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Co-funded by the European Union

UNIFHY

Regional self-assessment

GREEN

Moravian-Silesian Region
Czech Republic

2025_12_17
Design - version 2

Content

Aim of the document

This Regional Self-Assessment (RSA) identifies the obstacles and challenges that hinder the development of low-carbon gas value chains (i.e. biomethane and hydrogen, etc.), as well as the opportunities that low-carbon gases could bring in the energy transition in partner regions.

It will also provide a contemporary vision of the political, economic, socio-cultural, technological, legal, environmental and other factors that could condition the development of this low-carbon gas ecosystem in each region.

This detailed analysis will allow to address policy improvements for a specific regional policy instrument in the field of low-carbon gas ecosystem development, through several key objectives, such as:

- Map the regulatory framework affecting the development and implementation of low-carbon gases in the region's energy system, including legislation, incentives and potential constraints.
- Analyze existing energy infrastructure and identify public and private facilities where low-carbon gases can be integrated as part of the energy transition.
- Explore the challenges (such as funding constraints, regulatory barriers, technological bottlenecks and the need for cross-sectoral coordination) in deploying energy solutions based on low-carbon gases.
- Identify the potential for low-carbon gases in the region's energy system and devise feasible strategies in line with the region's long-term energy and climate goals.

Project identification

Acronym:	UNIFHY
Title:	Unifying policies to support the uptake of green hydrogen to decarbonize Europe
Project ID:	02C0503
Project duration:	01.04.2024 – 30.06.2028
Basic phase:	From 01.04.2024 to 31.03.2027
Follow-up phase:	From 01.04.2027 to 31.03.2028
Closing phase:	From 01.04.2028 to 30.06.2028

Partners/associated political bodies

Project partners

LP01 – Consortium Extremadura Energy Agency – AGENEX (Spain)
PP02 – Municipality of Aalborg (Denmark)
PP03 – Energy Agency of Southern Sweden (Sweden)
PP04 – Moravian-Silesian Region (Czech Republic)
PP05 - South East Energy Agency (Ireland)
PP06 – Lubelskie Voivodeship (Poland)

Affiliated political authority

APA01 - Directorate-General for Industry, Energy and Mining - Regional Government of Extremadura (Spain, LP01)
APA02 – Region Kalmar County (Sweden, PP03)
APA03 – Waterford County and County Council (Ireland, PP05)

Annotation of the project

There are different paces towards climate neutrality in the EU Member States and their regions; Some of them set more ambitious goals and deadlines for achieving it, while others fall short of meeting the set interim goals. For regions in a favourable position, it is important to continue with the more complex aspects of the energy transition, such as the gas sector's transition to renewable and low-carbon gases.

Although the share of renewable energy at EU level is growing rapidly, carbon dioxide emissions are still rising worldwide. This means that all countries must also increase their efforts to decarbonise the energy sector, and the main challenge is to reduce the amount of fossil fuels in end-use sectors, especially in industry and transport.

In addition, there are other challenges that need to be overcome in order to decarbonise the energy sector, such as security of energy supply, environmental sustainability and socio-economic aspects. To ensure a secure and stable energy supply, it is not enough to deploy new renewable energy (wind, solar) if it cannot be stored and used when needed.

The set of proposals included in the Fit for 55 package provides a coherent and balanced framework for achieving the EU's climate goals, and specifically includes a shift from gas to renewable and low-carbon gases, including hydrogen, and a proposal to review the design of the EU gas market. And in 2020, the European Commission proposed a hydrogen strategy for a climate-neutral Europe, which aims to accelerate the development of clean hydrogen as a cornerstone of a climate-neutral energy system.

UNIFHY will analyse policies and provide insights to policymakers in 6 EU regions: the municipality of Aalborg (DK) and the region of southern Sweden (SE) in the north; Moravian-Silesian Region (CZ) and Lublin Region (PL) in the east; the south-east region of Ireland (IE) in the west; and Extremadura (ES) in the south.

RSA summary

The presented document was created as a background material within the UNIFHY project – "Unifying Hydrogen Valleys as a stepping stone for a European Hydrogen Economy" and aims to contribute to a deeper understanding of the specifics, conditions and opportunities related to the development of the hydrogen economy in individual European regions.

The document thus provides an overview of the current state and potential of hydrogen technologies in the region. It identifies key actors, policies and strategic directions that can contribute to strengthening the sustainable energy transition. At the same time, it serves as an analytical and methodological framework for further decision-making at regional level, taking into account the European context and the objectives of the European Green Deal.

The content of the document is based on the structure set by the project consortium and reflects available data, expert knowledge and relevant strategic documents. It also includes thematic chapters devoted to the socio-economic context, technical background, research and innovation potential of the region, and obstacles and opportunities in the development of low-emission technologies.

The document is intended for the professional public as well as for representatives of local governments, research organizations and industrial entities. Its purpose is to support the mutual coordination of activities aimed at creating a functional and integrated hydrogen ecosystem in line with European ambitions in the field of decarbonisation and strengthening energy security.

1. European context

The European Union is moving towards climate neutrality and a fundamental energy transformation. In 2020, fossil fuels accounted for around 70% of the energy mix and more than 50% of energy was imported, mostly from Russia. The response is the adoption of strategic frameworks - the Green Agreement, the Hydrogen Strategy (2020), the REPowerEU Plan (2022), the Fit for 55 package and the TEN-E Regulation - which support the development of green gases and infrastructure. The aim is to install 40 GW of electrolysers by 2030 and to produce 20 million tonnes of renewable hydrogen per year.

The RED III Directive (2023) sets a binding share of 42.5% of energy from renewable sources by 2030 and tightens the rules for the production of renewable hydrogen (additionality, time and geographical correlation). In the Czech Republic, these rules are perceived as too restrictive and economically challenging. In addition, the Draghi Report (2024) highlights the lack of a unified industrial strategy, complex administration and the need for investments of up to €750-800 billion per year, therefore recommending the simplification of financial instruments and the promotion of European technology production.

Key message: The EU has set ambitious targets for the development of low-carbon gases, but achieving them depends on more flexible application of the rules, sufficient investment and better coordination of industrial policy.

In 2020, 42% of the energy consumed in the EU was[1] also produced in the Union and almost 60% was imported. The Russian Federation has long been the largest supplier of energy to the EU. Some Member States were more dependent on Russian energy than others, making them particularly vulnerable to energy shortages and rising energy prices.

[1] EEA

The share of renewable energy in the EU's energy mix has been steadily increasing in recent years. Renewable energy accounted for around 22% of the EU's total energy supply in 2020. In terms of specific energy sources, petroleum products, including petroleum, accounted for around 35% of the energy mix, while natural gas accounted for 24%. Nuclear energy contributed 13% and solid fossil fuels, such as coal, accounted for 12% in the same year.

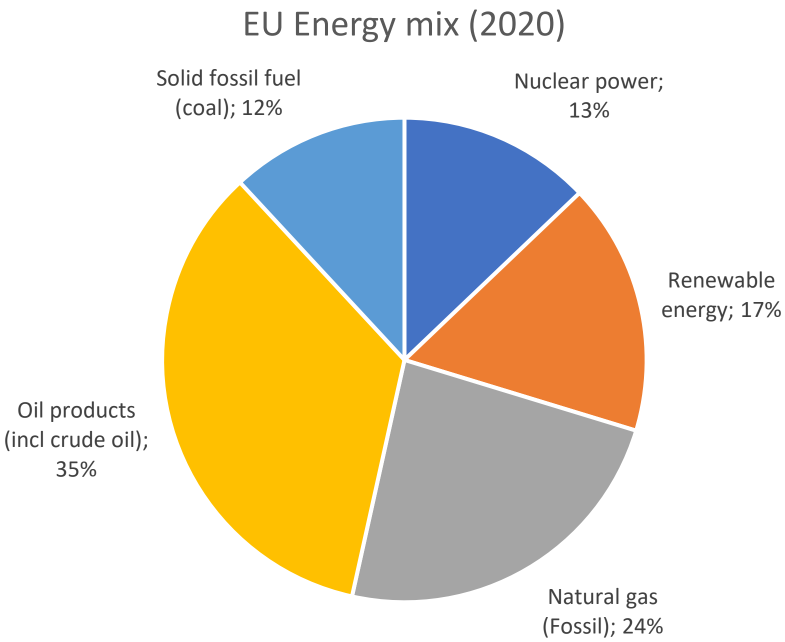

Chart 1: EU energy mix.

The European Union's transition to a climate-neutral economy requires a fundamental transformation of its energy system, with a particular focus on decarbonising hard-to-electrify sectors. Low-carbon gases, including green hydrogen, biomethane and syngases, are key enablers of this transition, supporting the EU's efforts to reduce dependence on fossil fuels, increase energy security and achieve a more integrated and resilient energy system. They serve as a critical complement to renewable electricity from wind and solar, providing solutions for energy storage, industrial applications, and transportation where direct electrification is impractical. Low-carbon gases are essential to achieving a secure, competitive and sustainable European energy system. Through coordinated policy action, infrastructure investments and market incentives, the EU is paving the way for a future where green energy gases play a central role in ensuring both climate neutrality and energy resilience.

At the heart of this transformation is the European Green Deal[2], which sets an ambitious goal of achieving net-zero greenhouse gas emissions by 2050[3]. To meet this goal, the EU has developed a

[2] The European Green Deal
[3] Long-term strategy 2050

number of strategic frameworks aimed at expanding the generation, infrastructure and market integration of green energy gases.

