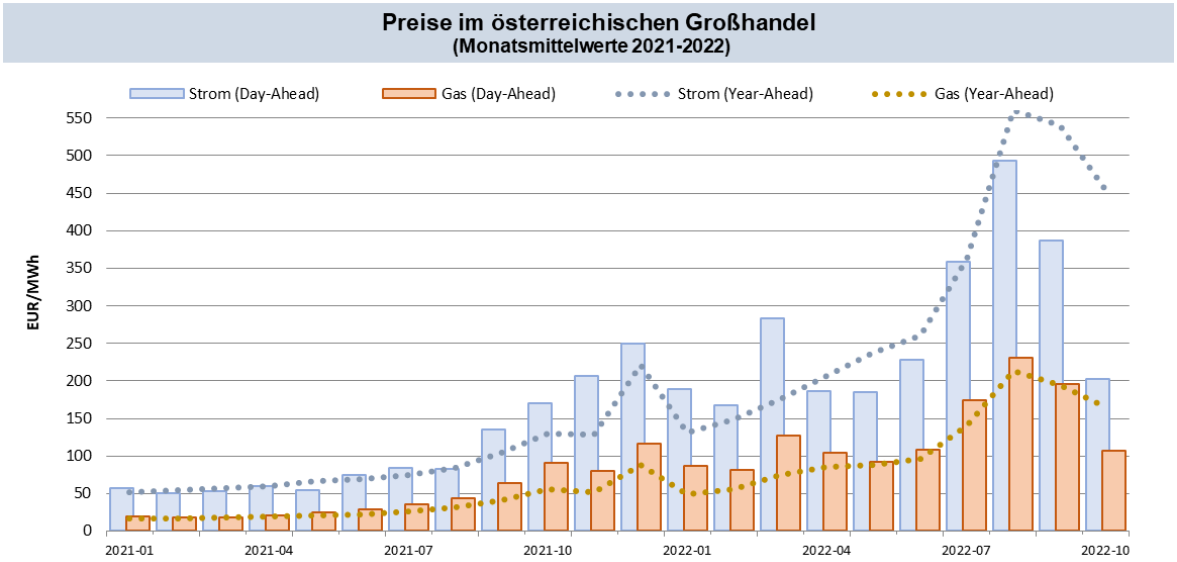


Figure 3: Source:https://www.e-control.at/gewerbe-newsletter-5/20222/-/asset_publisher/g53aNcEw1mMH/content/g-gro%25C3%259Fhandelsm%25C3%25A4rkte-1

3.2.6. Future Prospect

Austria is committed to reaching climate neutrality by 2040. Over three quarter of electricity generation already comes from renewables, with a target of achieving a 100% renewable electricity supply by 2030 (national balance). This requires investments to make networks more resilient and flexible, optimise demand side management, and updating the legal and regulatory framework to allow more consumer participation. Buildings and transport account for around half of total emissions. To progress the transition in these sectors, the government supports building renovation, switching from fossil fuels to sustainable heating systems, the electrification of transport and invests in public transport infrastructure.

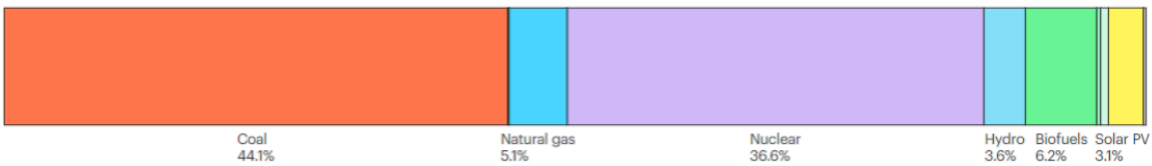
4. CZECH REPUBLIC

4.1 General Overview

The Czech Republic's electricity consumption has been steadily increasing over the years, driven by economic growth and industrial development. Net domestic consumption was around 60 TWh in 2022 and consumption per capita has increased by 12 % since 2000. Production of electricity in Czechia is higher than consumption, therefore Czechia is net exporter of electricity. In 2022 electricity generation reached 78.8 TWh and decreased slightly compared to year 2021 [1,2].

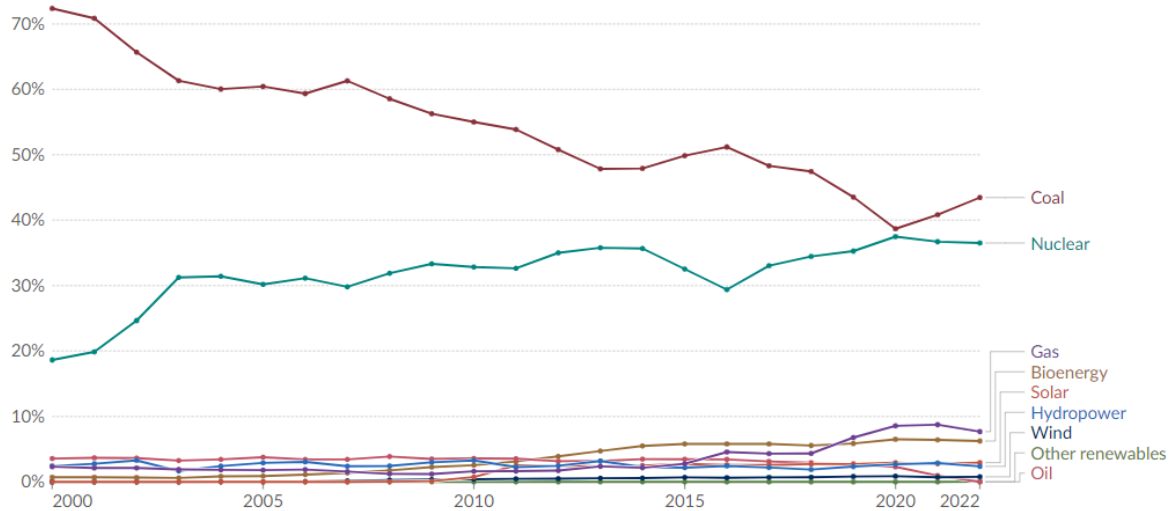
The country's energy sector is characterized by a diverse mix of energy sources, including coal, nuclear, natural gas, and renewables. While coal and nuclear power have historically been the dominant sources of electricity generation, the country has been gradually transitioning towards cleaner and more sustainable energy sources, such as wind, solar, and biomass. This transition is driven by various factors, including environmental concerns, technological advancements, and European Union directives aimed at reducing greenhouse gas emissions and increasing renewable energy deployment. However, the target of 42.5 % renewable energy by 2030 that EU set in September 2023 still looks unattainable for Czechia [3]. Share of renewable sources in Czechia electricity consumption in 2022 was only 18,2 % and share of renewables in electricity generation was only 12 % [4]. The biggest share had coal (44 %) and nuclear (36 %) (via Figure 1 and 2). The country is committed to phase-out coal by 2033 and plans to build new nuclear units at existing sites [2].

Figure 4: Electricity generation sources in Czechia in 2022



Source: IEA, 2024 [8]

Figure 5: Share of electricity production in Czechia from 2000 to 2022



Source: Our World in Data, 2024 [9]

4.2 Wholesale Electricity Market

The wholesale electricity market in the Czech Republic has undergone significant evolution since its inception. Historically, the market operated in a monopolistic environment, with state-owned entities dominating generation, transmission, and distribution. However, with the liberalization of the energy sector in the 1990s, the market opened up to competition, leading to the emergence of independent power producers, traders, and suppliers.

4.2.1. Basic Principles

In the Czech Republic, electricity is traded at Prague-based Power Exchange Central Europe (PXE), and at the wholesale level in the Czech Republic, electricity is traded via European Energy Exchange (EEX), through bilateral (over-the-counter) contracts, and in spot markets organised by the market operator OTE, a.s. [19].

After the Czech Republic joined the European Union on May 1, 2004, Czechia is required to comply with EU energy legislation, which is continuously developing in order to establish and maintain a competitive, secure and environmentally sustainable electricity market. The electricity supply market was liberalized on January 1, 2006, which brought similar changes as in Austria (described in the previous chapter) thanks to common EU regulations:

- The Czech electricity market has been unbundled and split into 4 segments: generation, transmission, distribution and supply to end-consumers.
- Large part of the generation, distribution and supply segments are integrated businesses owned by ČEZ, a.s. and its subsidiaries (CEZ Group).
- Sales to end-consumers have been liberalised but access to transmission and distribution grids remains regulated.
- The Czech electricity transmission network is interconnected with its neighboring countries and provides a transit system for Slovakia (SEPS), Poland (PSE), Austria (APG) and Germany (VET, E.ON).