A key policy in this context is the EU Hydrogen Strategy (2020),[4] which aims to establish green hydrogen as a cornerstone of Europe's energy and industrial system[5]. The strategy outlines a step-by-step approach that aims to deploy 40 GW of electrolyser capacity by 2030 and support the development of regional hydrogen clusters (hydrogen valleys) and cross-border infrastructure. This strategy is closely linked to wider European industrial policies and strengthens the role of hydrogen in decarbonising hard-to-reduce sectors such as steelmaking, chemicals and heavy transport.

The geopolitical situation has further highlighted the urgency of energy diversification. The REPowerEU plan (2022),[6] which was introduced in response to the energy crisis and the need to reduce dependence on Russian fossil fuels, significantly accelerates the deployment of renewable gases. Under this plan, the EU aims to produce and import 20 million tonnes of renewable hydrogen per year by 2030 and to expand biomethane production to 35 billion m3/year, using domestic resources and international partnerships. The current (2024) installed[7] biomethane production capacity within the EU is 5.2 billion m3.

Legislative frameworks such as the Fit for 55 package (2021)[8] reinforce these efforts by introducing carbon pricing mechanisms and sectoral targets that increase the competitiveness of green energy gases. The Decarbonisation of Gas and Hydrogen Directive – 2021/0425/COD) introduced rules on hydrogen networks, third-party access, separation of network producers and operators, and tariff structures. The TEN-E Regulation (2022/869/EU) allows hydrogen infrastructure (e.g. gas pipelines, electrolysers) to be classified as projects of common interest (PCI) – they can draw on European funds. In this context, the Delegated Act on the methodology for calculating greenhouse gas emissions from hydrogen (based on Article 28 RED II) is crucial, as it sets a maximum emission limit for low-carbon hydrogen: 3.38 kg CO_2e /kg H_2 and allows hydrogen to be classified as low-carbon, even if it is produced from fossil sources, if the majority of CO_2 is captured (e.g. using CCS/CCUS technologies).

The updated Renewable Energy Directive (RED III, 2023)[9] further strengthens their role by setting a legally binding target of 42.5% renewable energy by 2030, with additional support for biogas, green hydrogen and Power-to-X technologies. At the same time, the TEN-E Regulation (2022)[10] provides the regulatory basis for the development of cross-border infrastructure and ensures the smooth

4 EU Hydrogen Strategy (2020)
5 Hydrogen policy framework
6 REPowerEU (2022)
7 Biomethane Europe
8 Fit for 55 (2021)
9 RED III (2023)
10 TEN-E

integration of renewable gases into the European energy market.

1.1. Delegated acts

The term "delegated act" is used for non-legislative documents of legal norms (regulations, directives) in the so-called delegated powers, which supplement or amend certain elements of a legislative act adopted by the European Parliament and the Council of the EU. These are legal acts that can be independently processed by the European Commission after authorisation granted by the EU institutions, and the Commission usually processes the more technical aspects of the issues in question through delegated acts. As a set of rules that complement the RED (Renewable Energy Directive) directives , specifically in connection with the RED III regulation, which requires EU Member States to introduce so-called "renewable hydrogen", three delegated acts have been created that directly relate to the development of hydrogen technologies:

1) Act setting values for emission savings from carbon-containing fuels and methodology for assessing fuel emission savings from RFNBO – Renewable Fuels of Non-Biological Origin (2023).
2) Act defining the rules for the production of RFNBO fuels in the transport sector (2023).
3) Act supplementing Directive (EU) 2024/1788 of the European Parliament and of the Council by specifying the methodology for assessing greenhouse gas emission savings from low-carbon fuels (2025).

Following the first act, a prerequisite for the certification of hydrogen as RFNBO hydrogen is the fact that it must be produced from so-called fully renewable electricity and the electrical sources and electrolyser must meet the following three rules:

1. **Additionality** – from 2028, a renewable energy source must not be started up earlier than 36 months before the electrolyser is launched.
2. **Time correlation** – the electrolyser must match the electricity produced and the electricity consumed within a given month by 2030. From 2030 within a given hour. (In practice, from 2030 onwards, the electrolyser will only produce renewable hydrogen when the sun is shining or the wind is blowing at a given hour.)
3. **Geographical correlation** – the electrolyser and the renewable source must be located in the same trading zone. CZ = 1 zone.

However, from the point of view of the Moravian-Silesian Region, the current rules for the production of renewable hydrogen are excessively strict and do not reflect the real technical, economic and climate conditions in EU Member States with limited renewable energy sources (RES) potential or defined targets for the decarbonisation of the electricity system as a whole, including the Czech Republic. The main and primary comments are mainly directed at the following areas of the delegated act:

1. **Overestimated expectations of the level of investment costs and dynamics of the development of hydrogen technologies**
   The European Commission based its rules on estimates of the investment intensity of

electrolysers at the level of €600 per kW of installed capacity. However, according to implemented projects and public contracts, the real price currently exceeds €3,000 per kW, which significantly increases the cost of renewable hydrogen production and slows down the development of projects. The predicted price also had certain impacts on the thinking and setting up of support programmes in the Czech Republic or Member States, which failed in the initial initiatives also due to an insufficient level of support for the submitted projects.

2. **Restrictive rules of additionality, temporal and geographic correlation**
   The additionality rule (requirement for new RES) is too restrictive for strictly defined bidding zones, slowing down investments and making it practically impossible to implement hydrogen technologies in the investment decision-making phase and especially the use of electrolysis producing from RES in the production modes of technical surpluses in the grid. By its very nature, the time correlation, especially the hourly correlation, set from 2030 onwards, significantly reduces the capacity factor of the "i.e. use" of electrolysers, which significantly increases the price of the hydrogen produced due to the high fixed costs associated with the implementation of the investment itself.
   From the point of view of the Czech Republic, the geographical correlation illogically limits the possibility of using RES from other defined bidding zones, which is a fundamental and potentially suitable solution to the lack of renewable energy and existing surpluses in other EU countries, but implemented in different bidding zones, although the interconnected European network technically allows this possibility and in principle denies the functioning of the single (energy) market in the EU.

3. **The rules for the production of renewable hydrogen complicate investment in hydrogen technologies and reduce the usability of electrolysers and increase the price of renewable hydrogen**
   The current relationship between the rules for the production of renewable hydrogen and possibly low-emission hydrogen leads to the fact that electrolysers cannot be operated optimally, as the definition of production times and the purpose of their support is very clear and practically does not allow for the simultaneous use or financial support of equipment simultaneously for both purposes of use, or at the cost of such expenses associated with proving certification requirements for the production of renewable or low-carbon hydrogen, Which, in turn, has an immediate impact on the high price of hydrogen. In the Czech Republic, the current calculated and realistic production price of RFNBO hydrogen is around €15-16 per kg, while in Spain it is currently considered an achievable price of about half.

1.2. Criticisms and recommendations from the Draghi report[11]

The existing lack of a coordinated industrial strategy was highlighted by the so-called Draghi report from last year, which pointed out that the EU lacks a unified strategy for the development of "clean

[11] Draghi report

tech", including in areas such as electrolysers, hydrogen and solar technology. There is no clear industrial plan that would allow the EU to keep pace with competitors such as China or the US. The report notes insufficient investment in technological development and a total need for annual investments of up to €750-800 billion to maintain competitiveness in innovation, green technologies and energy infrastructure, with a complex and inflexible administrative framework and unbalanced financial instruments being one of the main obstacles to the development of hydrogen projects.

The report highlights the need to use simpler, transparent and common financial instruments, such as Carbon Contracts for Difference (CfDs) and the European Hydrogen Bank auctions, to mitigate uncertainty and promote market acceleration of hydrogen technologies. In addition, attention is also drawn to the excessive dependence of imports of technologies and materials, or the import of key components, especially from China, and without further support for domestic production of electrolysers and other technologies, there is a risk of increased dependence on external suppliers, which undermines the energy and economic security of the EU. In addition, sectors such as hydrogen face high operating costs and unclear business models in the early stages of development. Draghi warns that without support mechanisms (e.g. public investment and market risk protection), Europe may lose its technological advantage and innovation will move outside the EU.

Based on the recommendations in the Draghi report, the rules of the European Hydrogen Bank have been changed and its role has also been expanded, with the Commission restricting the use of Chinese components in hydrogen projects – in the new auction (from December 2024), a maximum of 25% of the technology can come from China.

2. Regional context

The Moravian-Silesian Region has historically been one of the most important industrial regions of the Czech Republic, based on coal mining, metallurgy and engineering. The structural changes following the decline of heavy industry are reflected in higher unemployment rates (4.1% vs. 2.6% nationwide), lower wages (41,653 CZK vs. 46,924 CZK) and the outflow of skilled workers. The Region has an area of 5,431 km², 1.18 million inhabitants and an above-average population density of 217 inhabitants/km². Industry remains a key sector here – it accounts for almost half of electricity consumption and is dominated by the automotive, metallurgical and engineering industries.

The Region has an important educational base headed by the Technical University of Ostrava, which represents a strategic potential for the development of hydrogen technologies and industrial transformation.

The Region's energy mix is gradually changing: black coal still accounts for 44.9% of electricity production, but renewable sources already account for 30.6% (920.8 GWh), which is above-average in the Czech Republic. Industry remains the largest electricity consumer (2,89 TWh), followed by households (1,28 TWh). The heating industry is still dependent on coal, but offers room for decarbonisation through biomass, waste heat and hydrogen solutions.

Key message: The region is facing a major structural and energy transformation. It has a strong industrial and educational base, but it also faces socio-economic challenges and the need to modernize the energy system towards low-carbon solutions.