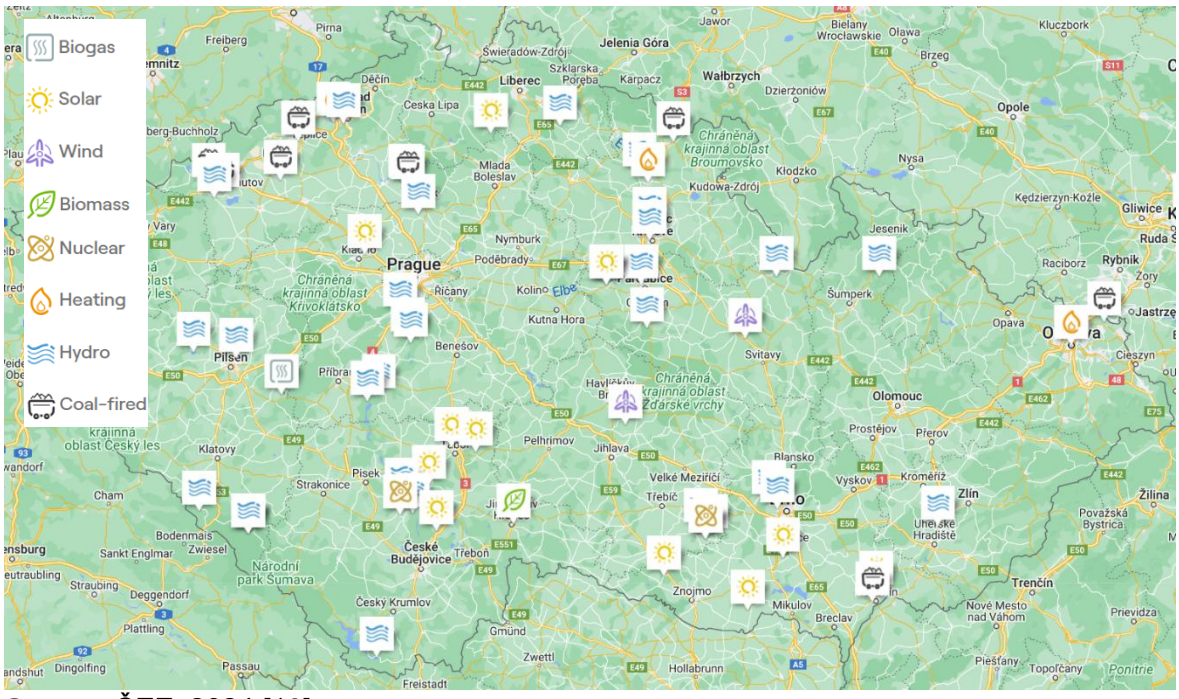
4.2.2. Market Participants

Key stakeholders in the Czech electricity sector include generators, transmission system operators, distribution system operators, suppliers, and regulatory authorities such as the Ministry of Industry and Trade and the Czech Energy Regulatory Office.

In the Czech electricity market are active following participants [7]:

Generators: The Czech Republic boasts a robust infrastructure network to support its electricity sector. This includes a diverse portfolio of generation assets, ranging from conventional thermal power plants to renewable energy installations. The country's nuclear power plants play a crucial role in providing baseload electricity and ensuring grid stability. The dominant electricity generator providing approximately 2/3 of the electricity used in the Czech Republic is **ČEZ**, a.s. ČEZ had 28 727 employees in 2022 and owns 7 coal, 2 nuclear (Temelín and Dukovany), 31 hydro (3 pumped), 12 photovoltaic and other power plants (via Figure 3). Other large electricity producers include Sev.en Energy AG, Sokolovská uhelná, a.s. and Energy and Industry Holding.

Figure 6: Powerplatnts in Czechia operated by ČEZ



Source: ČEZ, 2024 [10]

The transmission grid operator: In 2003, ČEZ transferred the entire Czech transmission grid to **ČEPS** (Czech Power System). ČEPS operates in the Czech Republic as the exclusive operator of the transmission system (TSO) based on a license from the ERO. ČEPS is fully owned by the Czech state and it is a joint stock company, which is responsible for the maintenance and upgrading of 44 substations comprising 79 transformers, which allow electricity to be supplied from the transmission system to the distribution network, as well as 400kV lines with a total length of 3,867 km and 220kV lines with a total length of 1,824 km [6]. Other ČEPS functions include:

- balancing the supply and demand of electricity on a minute-by-minute basis;
- ensuring the transmission of electricity between generators and distributors;
- assisting in the allocation of available transmission capacities to interconnectors through auctions;
- cooperating with other TSOs in Europe;
- contributing to the development of the Czech and European electricity markets.

Distribution grid operators (DSOs)**:** The distribution system is predominantly owned and operated by three joint stock companies created from REAS (as a result of privatization): **ČEZ Distribuce**, E.ON Distribuce and PREdistribuce. Relevant market participants must be provided with full access to the Czech transmission and distribution networks, including the ability to transmit or distribute electricity throughout the networks to the technically practicable extent. However, there are about 300 licensed distributors in the Czech market and their main function is to distribute and manage energy from the generation sources to the final consumers.

The market operator: The Czech electricity market operator is **OTE, a.s**. It is owned by the Czech Republic and its responsibility is to administer and report on the electricity markets and perform an accounting function in respect of the energy balancing market (in cooperation with ČEPS and TSO). OTE processes and publishes monthly and annual reports on the electricity markets, including informing TSO of non-compliance with payment obligations by market participants. OTE also organizes the short-term electricity markets.

Electricity traders: Besides OTE, trading on the electricity spot market is organised by Power Exchange Central Europe (**PXE**), which is the main platform for trading wholesale electricity in the Czechia. PXE is a subsidiary of the Prague Stock Exchange where market participants (entities or individuals) buy and sell electricity as a commodity for financial gain through auctions and bilateral contracts. PXE operates various market segments, including day-ahead, intraday, and balancing markets, to ensure efficient price discovery and grid stability. Additionally, the Czech Republic's strategic geographic location in Central Europe makes it an important energy hub, with significant opportunities for regional cooperation and energy trade with neighboring markets like Slovak and Hungarian.

End-consumers: The last link in the electricity supply-consumer chain are customers (households or enterprises) who are buying the electricity from suppliers based on the contract. Before liberalization, end-consumers were classified as ‘protected customers’ and the price of electricity was determined by the ERO. After the electricity market liberalization, end-consumers can freely choose their electricity provider based on current market conditions like price, service quality, and sustainability criteria. By law, the customer has the right to the supply of energy of adequate quality.

4.2.3. Regulation Authority

The main government authorities which supervise the Czech energy sector are the Energy Regulatory Office (**ERO**), the State Energy Inspectorate (SEI), the Ministry of Industry and Trade in the Czech Republic, the Ministry of Environmental Matters of the Czech Republic and the State Office for Nuclear Safety (SONS) [7].

ERO serves as the national Czech energy regulator who is responsible for:

- licensing entities on the electricity market (generators, operators and traders),
- pricing and setting tariffs for the regulated part of electricity, where economic competition is not ensured, e.g. transmission and distribution (natural monopolies),
- quality regulation across the entire energy value chain.

ERO’s head office is in Jihlava and it was established in 2001 by the Energy Act (458/2000), which also sets out its competences [5]. The ERO's primary objective is to create a level playing field for market participants, promote investment in infrastructure, and safeguard the interests of consumers. ERO had 251 employees in 2021.

4.2.4. Wholesale electricity market types

In the Czech Republic, wholesale electricity markets can be categorized into several types based on their operational characteristics, market design and time horizont [11]:

i.a Unorganized Market

In this market, bilateral agreements are concluded where two parties negotiate the terms of the trade independently without being restricted by rules. However, these agreements must be reported to the market operator by a certain deadline before the trade is concluded. The disadvantage of this trading method is the search for a counterparty with whom all conditions must be negotiated, which can sometimes be impossible. On the other hand, very specific trades can be negotiated, which could not take place on the stock exchange.

i.b Organized Market

In the organized market, participants have one central counterparty, such as a stock exchange. The exchange manages the market, sets the rules, and ensures the financial settlement of trades. Finding trading transactions can be done:

- through auction, where bids and offers are submitted before the deadline, and then the auction is evaluated as the intersection of the supply and demand curves;
- trades take place continuously, where bids and offers are matched immediately if there is a corresponding counterparty (if not, the bid or offer waits for a specified time to see if a matching counterparty appears).

ii.a Long-Term Market

As the name suggests, trading on this market takes place over longer and more distant time horizons. This market functions more as financial hedging of electricity prices in the long term. Physical delivery of electricity may not always occur on this market. The contracts traded on this market include futures, forwards or Contracts for Difference (CfD).

ii.b Short-Term Market

Trading on this market takes place with delivery ranging from days to hours in advance. There are also several ways to trade here:

I. Block Market – trading on the block market is done with products: Base, Peak, or Off-Peak. The names determine the time of day the delivery is closed (Base = whole day, Peak = from 8 to 20 o'clock, Off-Peak = from 20 to 8 o'clock).
II. Day-ahead Market – trading is done with delivery for the next day. Trading takes place in the form of 24 auctions – one for each hour of the day. The result of the auction is always the final price and traded quantity of energy. This is the most liquid market, setting the reference price for most of the electricity traded in the country.
III. Intraday Market – trading on the intraday market takes place on the same day, usually at least one hour in advance. Participants who unexpectedly have a shortage or surplus of energy can secure their position on this market and trading on this market is done continuously.
IV. Balancing Market – this market has a central demand/supply managed by the transmission system operator, closes 30 minutes before the start of delivery, and the transmission system operator can purchase balancing energy here.

4.2.5. Price development

In March 2024, the average wholesale electricity price in Czechia was at the level of 65 EUR/MWh, which is big descrease in comparison to the previous years. While the amount of electricity traded in the markets hasnť changed that much in the 3 previous years, electricity prices have been extremely changing thanks to energy supply shortage that severely impacted Europe (via Figure 7). The causes of the crisis are post-COVID economic recovery starting in 2021, Russian interference with gas supply to the EU and Russian invasion of Ukraine [17].

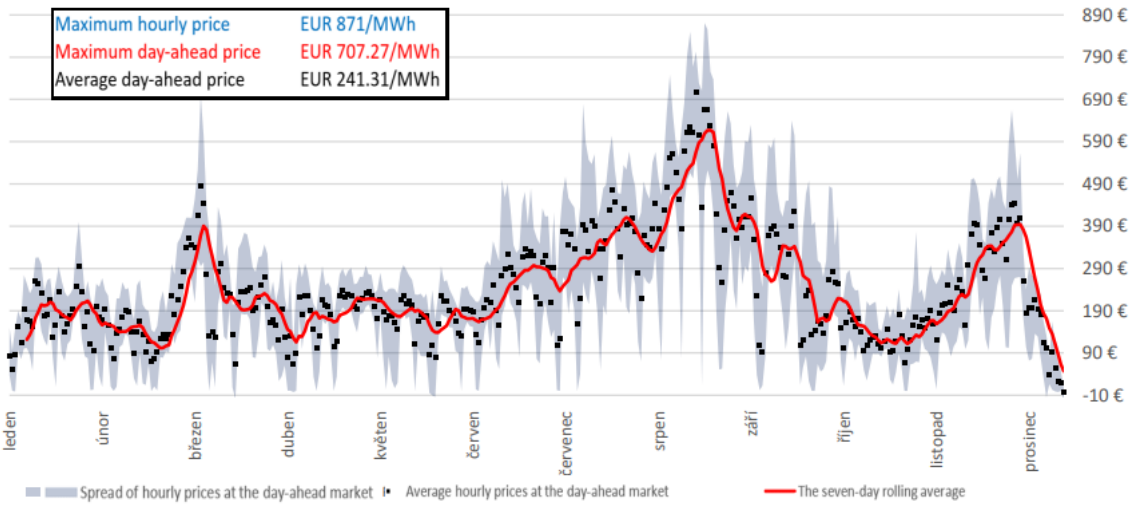
Figure 7: Electricity wholesale market indicators

	2018	2019	2020	2021	2022
Volume traded in the spot electricity market [GWh]	23,459	24,909	26,853	29,578	29,419
Volume traded at PXE futures market [GWh]	26,410	31,511	27,063	33,793	13,675
Total traded volume [GWh]	49,869	56,420	53,916	63,371	43,094
Average incremental price in the day-ahead market [EUR/MWh]	46.02	40.21	33.62	100.66	247.43

Source: ERO, 2023 [19]

The year 2022 was extremely volatile from the perspective of spot and forward electricity prices – in the first half of the year, wholesale electricity prices varied at the successive price level of EUR 100-390/MWh, but they started to surge in the second half of the year (via Figure 8). At the end of the year, the maximum hourly price at the day-ahead market climbed to EUR 871/MWh. The high electricity prices were caused by a combination of the rising prices of natural gas, emission allowances, and other energy commodities.