2.1. Basic socio-economic context

Analyzed territory (region)

The Moravian-Silesian Region is the region of the Czech Republic historically most oriented towards coal mining and heavy industry. Since the end of the 18th century, it has been the focus of black coal mining, iron production and the steel industry. The region's strong focus on heavy industry has meant and still means a great environmental burden for the region, and the cessation of coal mining and the subsequent decline in the steel industry also represents a great socio-economic burden.

The termination of coal mining (at present, only one active mine is mined - the ČSM Coal mine) and the subsequent decline in heavy industry caused the Moravian-Silesian Region to become one of the structurally affected regions, i.e. areas facing significant economic and social problems caused by the decline of traditional industries. These problems include high unemployment rates, job losses and a lack of economic diversification.

The high unemployment rate, especially in the long term, points to the structural damage to the region. In the case of the Moravian-Silesian Region, the unemployment rate at the end of 2024 is 4,1 %, while the average unemployment rate in the Czech Republic as a whole is only 2,6 %. It is interesting that the other two structurally affected regions in the Czech Republic – the Karlovy Vary and Ústí nad Labem regions – also have an unemployment rate of 4,1 %, by far the highest of all regions of the Czech Republic. This high figure points to serious employment problems in the region, especially in view of the fact that the high unemployment rate has been going on for a long time. Other values, such as the size of income per capita and its comparison with other regions (or the whole country), also point to structural problems. The average gross wage (in Q1 2025) was CZK 41,653 in the Moravian-Silesian Region, while it was CZK 46,924 in the Czech Republic as a whole.

The educational structure of the population is also considered problematic in the affected regions. Although there are universities in the Moravian-Silesian Region, their graduates often leave the region, leaving people with lower education in the region. Even so, the level of education in the region is slightly increasing over time. While in 2013 the tertiary educated population of the region was 19,3 %, in 2023 it was already 22,5 %. Similarly, the number of inhabitants with a high school diploma increased to 37,9 % in 2023 compared to 34,9 % in 2013.

Area (km^2)

5 431 km^2

Population

1 182 613 inhabitants (as of 31.12.2024). Population density – 217 inhabitants/km^2, which is almost double the population density compared to the Czech Republic average (137 inhabitants/m^2).

2.1.1. Socio-economic characteristics of the territory

Median net household income

The average gross monthly wage per full-time equivalent number of employees in the Moravian-Silesian Region is CZK 41,316, a year-on-year index of 106,5 %, median net household income 50,101 CZK / month (1,964.75 EUR / month, i.e. 23,577 EUR / year).

Energy consumption in the home

Net electricity consumption in households per capita in the Moravian-Silesian Region reached 1,174.6 kWh in 2024, slightly increasing by 1.6 % (by 18.4 kWh) compared to 2023. Compared to the national average (1,433.4 kWh), net electricity consumption in households per capita in the Moravian-Silesian Region was 258.8 kWh lower.

This reduced electricity consumption in households was mainly influenced by households' efforts to save money due to rising electricity prices. In terms of net electricity consumption in households per capita in an inter-regional comparison, the Moravian-Silesian Region has the second lowest value, behind the capital city of Prague (1,150.24 kWh).

Table 1: Electricity consumption in the Moravian-Silesian Region in 2023.

	2021	2022	2023
Electricity consumption netto1) (GWh)	**7 965,1**	**7 449,3**	**7 090,3**
Share of the Czech Republic (%)	13,3	12,9	12,7
Industry	3 778,5	3 782,4	3 367,4
Energetics	1 172,2	843,6	997,0
Right	54,8	53,3	53,9
building industry	46,3	49,3	42,4
Agriculture and forestry	46,3	44,8	40,7
Households	1 528,3	1 391,0	1 375,0
Trade, Services, Education and Health Care	1 326,9	1 281,4	1 208,5
Net electricity consumption in householdsper 1 inhabitant (kWh)	1 295,0	1 171,1	1 155,3
Share of industries in net electricity consumption1) in the region (%)	**100,0**	**100,0**	**100,0**
Industry	47,4	50,8	47,5
Energetics	14,7	11,3	14,1
Right	0,7	0,7	0,8
building industry	0,6	0,7	0,6
Agriculture and forestry	0,6	0,6	0,6
Households	19,2	18,7	19,4
Trade, Services, Education and Health Care	16,7	17,2	17,0

Source: Statistical Yearbook of the Moravian-Silesian Region for 2023, Czech Statistical Office, https://csu.gov.cz/docs/107508/0744707f-7ee9-8d67-9846-96b6a2a55771/330100241403.xlsx?version=1.0

Table 2: Net electricity consumption in the Moravian-Silesian Region in the first quarter of 2025.

	Net electricity consumption [MWh]					
	January		February		March	
	Region	Share in the Czech Republic	Region	Share in the Czech Republic	Region	Share in the Czech Republic
On the whole			**1 610 262,2**			
	571 054,3	10,8%	**504 532,7**	10,4%	**534 675,1**	11,1%
Wholesale customers from VHV.	122 441,5	19,6%	86 619,0	15,9%	131 297,8	20,1%
wholesale customers from HV.	208 215,4	10,5%	198 864,4	10,7%	207 259,6	10,8%
entrepreneurs	69 032,6	8,6%	62 693,0	8,6%	58 155,5	8,3%
households	171 364,9	9,0%	156 356,3	9,1%	137 962,2	9,0%

Source: Quarterly Report on the Operation of the Electricity System of the Czech Republic Q1 2025, Energy Regulatory Office, https://eru.gov.cz/sites/default/files/obsah/prilohy/ctvrtletnizprava2025iq.pdf

2.1.2. Industrial landscape

The Moravian-Silesian Region is one of the "industrial hearts" of the Czech Republic, especially thanks to the historical development of coal mining, metallurgy and engineering. This industrial base was formed as early as the 19th century and remains crucial to employment, export performance and the economic profile of the region to this day. At the same time, however, it is also a challenge in terms of transformation to a low-carbon economy.

Selected indicators by region in Q1 – Q4 2024 are listed in the table in Annex 1.

Table 3 below contains data on the number of enterprises with 100 or more employees based in the Moravian-Silesian Region, at the same time the table also contains the number of employees in these enterprises, but it does not contain a list of all enterprises in the Region, as well as the total number of employees in industry. The data in the table are valid as of the end of 2023.

It is clear from the table that the manufacturing industry occupies a privileged position in the region and manufacturing industry enterprises account for almost 95% of all considered industrial enterprises in the region. Similarly, the number of employees is the majority in the manufacturing industry.

Within the manufacturing industry, the most important in the Moravian-Silesian Region is the manufacture of motor vehicles (36 enterprises with more than 100 employees with a share of 15.79% of the total industry), which is also the most important in terms of the number of employees (24.74% of employees in industry). The industry with the second highest number of enterprises is manufacture of fabricated metal products (35 enterprises accounting for 15.35% of the total). Interestingly, this industry is also not second in terms of the number of employees. In terms of the number of employees, the second position is occupied by the production of basic metals, metallurgical processing of metals, foundry. This fact is due to the nature of this industry, which has a high proportion of human labour and is thus in a way characteristic of the Moravian-Silesian Region.

Table 3: Industrial enterprises with 100 or more employees based in the Moravian-Silesian Region in 2023

Industries	Number of businesses	Number of Enterprises (%)	Average registered number of employees (natural persons)	Average registered number of employees (%)
Total industry	**228**	**-**	**96 148**	**-**
therefrom:				
manufacturing industry	216	94,74	90 075	93,68
therein:				
Production of food products	20	8,77	3 801	3,95
Beverage production	1	0,44	i. d.	
Tobacco products	-		-	
Clothing production	2	0,88	i. d.	
production of leather and related products	-		-	
woodworking, manufacture of wooden, cork, wicker and straw products, except furniture	2	0,88	i. d.	
Production of paper and paper products	5	2,19	2 299	2,39
Production of coke and refined petroleum products	1	0,44	i. d.	
Production of chemicals and chemical preparations	4	1,75	1 013	1,05
Production of basic pharmaceutical products and pharmaceutical preparations	4	1,75	3 023	3,14
Production of rubber and plastic products	12	5,26	2 866	2,98
production of basic metals, metallurgical processing of metals; Foundry	16	7,02	17 972	18,69
manufacture of fabricated metal products, except machinery and equipment	35	15,35	6 731	7,00
Electrical equipment manufacturing	14	6,14	6 527	6,79
Manufacture of machinery and equipment n.e.c.	28	12,28	8 757	9,11
manufacture of motor vehicles (except motorcycles), trailers and semi-trailers	36	15,79	23 785	24,74
Manufacture of other means of transport and equipment	9	3,95	4 797	4,99
Other manufacturing	2	0,88	i. d.	
Repair and installation of machinery and equipment	8	3,51	1 908	1,98
Industries with less than 1000 employees	17	7,46	4 286	4,46

Source: Czech Statistical Office, MSVK's own regulation.

Number and size of companies

Small enterprises: 380, medium-sized enterprises: 738, large enterprises: 114 (the most important of which e.g. Hyundai Motor Manufacturing Czech, s.r.o., Brose CZ, s.r.o., Třinecké železárny, a.s., Liberty Ostrava, a.s., AL INVEST Břidličná, a.s., PO Lighting Czech s.r.o., Tietoevry Czechia, s.r.o., ŽDB Drátovna, a.s., Bonatrans, a.s., Plakor Czech, s.r.o., OKD, a.s., Dopravní podnik Ostrava a.s.).