Figure 8: Czech electricity spot market (day-ahead market) in 2022 [EUR/MWh]



Source: ERO, 2023 [19]

4.2.6. Future Prospect

Looking ahead, the future of the wholesale electricity market in the Czech Republic is likely to be shaped by factors such as renewable energy integration, market coupling with neighboring countries, and technological advancements, including smart grid technologies and demand response. Czechia is Europe's third largest coal power producer (after Germany and Poland) with the highest emissons per capita which means that transition away from fossil fuels is needed [12].

While the goal of EU funds is to support a sustainable low-carbon-emission economy and ensure energy security by utilizing alternative energies, the Czech approach is different. Due to EU regulations, the country is committed to phase-out coal by 2033 so the share of coal energy will be decreasing every year. However, it will be replaced by both large nuclear reactors and ČEZ is already in the middle of the installation of a series of small modular reactors. The share of alternative energies will grow but its potential for becoming the backbone of the energy sector is unclear [1].

The State Energy Policy examines in detail 6 different scenarios, energy mixes, how the Czech Republic's consumption could be covered in the future: Gas, Green, Optimized, Safe, Conventional, Decarbonisation. The first two scenarios, Gas and Green, were excluded due to failure to meet the strategic objective which was national energy security. In both scenarios, the Czech Republic would be dependent on foreign energy supply. In all other scenarios, the development of nuclear energy is envisaged, with the Optimized Scenario, according to which the Czech Republic needs a total of 3 new nuclear reactors, being evaluated as the most appropriate scenario [13].

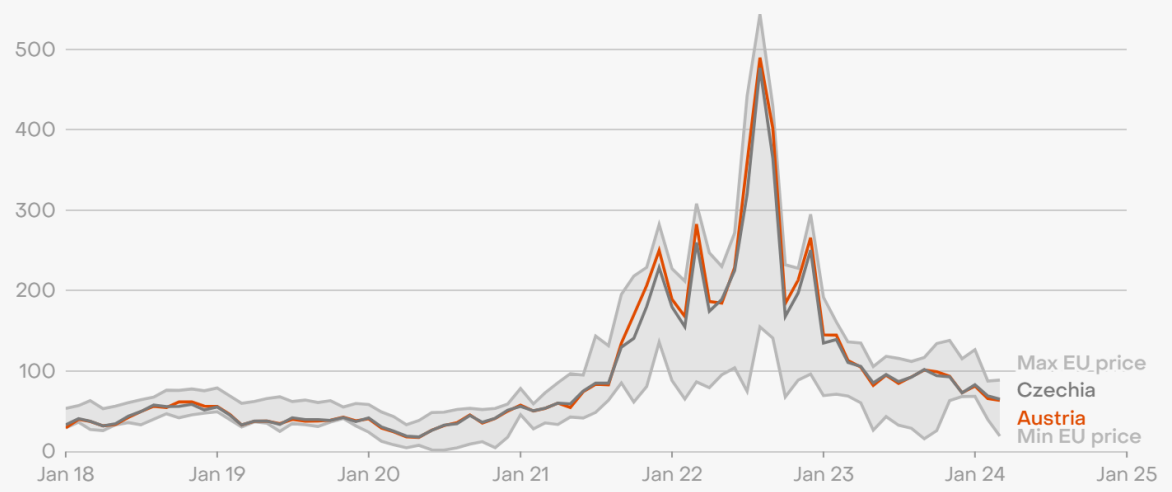
According to the State Energy Policy, the target value of a portion of power generation from primary sources in total gross power generation as of 2040 is at least 80 %, considering the following power generation structure [13]:

- nuclear fuel 46 up to 58 %,
- renewable and secondary resources 18 up to 25 %,
- natural gas 5 up to 15 %,
- brown coal and black coal 11 up to 21 %.