Employment

The total number of economically active inhabitants in the industrial sector is about a third, i.e. 29.4% (Q4 2024), with the vast majority being the manufacturing sector (25.1%), a minority, already completely dominant in the past, the mining and quarrying sector, which today amounts to only 0.7%. Other sectors include "*Electricity, gas, heat and air conditioning production and distribution*" of 1.8% and "*Water supply; activities related to wastewater, waste and remediation*" of 1.9 %

Production and capacity

One of the most widespread industries in the Moravian-Silesian Region is metallurgy. There are both metallurgical companies in the Czech Republic with a complete metallurgical cycle – Třinecké železárny and Liberty Ostrava operating in the "Nová huť" complex in Ostrava. A metallurgical company with an incomplete metallurgical cycle includes, for example, Vítkovice Steel. An important steel processor is the company ŽDB Drátovna in Bohumín.

In the region, heavy engineering is widespread (e.g. Škoda Vagonka in Ostrava) and car production is also important. Hyundai, a major car manufacturer, has a factory in Nošovice. The Czech truck manufacturer TATRA is located in Kopřivnice. Kopřivnice is also home to Brose CZ, a major manufacturer of automotive parts.

Major industrial players in the region include: **Liberty Ostrava** (formerly Nová huť) played a key role in the production of pig iron, steel and rolled products. It was also one of the largest emitters of CO_2 emissions in the Czech Republic – the plan for the transformation to green steel and the use of hydrogen is therefore essential for the region's climate goals.

Vítkovice a.s., whose history dates back to 1828. In the times of the Austro-Hungarian Empire and Czechoslovakia, it was a strategic industrial complex with its own railway, steel production and engineering. Today, they are no longer a unified colossus, but a collection of companies specializing in engineering, power engineering and pressure systems.

Moravia Steel is one of the most important steel producers in Central Europe. It is significantly involved in CSR activities in the region and is the bearer of several environmental and technological innovations.

Cylinders Holding a. s. specializes in the production of seamless steel cylinders – for industry, healthcare, hydrogen and energy. It plays an important role in the development of hydrogen technologies, including solutions for mobility and energy.

Veolia Energie ČR a.s. It operates heating systems in Ostrava, Karviná, Krnov, Přerov and other cities. It is one of the main players in the decarbonisation of the heating industry and the implementation of renewable sources, including hydrogen.

Tatra Trucks is engaged in the development and production of special vehicles for the army, firefighters and industrial use. It is this company that is working on the development of hydrogen trucks, with the launch of the first fuel cell vehicle (e-Force Drive) in 2023.

In connection with its own product development, we cannot forget the HAGEMANN company, which focuses on the modification of municipal and special vehicles, especially superstructures. It is a major regional company with innovations in clean mobility, which launched its own N1 category vehicle with fuel cell drive in June 2025.

The mining industry, although significantly represented in the past, is undergoing an overall decline. Historically, black coal mining itself was one of the most important industries in the region and provided the vast majority of jobs (including related professions and mine operators). The region is mainly mined for black coal, with mining gases and related mineral products to a lesser extent. Previously, there were a number of mines and large mines, but they were closed due to uneconomical mining and environmental pollution at the beginning of the 1990s, especially in the Ostrava part of the district. In 2025, the last large deep black coal mine operated by the state-owned company OKD a.s. is located in part of the Karviná districthttps://cs.wikipedia.org/wiki/OKD. It is the ČSM mine (North and South locations) with an annual coal production of about 1.2 million tonnes of high-quality coal. The total and final end of hard coal mining is planned for 2026.

Although the region has relatively little agricultural land (most of it is in the Opava district), there are also several food companies in the Moravian-Silesian Region. The traditional biscuit manufacturer Opavia has its headquarters and one of the production facilities in Opavahttps://cs.wikipedia.org/wiki/Opavia. Another traditional company is the lemonade manufacturer Kofola, which is based and produces lemonades in Krnov. Other beverage producers include several breweries – e.g. Ostravar Brewery in Ostrava or Radegast in Nošovice. One of the largest dairies in the Czech Republic, Mlékárna Kunín, is located in Ostrava-Martinov. However, the use of biogas in this segment is negligible.

Educational infrastructure

There are currently 102 secondary vocational schools with a total of 37,400 pupils (out of a total of 139 schools and 52,303 pupils) in the Moravian-Silesian Region. Of this number, a significant part is made up of 59 industrial and technical schools, which offer up to 100 fields of study suitable for teaching thematically focused on hydrogen - its properties, functions, operation and service of hydrogen technologies. These schools thus represent a strong potential for the development of vocational education in the field of hydrogen economy and the preparation of a qualified workforce for the future of hydrogen energy.

There is only one technical university in the region – VSB – Technical University of Ostrava (out of a total of three universities), which plays a key role in the education of technically oriented experts in the region. The Moravian-Silesian Hydrogen Cluster works closely with this university to develop professional education and research in the field of hydrogen technologies. The five faculties that have the greatest potential for teaching hydrogen-related topics are also identified – from its chemical and physical properties, through the principles of production, storage and distribution, to the operation and service of equipment working with hydrogen. There are currently 7,693 students studying at these five faculties, which represents considerable human potential for the future development of the hydrogen economy not only in the region, but also at the national level. Approximately 1,449 graduates successfully complete their studies here every year, and they can be prepared for the specific needs of the labour market in the field of hydrogen technologies through a suitably focused educational programme. The university thus represents a fundamental partner for the development of the knowledge and innovation ecosystem in the region, and its involvement in hydrogen initiatives is of strategic importance for the transformation of the Moravian-Silesian Region towards a modern, low-emission and technologically advanced economy.

Figure 1: Map of major companies in the Moravian-Silesian Region.

Economic significance: Contribution of the sector to the economy of the region:

Share of GDP – total GDP 655,119 million CZK / 26,204,760 EUR, GDP per capita 550,454 CZK / 22,932 EUR. The share of direct export sales in sales of industrial products and services in the Moravian-Silesian Region was 58.6% in 2023, increasing by 0.9 percentage point year-on-year.

Indicator	Description
Territory	Moravian-Silesian Region
Area (km2)	5 431 km^2
Total population in your region	1 182 613
Number of municipalities in your region	300
Number of municipalities (<5,000 inhabitants)	268 (as of 31/12/2024)
Number of municipalities (>5,000 inhabitants)	32

Average number of inhabitants per municipality	3 942
Median net household income (€) [in your region and country]	23 577 (region MSK) / 25 150 (Czech Republic)
Annual household energy consumption in your region (MWh)	1 389 081,90 / 2,7
Industrial landscape	YES

2.2. Energy context

The energy mix of the Moravian-Silesian Region is undergoing a gradual but clear transformation towards greater sustainability and decarbonisation. Although hard coal still accounts for the largest component of production (1,350.6 GWh, i.e. 44.9%), a significant relative decrease in its share is evident compared to previous periods. Together with brown coal (2.35%), fossil coal still provides almost half of the region's electricity production, which points to the region's continuing structural dependence on traditional sources.

As far as the heating industry is concerned, the Moravian-Silesian Region is one of the most important regions in the Czech Republic for energy. Approximately 26,900 TJ of heat is produced annually, which corresponds to about 7,500 GWh. Heat production is still largely dependent on fossil fuels, but the share of renewable and secondary sources is gradually increasing.

2.2.1. Regional energy production

Table 4 shows the share of individual fuels and technologies that generate electricity production in the Moravian-Silesian Region:

Table 4: Share of fuels and technologies in gross electricity production in the Moravian-Silesian Region.

Fuel type:	GWh	Share
bituminous coal	1350,6	44,90 %
lignite	70,8	2,35 %
natural gas	133,5	4,44 %
Other gases	507,2	16,86 %
Other solid fuels	1,7	0,05 %
Waste heat	23,2	0,77 %
Fuel oils	0,7	0,02 %
RES	920,8	30,61 %

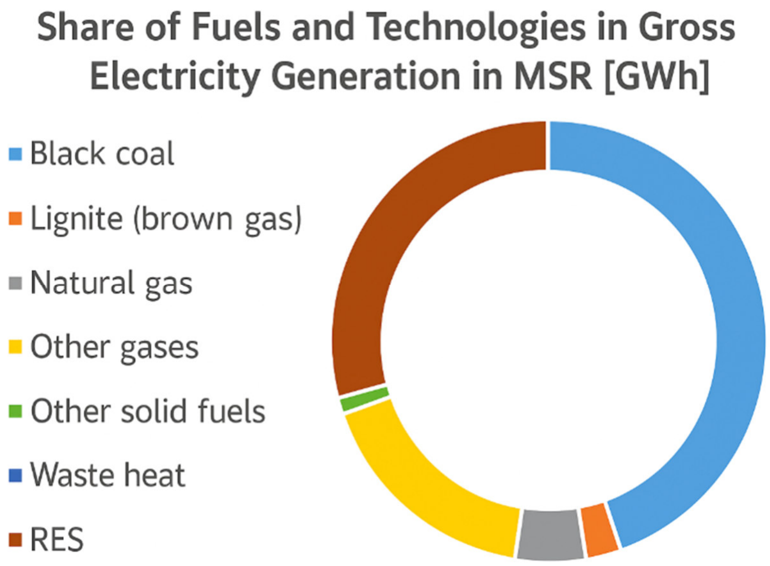

Chart 2: Share of fuels and technologies in gross electricity production in the Moravian-Silesian Region.

Natural gas (4.44%) and other sources, such as waste heat (0.77%) or fuel oils (0.02%), are rather complementary components of the system. Nevertheless, it is necessary to take into account their role in the transitional phase of the transformation and in stabilizing the energy grid.

A positive trend is a significant increase in the share of renewable energy sources (RES), which currently accounts for 30.61% with a volume of 920.8 GWh. This growth reflects the region's efforts to adapt to climate commitments and to make efficient use of available natural conditions and support from national and European funds. An important role is also played by the so-called other gases (16.86%), which come from industrial processes and represent an important component for the combined production of electricity and heat.

The graph below, showing the share of renewable energy sources (RES) in gross electricity production in individual regions of the Czech Republic, shows that the Moravian-Silesian Region occupies an above-average position, both in the absolute volume of electricity production from RES (920.8 GWh) and in its relative representation. RES accounts for more than 30% of the total production here, which ensures the region approximately 6th and 7th place in the inter-regional comparison. This position is remarkable due to the industrial character of the region, its historical dependence on coal and the limited natural conditions for some types of RES (e.g. hydroelectric or wind power plants). The high share of renewables is therefore not the result of natural assumptions, but of purposeful investments, technological development and systemic support for the transition to low-emission energy.

In this context, the potential of hydrogen as a supporting component of the region's modern, low-emission energy system comes to the fore. Hydrogen is not only an alternative to conventional fossil fuels, but also a flexible medium that can connect renewable generation with the needs of industry, transport and energy storage. Due to the growing share of RES, there is room for the production of green hydrogen by electrolysis in times of energy surplus.

The Moravian-Silesian Hydrogen Cluster sees this situation as a key prerequisite for the development of green hydrogen, the production of which is conditional on the availability of surplus electricity from RES. With the growing share of renewable resources in the region, the potential for water electrolysis and the production of clean hydrogen for further use in industry, transport and energy infrastructure is also growing. This creates the possibility to use RES not only as a source of final electricity consumption, but as a raw material for a wider energy and industrial transformation.

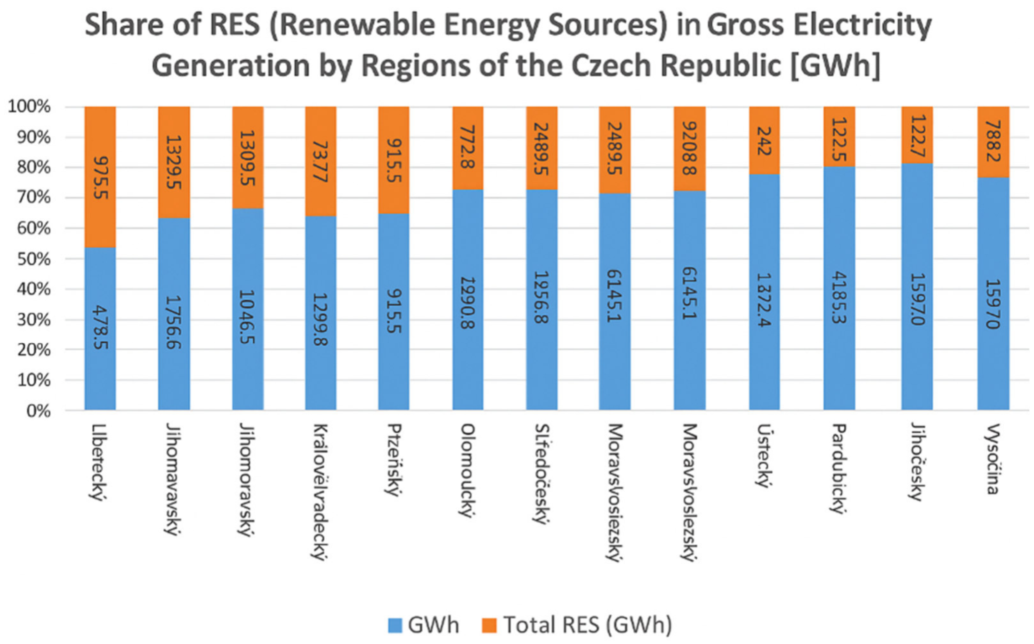

Chart 3: Share of renewable energy sources in gross electricity production in the regions of the Czech Republic.

The position of the Moravian-Silesian Region in the field of renewable energy already exceeds historical stereotypes. The development of the hydrogen economy is a logical and strategic step to further strengthen this positive trend while addressing the structural challenges facing the region.

The strategic focus on the use of renewable resources in combination with hydrogen technologies brings energy diversification and flexibility to the Moravian-Silesian Region, a reduction in the emission burden of traditional industrial areas, the possibility of energy storage through hydrogen and new impulses for the innovation ecosystem and employment. In the context of regional and national planning, it is therefore desirable to strengthen RES capacities as a basis for the production of green hydrogen, to build infrastructure for its storage, transport and use, and to integrate hydrogen technologies into regional transformation plans

The region has ideal prerequisites for this transformation – technological know-how, industrial background, academic capacities and institutional support. A strategic focus on hydrogen is therefore a logical and necessary step towards achieving climate neutrality and economic competitiveness in the Moravian-Silesian Region.

Heating sector

The Moravian-Silesian Region is one of the most important energy regions in the Czech Republic. Approximately 26,900 TJ of heat is produced annually, which corresponds to about 7,500 GWh. Heat production is still largely dependent on fossil fuels, but the share of renewable and secondary sources is gradually increasing. The main fuel sources of heat include:

1. **Hard coal – 10,999 TJ (3,055 GWh)**

Black coal continues to be the dominant fuel for heat production in the region. Its importance is related to the historical development of industry and coal mining, especially in the Ostrava-Karviná region. However, this resource represents an environmental burden and is unsustainable in terms of climate commitments in the long term.

2. **Biomass – 5,997 TJ (1,666 GWh)**

Biomass is one of the key renewable heat sources in the region. Its increasing use contributes to the reduction of greenhouse gas emissions and supports the development of local fuel chains. Biomass sources are mostly of forest or agricultural origin.

3. **Other gases – 4 464 TJ (1 240 GWh)**

This category mainly includes coke oven gas, blast furnace gas and other by-products of industrial production. Their energy use is typical for industrially oriented regions and represents a form of efficient waste management in production.

4. **Waste heat – 1,589 TJ (441 GWh)**

Waste heat from industrial equipment or cogeneration units represents an important secondary source of energy. Its further use is in line with the principles of the circular economy and increases the overall efficiency of the energy system.

The structure of heat production in the Moravian-Silesian Region shows that the region still has considerable potential for the decarbonisation of the heating sector, in particular through the gradual phase-out of coal production and its replacement with biomass, waste heat and possibly hydrogen, the modernisation of the district heating (central heat supply) infrastructure, as well as the promotion of the circular economy in industry and energy recovery of waste. However, the transition to low-emission sources will require both technological investments and strategic planning in the area and coordination between the public and private sectors.

Regional energy production (sources)	**Description**
Electricity (GWh)	3008,8
Hard coal (GWh)	3055
Biomass (GWh)	1666
Other gases (GWh)	1240
Waste heat (GWh)	1589
Total energy demand in the region (GWh)	5930,08
Of which produced at regional level %	50,73

2.2.2. Regional energy consumption

The total electricity consumption in the Moravian-Silesian Region in 2024 was 5,930.08 GWh. This is the net electricity consumption differentiated by consumption category (large consumers, small consumers, population), as broken down by the ERO. However, if the consumption of the transmission and distribution system operator, local consumption and technological self-consumption for heat production are added to this consumption, the electricity consumption in the region will increase to 6,809.046 GWh. This is more than twice the electricity produced in the region. It is therefore clear that the region is not self-sufficient in terms of electricity and must import electricity.

When dividing electricity consumption by sectors of the national economy, the above-mentioned total consumption of 6,809.046 GWh is considered. The largest consumer of electricity in the Moravian-Silesian Region in this breakdown is industry. It consumed almost 2,891 GWh in 2024, i.e. less than 43% of the total regional consumption. Households are in second place, with a consumption of 1,389.1 GWh accounting for about 20% of the total energy consumption in the Moravian-Silesian Region. Other significant consumers of electricity are the trade and services sector (1,280.2 GWh) and the energy sector (1,107.9 GWh), while other sectors are already negligible in terms of electricity consumption.

The values of electricity consumption for individual sectors of the national economy are given in the following table:

Table 5: Electricity consumption [GWh] in the regions of the Czech Republic in 2024.