5. COMPARSION BETWEEN AUSTRIA, CZECHIA AND EUROPEAN UNION

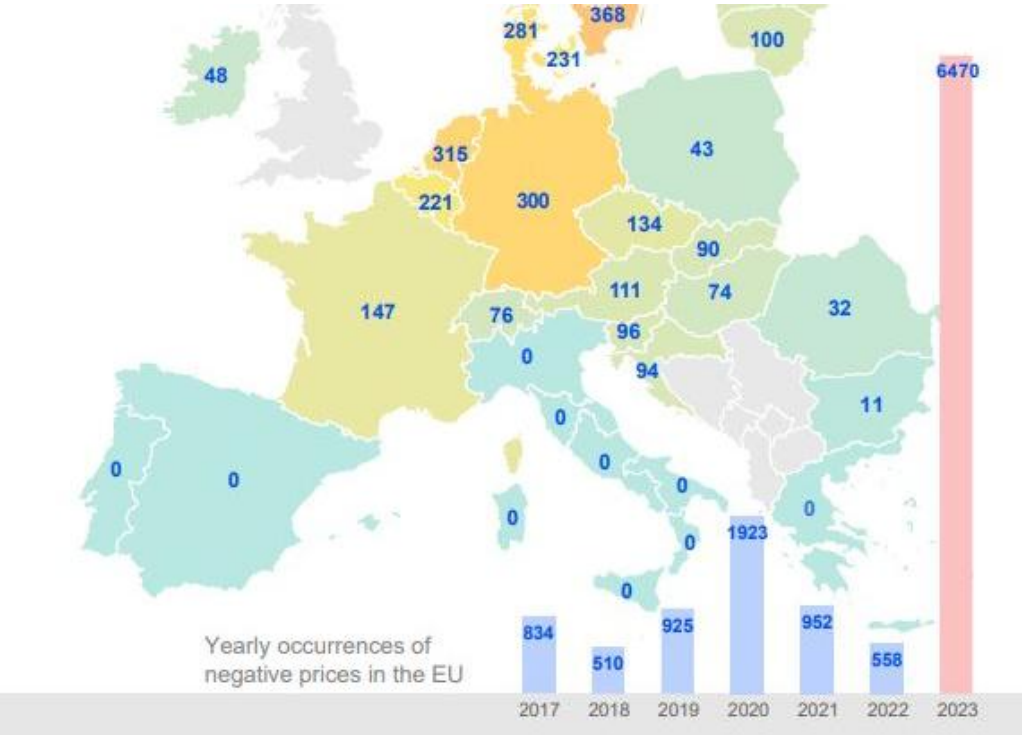
Currently, several hundred companies are involved in wholesale electricity trading in Europe and more than 10 000 transactions take place every day. Wholesale prices are highly sensitive to available production and transmission capacity, as energy has to be produced when it is needed and cannot be stored on an industrial scale [14]. The market situation in the EU countries was changing dramatically between January 2022 and January 2024 due to energy supply shortages, and in 2023 there was even an unprecedented record of negative prices (via Figure 10) as a result of the increasing share of renewables. However, the development of wholesale electricity prices in the Czech Republic and Austria was almost identical (via Figure 9).

Figure 9: Wholesale electricity prices in EU from 2018 to now (in € per megawatt hour)



Source: EMBER, 2024 [15]

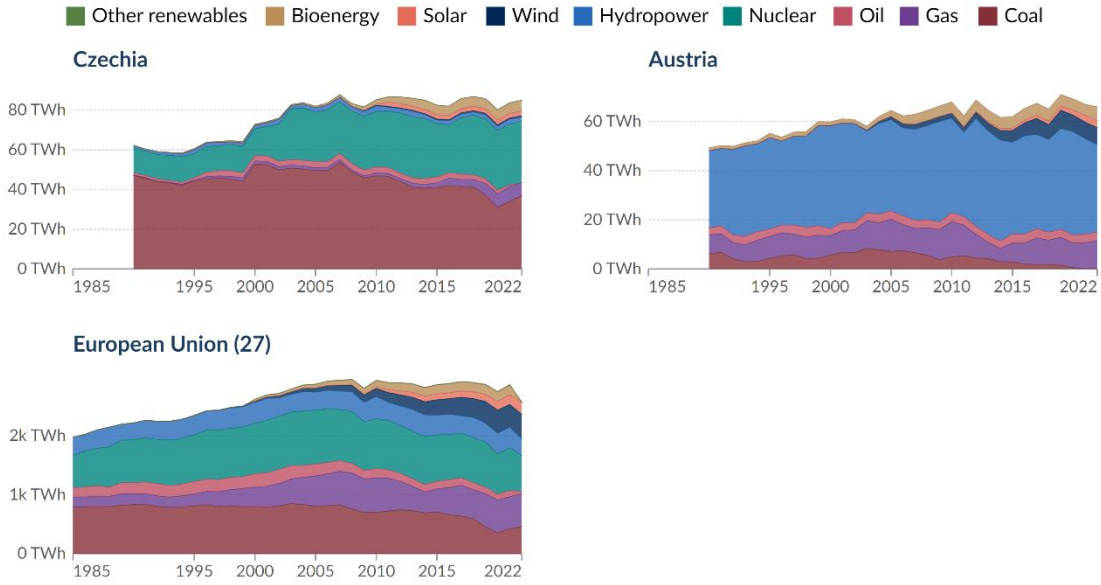
Figure 10: Occurrence of negative electricity prices on individual markets in EU in 2023



Source: ACER, 2023 [16]