	Industry	Energetics	Transport	Construction	Agriculture and forestry	Households	Trade, services, education, healthcare	Other	Total
Czech Republic	20 500,2	4 170,9	697,3	433,3	886,6	15 637,2	13 336,7	261,6	55 924,0
capital city Prague	320,6	270,3	369,3	65,9	8,3	1 607,9	3 179,3	76,2	5 897,9
South Bohemian Region	917,5	91,4	14,6	15,7	97,1	1 125,5	558,8	38,7	2 859,4
South Moravian Region	1 796,7	275,0	59,7	54,4	125,0	1 563,2	1 311,8	42,3	5 228,1
Karlovy Vary Region	437,3	302,9	5,1	16,4	11,2	379,9	331,0	2,3	1 486,1
Vysočina Region	1 257,5	73,6	8,8	23,4	110,4	735,5	399,4	29,2	2 637,8
Hradec Králové Region	1 210,5	302,8	23,6	19,9	65,4	943,2	787,7	7,0	3 360,1
Liberec Region	1 044,0	103,0	15,6	17,6	18,4	731,1	437,3	2,6	2 369,6
Moravian-Silesian Region	2 890,9	1 107,9	53,5	38,1	40,4	1 389,1	1 280,2	8,9	6 809,0
Olomouc Region	1 400,0	64,4	14,7	32,3	56,1	813,1	626,1	8,0	3 014,7
Pardubice Region	936,2	128,5	17,6	19,2	68,8	737,1	452,5	9,7	2 369,7
Pilsen Region	1 160,5	56,9	29,2	17,8	67,6	905,6	696,5	5,5	2 939,5
Central Bohemian Region	2 861,2	405,0	40,1	64,4	129,7	2 885,1	1 747,1	12,6	8 145,2
Ústí nad Labem Region	3 133,9	341,2	31,3	33,4	33,8	1 064,9	1 099,1	7,1	5 744,8
Zlín Region	1 133,4	647,9	14,3	14,6	54,5	756,0	430,0	11,3	3 062,0

Source: Annual Report on the Operation of the Electricity System of the Czech Republic, 2024. Energy Regulatory Office. Custom modification of MSVK. https://eru.gov.cz/sites/default/files/obsah/prilohy/eruelektro2024.pdf

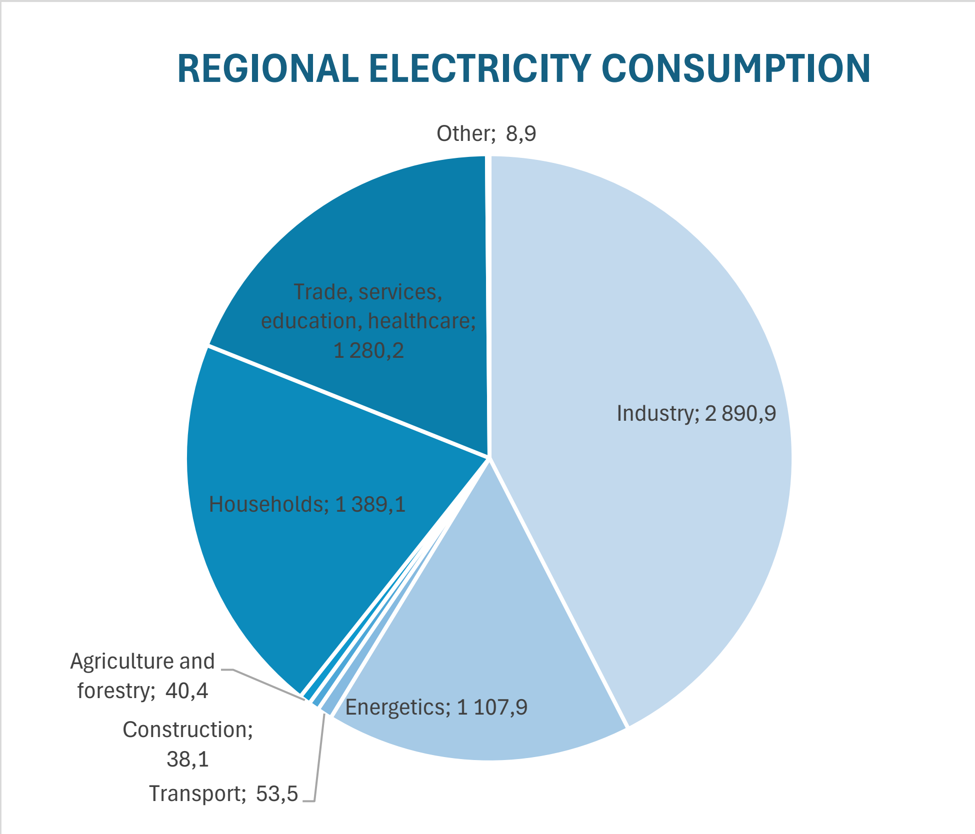

Chart 4: Share of electricity consumption [%] in the Moravian-Silesian Region for individual sectors of the national economy in 2024. Source: ERO, MSVK's own modification.

According to 2024 statistics, the Moravian-Silesian Region reported the highest net electricity consumption in industry of all regions in the Czech Republic, with a total share of 14.1% of the total net energy consumption in the Czech Republic.

In the energy sector, the Moravian-Silesian Region dominates with 26.6% of net consumption. In terms of total annual net consumption, MSK is an electricity consumer, which has the second highest volume after the Central Bohemian Region compared to other regions of the Czech Republic.

Energy consumption by industry	**Description**
Industry (GWh)	2890.9
Transport (GWh)	53.5
Household (GWh)	1389.1
Other services (including companies, offices, warehouses and sports facilities) (GWh)	1280.2
Agriculture, forestry and fisheries (GWh)	40.4
Public Sector (GWh)	N. A.

3. Policy and regulatory framework

The chapter summarizes the main strategic and legislative documents that determine the direction of the Czech and Moravian-Silesian regions in the field of low-carbon technologies and hydrogen. At the national level, the key objectives are based on the Hydrogen Strategy of the Czech Republic (updated 2024), the State Energy Concept, the Climate Protection Policy, the National Energy and Climate Plan and the National Clean Mobility Action Plan. These documents define the long-term goals of decarbonization, strengthening energy security and developing clean mobility. Updates of the strategic frameworks take place gradually – e.g. the Hydrogen Strategy has been expanded with a view to 2050, while a new version of the State Energy Concept is in preparation.
At the regional level, the Moravian-Silesian Region develops national policies into concrete measures through documents such as the Regional Development Strategy 2019–2027, the Territorial Energy Concept 2020–2044, the Hydrogen Technology Development Strategy 2024–2034, the Regional Innovation Strategy and other territorial and thematic plans. These strategies support the transformation of the regional economy, the shift away from coal and the use of financial instruments, especially the Operational Programme Fair Transformation.
Key message: The Czech Republic and the Moravian-Silesian Region have created a relatively broad strategic framework for the development of the hydrogen economy and low-carbon transformation. The challenge remains the coherence of the documents, their topicality and effective implementation in practice.

Among the basic documents at the national level dealing with the development of low-carbon gases are the Hydrogen Strategy of the Czech Republic (updated in 2024), the State Energy Concept of the Czech Republic, the Climate Protection Policy of the Czech Republic, the National Plan of the Czech Republic in the field of energy and climate and last but not least the National Action Plan on Clean Mobility.

The Hydrogen Strategy of the Czech Republic[12], updated in 2024 is a basic document at the national level prepared by the Ministry of Industry and Trade of the Czech Republic and approved by the government its updated version on 17 July 2024 (this update covers the time horizon up to 2050). The Hydrogen Strategy seeks ways to meet decarbonisation goals using hydrogen and the deployment of hydrogen technologies in sectors suitable for its use. The main strategic goals of the Strategy are primarily to reduce CO2 emissions in the Czech Republic and to promote economic growth and increase the competitiveness of the Czech Republic, while it is based on four pillars (mainly production of renewable and low-carbon hydrogen)

and these pillars are interconnected (consumption of hydrogen must be in balance with its production, import and storage). The specific goals are primarily focused on the time period between 2024 and 2035, with an emphasis on meeting the goals defined by European legislation (RED Directive) using the production of hydrogen from national renewable energy sources and in this respect characterizes three stages of development, which differ in the ways of hydrogen production, its distribution, use and expected price.

- Local islands with a production price of 8 EUR/kg)
- Global bridges with a price of 2.7 – 4 EUR/kg)
- New technologies with a production price of 2 EUR/kg.

The State Energy Policy of the Czech Republic[13] from the Ministry of Industry and Trade of the Czech Republic in 2014 defines the main mission of ensuring a reliable, safe and environmentally friendly supply of energy for the needs of the population and economy of the Czech Republic, at competitive and affordable prices. At the same time, its objective is to ensure uninterrupted energy supply in crisis situations. Last but not least, its objective is also to ensure a stable and predictable business environment, efficient state administration and sufficient and secure energy infrastructure. The State Energy Concept identifies five strategic priorities to contribute to the fulfilment of the top objectives:

- a balanced mix of primary energy sources as well as sources of electricity production,
- increasing the energy efficiency of the national economy,
- developing the network infrastructure of the Czech Republic, strengthening international cooperation and integration of electricity and gas markets in the region,
- supporting research, development, innovation ensuring the competitiveness of the Czech energy sector, supporting education, with the aim of the necessity of generational renewal,

[12] https://mpo.gov.cz/assets/cz/prumysl/strategicke-projekty/2024/7/Vodikova-strategie-CR-aktualizace-2024.pdf

[13] https://mpo.gov.cz/assets/cz/energetika/statni-energeticka-politika/2016/12/Statni-energeticka-koncepce-_2015_.pdf

- increasing the energy security and resilience of the Czech Republic.

The valid concept was approved already in 2015, so it is now obsolete. An update is being worked on, but unfortunately the update is not yet approved.

The Climate Protection Policy in the Czech Republic[14] with the guarantor and creator of the Ministry of the Environment of the Czech Republic was approved by the Government of the Czech Republic on 22 March 2017. An evaluation of the document was prepared and submitted to the Government in 2021 and an update is planned. This document defines the main objectives

and measures in the area of climate protection at the national level so as to ensure the fulfilment of greenhouse gas emission reduction targets following the obligations arising from international agreements. This strategy in the area of climate protection focuses on the period 2017 to 2030, with a view to 2050, and should thus contribute to the long-term transition to a sustainable low-emission economy of the Czech Republic. The policy contains a total of 41 measures, ranging from cross-cutting themes and policies, through measures in individual sectors to research and development, monitoring and measures in the area of international climate protection and development cooperation.