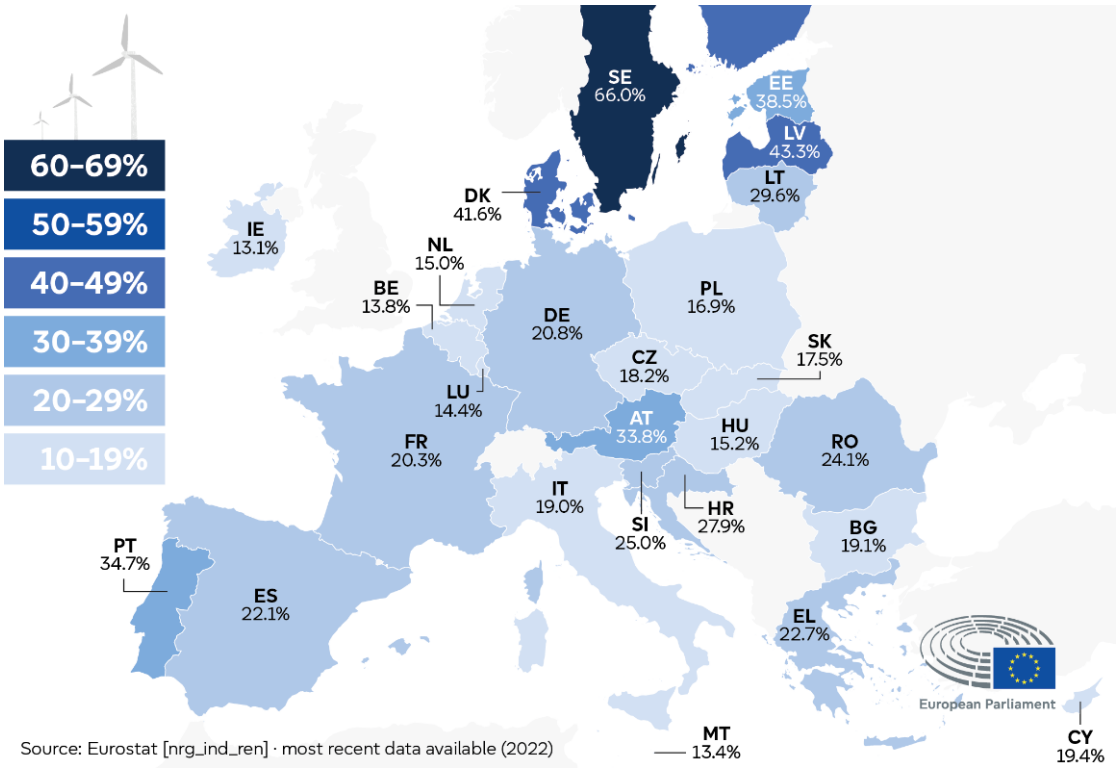
The electricity mix of EU and its countries differ considerably. The largest source of electricity production within the EU is nuclear energy, in Austria hydropower and in the Czech Republic coal (via Figure 11). Although European Union supports conservation efforts and increasing the use of renewable energy sources, not every country is close to meeting the EU's binding renewable energy target of at least 42.5 % by 2030. Austria is much better on its way to achieving this goal than Czechia (via Figure 12).

Figure 11: Electricity production by source in Czechia, Austria and EU



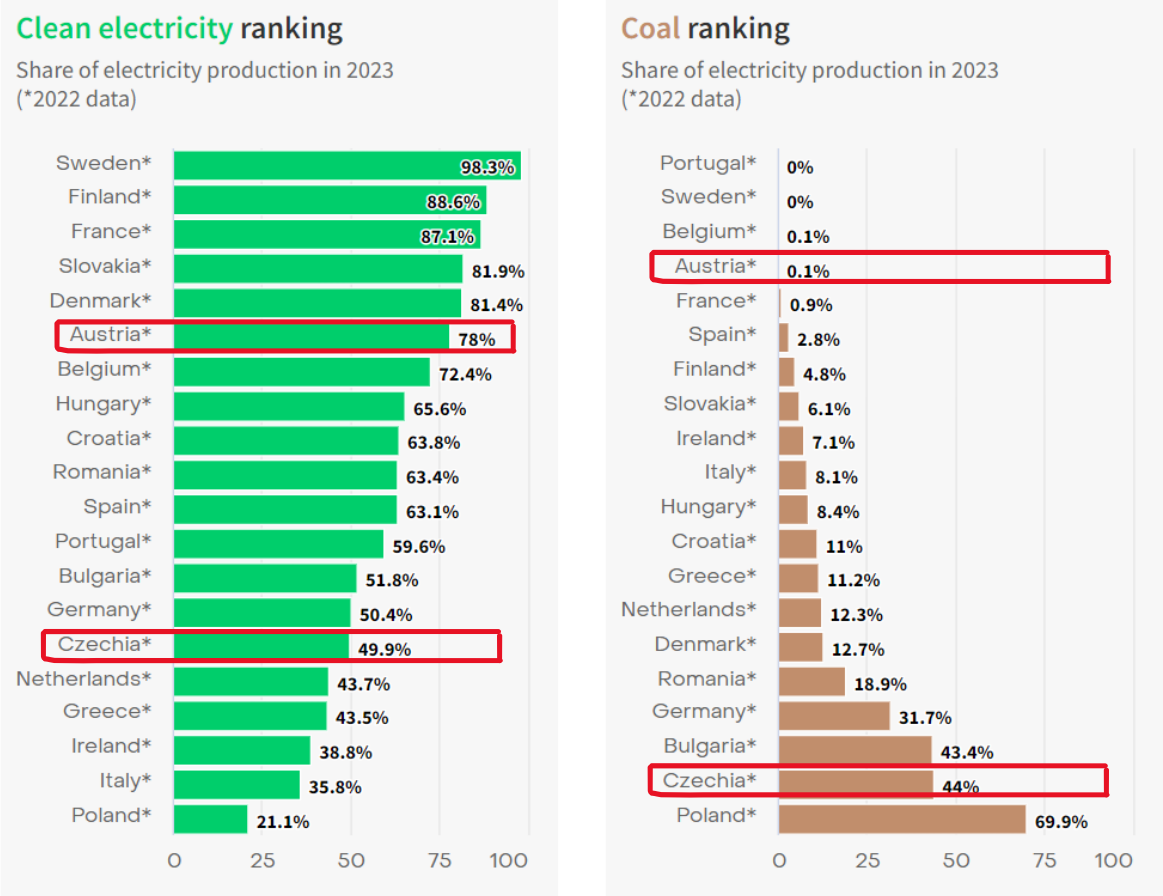
Data source: Ember - Yearly Electricity Data (2023); Ember - European Electricity Review (2022); Energy Institute - Statistical Review of World Energy (2023)
Note: Other renewables include waste, geothermal, wave and tidal.