National Energy and Climate Plan of the Czech Republic[15] - prepared by the Ministry of Industry and Trade of the Czech Republic in 2024 (approved by the government of the Czech Republic on 13 January 2020, update approved on 18 December 2024). This plan was prepared on the basis of the requirement of Regulation (EU) 2018/1999 of the European Parliament and of the Council on the governance of the Energy Union and climate action and contains objectives and policies in all five dimensions of the Energy Union for the period 2021-2030 with a view to 2050. These are the areas of greenhouse gas reduction, energy efficiency, internal energy market, energy security and research, innovation and competitiveness.

National Action Plan for Clean Mobility[16] **-** prepared by the Ministry of Transport of the Czech Republic in 2024 (update approved by the Government of the Czech Republic on 28 August 2024). The document is a key step in supporting the development of sustainable transport and the implementation of alternative drives in the Czech Republic. The updated plan focuses mainly on electromobility, hydrogen mobility and the use of natural gas, setting specific targets for individual fuel types. The update of the NAP CM sets out six strategic goals aimed at accelerating the development of vehicles with alternative drive.

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[14] https://mzp.gov.cz/system/files/2024-08/OPOK-POK-20170329_0.pdf

[15] https://mpo.gov.cz/assets/cz/energetika/strategicke-a-koncepcni-dokumenty/2024/12/Vnitrostatni-plan-Ceske-republiky-v-oblasti-energetiky-a-klimatu-_prosinec-2024_.pdf

[16] https://mpo.gov.cz/assets/cz/prumysl/zpracovatelsky-prumysl/automobilovy-prumysl/2024/10/2-Aktualizace-NAP-CM.docx

3.2. Policies at regional level

The documents mentioned in the previous sub-chapter were the basis for the strategies and plans below in the Moravian-Silesian Region. Each of these documents has a holder who is also responsible for its application and evaluation:

- Development Strategy of the Moravian-Silesian Region 2019–2027
- Territorial energy concept of the Moravian-Silesian Region (2020-2044)
- Development Strategy of the Smart Region of the Moravian-Silesian Region 2017–2023 “Smarter Region”
- Vision 2030 (Coalition Programme for the Moravian-Silesian Region)
- Integrated Territorial Strategy of the Ostrava Metropolitan Region – Integrated Territorial Investment (ITI) for the period 2021-2027
- Regional Innovation Strategy of the Moravian-Silesian Region 2021–2027
- Transformation plan of the Moravian-Silesian Region
- Comprehensive Action Plan Strategy for the Economic Restructuring of the Ústí, Moravian-Silesian, Karlovy Vary Region (2023-2024)
- Hydrogen Technology Development Strategy 2024-2034
- Impact study of the exit from energy burning of coal in the Moravian-Silesian Region/November 2020

The basic conceptual document of the Moravian-Silesian Region is the **Strategy of Development of the Moravian-Silesian Region 2019-2027**[17]. It is prepared as a medium-term strategic document that fulfils the conditions arising from Act No. 248/2000 Coll., on support for regional development. The current Development Strategy defines five global strategic objectives, such as a competitive, innovation-based economy, good education and high employment, a cohesive society, a quality and cultural environment, services and infrastructure for life, and effective governance.

However, a key document in the context of hydrogen development is the **Hydrogen Technology Development Strategy 2024-2034**[18]. The Moravian-Silesian Region is one of two regions of the Czech Republic that have a separate document, which underlines the public support for hydrogen in society. Within the framework of the Strategy, individual areas of goals were defined, which the Moravian-Silesian Region should aim for in the period up to 2030 and with a view to 2034, where the long-term outlook of this Strategy ends. The strategy thus follows similar documents, such as the POHO 2030 Concept (Pohornická Krajina) or the Coal Departure Study, and it becomes a data input demonstrating and quantifying the possibilities of hydrogen deployment in the Moravian-Silesian Region, not only for these mentioned documents. At the same time, key actions have been identified to serve these objectives. Key actions are defined in three time horizons: short-term to 2027, medium-term to 2030 and to 2034 as a long-term perspective. An update of this strategy is currently being prepared.

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[17] https://www.msk.cz/cs/temata/cestovni_ruch/strategie-rozvoje-moravskoslezskeho-kraje-2019_2027-1291/
[18] https://www.ms-vk.cz/wp-content/uploads/simple-file-list/Dokumenty/Strategie-rozvoje-H2T-v-MSK-graficka-podoba.pdf

The most important regional planning document of the **Region are the Principles of Territorial Development of the Moravian-Silesian Region (ZÚR MSK)**[19], which establish the basic requirements for an effective and economical arrangement of the territory of the Region, define areas and corridors of supra-local importance, establish requirements for their use, especially areas or corridors for public utility buildings, public utility measures, establish criteria for deciding on possible variants or alternatives of changes in their use. The OCT also defines areas and corridors in order to examine the possibilities of future use and supplement areas for wind power plants. I don't know. The territorial energy concept of the Moravian-Silesian Region for the period 2020-2044 sets the tone by defining the region's departure from the energy use of coal. In the field of transport, the emphasis is on increasing gas consumption. The concept describes stagnant electricity consumption, reduction of electricity consumption due to increased energy efficiency of large appliances and lighting and slight increase of consumption due to electromobility, describes increasing share of renewable and secondary energy sources, especially biomass and waste, as well as increasing the number of installations of small PV power plants.

Great emphasis is placed on the energy security of the region **The impact study of the exit from the energy burning of coal in the Moravian-Silesian Region**[20] proposes a solution to secure the supply of thermal energy to the population, the non-residential sector and industry on the territory of the Moravian-Silesian Region in the interval of 2020-2050, in which it is to occur to stop burning coal to generate heat. The main objective of the study is to examine the technical possibility of replacing technologies based on the energy burning of coal with technologies using low-emission energy sources for the production of heat for the supply of the population and other customers, including the supply of heat for technological processes in the industry, to reduce emissions from the burning of coal. The impact study demonstrates that such a goal is achievable. The study also describes potential risks in the solutions and measures that will help achieve the goal.

The **Operational Programme Fair Transformation[21] (OP ST)** within the framework of the Fair Transformation Mechanism of the EU is linked to the above mentioned documents. OP ST is aimed at addressing the negative impacts of the shift away from coal in the most affected regions. The programme announces thematic calls aimed, among other things, at the development of new renewable resources and related technologies such as hydrogen valleys encompassing the complete chain, from research and development, to production and storage, to the use of green hydrogen in industry and transport. In this mechanism at the regional level, hydrogen technologies have a special allocation for their pilot development.

3.2.1. Local Initiative

Decarbonisation of the region by using hydrogen is a new way for the region, therefore a local initiative – Moravskoslezský Vodíkový Klastr, z.s. has been established to actively support the development of the Hydrogen Valley ecosystem of the Moravian-Silesian Region and the application of hydrogen technologies in the economic transformation of our region. It seeks to build partnerships and cooperation with entities active in the field of hydrogen technologies. The aim of this endeavour is to make optimal use of these new technologies in the framework of sustainable development of the region. The founders of MSVK, z. s., became the Moravian-Silesian Region,

[19] https://www.msk.cz/cs/temata/uzemni_planovani/uplne-zneni-zur-msk-po-vydani-aktualizaci-c--1--2a--2b--3--4--5--6--7--8a--8b-a-zmeny-c--11-pravni-stav-13194/
[20] https://www.msk.cz/assets/temata/chytry_region/uek_2022.pdf
[21] https://opst.cz/

Cylinders Holding and VŠB–TUO, thereby ensuring representation of the public, academic and commercial sectors. Today, MSVK has 31 members whose activities cover the entire hydrogen value chain and include enterprises of various sizes. The importance of the cluster was officially confirmed by the Moravian-Silesian Region Council, which entrusted it with the role of responsible regional platform and guarantor of the Strategy for the Development of Hydrogen Technologies in the Region. This strategy was prepared under the cluster's banner in 2023 and a year later the regional council approved it as a separate strategic document. At the same time, it highlighted the concept of the so-called "Hydrogen Network Solution in the Moravian-Silesian Region" as a key tool for the pilot development of the Hydrogen Valley, which is further developed under the responsibility of MSVK.

Table 6: Summary of strategy papers at national and regional level.

Name of the document	Carrier (responsible institution)	Evaluation (YES/NO) location of evaluation	Update / scheduled (YES/NO/Schedule)
Hydrogen Strategy of the Czech Republic	*Ministry of Industry and Trade of the Czech Republic*	*NO*	*YES 17. 7. 2024*
State Energy Concept of the Czech Republic (2014)	*Ministry of Industry and Trade of the Czech Republic*	*NO*	*Planned*
Climate protection policy in the Czech Republic	*Ministry of Industry and Trade of the Czech Republic*	*link to evaluation*	*Planned*
National Energy and Climate Plan of the Czech Republic	*Ministry of Industry and Trade of the Czech Republic*	*NO*	*YES 18. 12. 2024*
National Action Plan on Clean Mobility	*Ministry of Industry and Trade of the Czech Republic*	*link to evaluation*	*YES 28. 8. 2024*
Smart Region Development Strategy of the Moravian-Silesian Region 2017–2023 "Smarter Region"	*Moraviasilesian region*	*NO*	*NO*
Territorial energy concept of the Moravian-Silesian Region (2020-2044)	*Moraviasilesian region*	*NO*	*NO*
Smart Region Development Strategy of the Moravian-Silesian Region 2017–2023 "Smarter Region"	*Moraviasilesian region*	*NO*	*Planned*
Vision 2030 (Coalition Programme for the Moravian-Silesian Region)	*Moraviasilesian region*	*NO*	*NO*
Integrated Territorial Strategy of the Ostrava Metropolitan Region (ITI) 2021–2027	*Ostrava metropolitan area/region/town*	*NO*	*NO*
Regional Innovation Strategy of the Moravian-Silesian Region 2021–2027	*Moraviasilesian region*	*NO*	*NO*
Transformation Plan of the Moravian-Silesian Region	*Moraviasilesian region*	*NO*	*NO*