Figure 12: Share of renewable energy in overal consumption per country in 2022



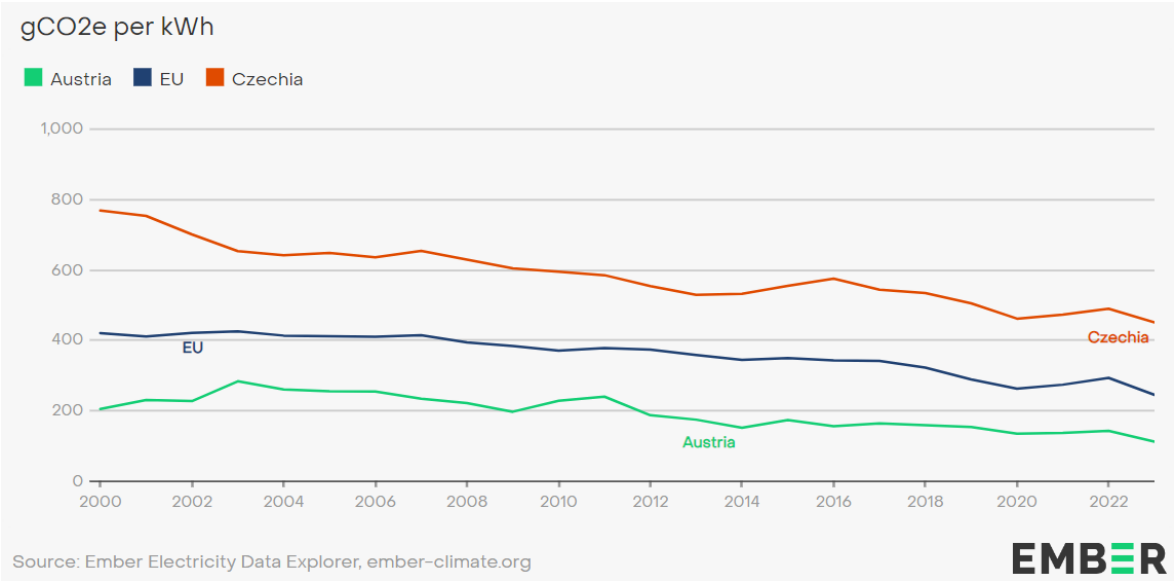
Austria is even in top 6 countries in the Clean electricity ranking, while Czechia is at the bottom of the ladder (via Figure 13). This is due to the large difference in share of coal in electricity production in both countries. Emissions from energy production are thanks to coal in the Czech republic under the EU average and in Austria above (via Figure 14).

Figure 13: Rank of 20 largest electricity generators in EU



Source: EMBER, 2023 [18]

Figure 14: Yearly CO_2 emissions intensity in Austria and Czechia



6. CONCLUSION

Both Austria and the Czech Republic are important players in the European electricity markets. In terms of electricity consumption, the Czech Republic and Austria are fairly similar. However, a notable contrast emerges in their electricity production. Over the past two decades, Austria has predominantly been a net importer of energy, whereas the Czech Republic has consistently exported electricity from 2000 to 2022.

Moreover, there's a significant disparity in their energy mixes. Austria primarily relies on hydropower and other renewable energy sources, whereas the Czech Republic's energy landscape is dominated by coal and nuclear power. Consequently, power-related emissions in the Czech Republic constitute 50 percent of the total, compared to 20 percent in Austria. This indicates a much greater climate impact from electricity generation in the Czech Republic compared to Austria.

The basic principles of both countries are the same, following the legal framework of the European Union’s internal energy market. Both countries‘ electricity markets have been unbundled and split in into generation, transmission, distribution and supply to end-consumers segments. Accordingly, sales to end-consumers have been liberalised whilst access to transmission and distribution grids remains regulated. The main market players in both countries follow a similar pattern. They engage in the broader European electricity market while also trading on national exchanges such as EXAA in Austria and PXE in the Czech Republic.

Even wholesale electricity prices in Austria and Czechia fluctuate in a relatively similar way. Prices have been stable around 40 EUR/MWh until the end of 2020, when energy supply shortages drove electricity prices up to between 150 and 270 EUR/MWh, and in August 2022 both countries reached new price highs.

In terms of future prospects, both countries diverge significantly. The Czech Republic aims to expand the use of nuclear reactors, whereas Austria focuses on boosting solar power and other renewable sources. However, nuclear and renewables are seen as key to ensuring energy security and meeting climate commitments, so both countries are well on their way to developing sustainable electricity markets.

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