Summary Action Plan Strategy for the Economic Restructuring of the Ústí, Moravian-Silesian and Karlovy Vary Regions (2023-2024)	*Ministry of Industry and Trade of the Czech Republic + regional governments*	*NO*	*NO*
Hydrogen technology development strategy 2024-2034	*Moraviasilesian region*	*NO*	*Planned*
Impact Study on the Exit from Energy Coal Combustion in the Moravian-Silesian Region (2020)	*Moraviasilesian region + external processors*	*NO*	*NO*

4. PESTEL Analysis

Factor	Strengths/Opportunities	Weaknesses / Threats
Political	*The construction of the Hydrogen Valley, which aims to develop and develop hydrogen technologies, strengthen partnerships in the development of hydrogen technologies across the region.* *Through the Moravian-Silesian Hydrogen Cluster, z. s., to actively address and engage stakeholders on a regional and supra-regional scale, by connecting stakeholders dealing with hydrogen technologies.* *Participate in hydrogen initiatives to facilitate knowledge sharing and transfer, technology transfer and market access.*	*Lack of political will to develop the hydrogen market at the national level, which slows down the development of the MSK Hydrogen Valley and creates an uncertain future for the development of hydrogen technologies itself*
Economic	*It will increase the economic development of the region, its competitiveness and will lead to the mitigation of negative impacts on the environment. drawing on EU funds, in particular through the Just Transition Fund, the Modernisation Fund or the ESI Funds and instruments of the European Investment Bank (EIB), the Sovereignty Fund provided through the so-called Important Projects of Common European Interest (IPCEI) or Horizon Europe, and to attract international investment and support the growth of the hydrogen market.*	*Possibility of investment support from national or EU sources (Sovereignty Fund) provided through so-called important projects of common European interest (IPCEI) or Horizon Europe.*
Sociocultural	*Development of education in its territory through the introduction of new fields dealing with the production of energy from RES at secondary industrial and university schools, retraining of the workforce and creation of new jobs in fields related to the hydrogen economy, educational programs with application to the hydrogen industry.* *The opening of new jobs is crucial both for reducing unemployment in the region in the*	*The problem of unemployment, where its rate in the region is the second highest across the Czech Republic, and the lack of qualified labour for the development of hydrogen technologies. In addition, unemployment could increase if measures are not put in place to mitigate the consequences of the transition to more sustainable energy sources.* *In addition to reducing the negative impact on the environment, the region's low-carbon transformation should also be socially just so as not to widen disparities across society.*

	context of the green transition and for preventing the phenomenon of the so-called "brain drain".	
Technological	*Part of the existing steel pipe can be transformed into polyethylene, which allows hydrogen to be transferred without the risk of the system collapsing due to embrittlement of the structure, as is the case with steel.* *First, focus on the use of so-called "gray hydrogen", which is obtained from fossil fuels such as coal or natural gas. Subsequently, the production of green hydrogen from solar or wind energy is planned.*	*Hydrogen distribution across the Moravian-Silesian Region requires "repurposing" of existing gas infrastructure*
Legislative	*Modification of the rules and full operationalisation of the European Hydrogen Bank's mechanisms, completion of the implementation of the Fit for 55 package, measures for the hydrogen and decarbonised gas market and the so-called 'Hydrogen Market'. A Net-Zero Industry Act under the Green Deal Industrial Plan.* *At the regional level, the key documents are considered to be dealing with the construction of a hydrogen infrastructure (the use of hydrogen in suburban and individual transport, industry and energy) and the focus on the need to build trans-regional and international cooperation across hydrogen valleys.*	*Gaps in European legislation in the practical use of hydrogen, which brings uncertainty not only to investors, but also to producers and consumers.*
Environmental	*The transition to a hydrogen economy will help minimize negative environmental impacts, zero-emission transport and discharges into the environment only water vapor, decarbonization of the region's industries, especially the metallurgical and chemical industries, the use of hydrogen as a raw material for chemical processes replacing fossil fuels in order to reduce carbon emissions.* *In agriculture, green hydrogen can be the main means of producing "carbon-free" ammonia and fertilizers.*	*Negative environmental impacts by reducing CO2 emissions as well as other greenhouse gas emissions, decarbonisation efforts*

5. Key players, stakeholders and value chain

Thanks to a strong industrial base, technical know-how and an active approach to transformation, the Moravian-Silesian region has the potential to become one of the main centres of the hydrogen economy in the Czech Republic. The transition to a low-carbon economy creates space for cooperation of companies, research institutions, public administration and start-ups across the whole value chain — from the production and distribution of hydrogen to its storage and end-use.

The chapter is broken down by key sectors in which hydrogen technologies are beginning to be promoted.

- **Energy: hydrogen has the potential for accumulation of energy from RES, decentralised production of electricity and heat as well as modernisation of the heating industry.**
- **Transport: opportunities for the use of hydrogen in road, rail and air transport are developing, including the building of infrastructure and the involvement of transport vehicle manufacturers.**
- **Industry: the metallurgy, chemical and engineering sectors in particular see hydrogen as a tool for decarbonisation and modernisation of operations.**
- **Logistics and storage: hydrogen import, distribution and supply capacities are emerging, which will be essential for regional supply chains.**

Key message: The region brings together a wide range of actors covering all key links in the hydrogen value chain, creating good conditions for a strong innovation and industrial ecosystem to emerge.

Thanks to its industrial tradition, technical know-how and active approach to transformation, the Moravian-Silesian Region is one of the regions with the greatest potential for the development of the hydrogen economy in the Czech Republic. The transition to a low-carbon economy creates space for new forms of cooperation between industry, academia and public administration.

The key players in the region's future hydrogen ecosystem include not only traditional industrial companies (e.g. in metallurgy, energy or chemistry), but also innovative companies, research institutions, universities and specialized logistics companies. These players are involved in the development of technologies for the production, distribution, storage and use of hydrogen in production, transport and energy. The development of the hydrogen economy in the region is also supported by strategic documents such as *the Regional Innovation Strategy* or *the Just Territorial Transition Plan*, and the implementation of specific projects within the regional platform – **the Moravian-Silesian Hydrogen Cluster z. s.** The region is thus heading towards becoming one of the key centres of the hydrogen economy in Central Europe.

5.1. Energy and key players in the Moravian-Silesian Region

Hydrogen technologies represent a promising tool for the energy transition not only at the national level, but also within the Moravian-Silesian Region. They can be used in the field of energy storage as well as decentralized electricity and heat generation. One of the key benefits of hydrogen is its use as a medium for long-term storage of excess electricity from renewable sources such as solar or wind power plants. As a result, hydrogen can play an important role in managing the stability of the electricity grid and balancing energy production and consumption seasonally. Another use is decentralized energy production using fuel cells, which can supply households, companies or public buildings with electricity and heat. These technologies are particularly suitable where a centralized grid is not available or where higher energy self-sufficiency is desirable.

In the field of heating, two companies play an important role in Ostrava. The largest part of the heat network is operated by **Veolia Energie ČR, a. s.**, which produces heat in its facilities in the city of Ostrava – specifically in the Přívoz heating plant, the Třebovice power plant and in local boiler rooms – and also buys it from **TAMEH Czech, s.r.o.** The total length of the heat networks managed by Veolia in Ostrava is 344 km (of which 128 km are hot water, 162 km are hot water and 54 km are steam networks). Approximately 100,050 apartments are supplied from these networks.

The second largest distribution network is operated by **ČEZ Energetické služby, s.r.o.**, which provides heat supply in the Ostrava-Vítkovice area. Its network is 21.88 km long (of which 18.38 km is hot water and 3.5 km is heat pipeline). Heat is supplied both from its own source (the former Vítkovice Energy Centre) and from Veolia. The supplies are intended primarily for the industrial sector, but also for 310 residential units at 164 supply points.

In addition to traditional energy companies, there are also companies in the region that are actively interested in the development of hydrogen and alternative energy solutions:

- **GasNet, s.r.o.** – prepare the infrastructure for blending, i.e. blending and distribution of hydrogen within the existing gas network;
- **GreenGas DPB, a.s.** – it is engaged in the production of biomethane and the energy use of gaseous fuels, including the current extraction of mine gas;
- **Alternative Energy Systems a.s.** – focuses on innovative projects in the field of renewable resources and hydrogen, in particular its pyrolytic production;
- **Green Power Investment s.r.o., Reno Energie, a.s.** – invest in sustainable energy projects, including hydrogen technologies;
- **ORLEN Unipetrol RPA** – prepares hydrogen projects as part of its refining and petrochemical activities;
- **Moravian Oil Mines** (MND) – has infrastructure that could be used for underground hydrogen storage;
- **OKD a. s.** – their phased-out mines could be used in the future as hydrogen or CO_2 storage facilities within so-called energy storage.

5.2. Transport and key players in the Moravian-Silesian Region

Hydrogen technologies represent a major opportunity for the decarbonisation of transport, across all key segments – road, rail and air. Thanks to its industrial background and existing transport infrastructure, the Moravian-Silesian Region offers suitable conditions for testing and implementing these technologies in practice.

In the field of road transport, hydrogen fuel cells are proving to be a suitable solution, especially for buses, trucks and passenger cars over longer distances. Compared to battery electromobility, they allow for faster refuelling and greater range, which is a major advantage, especially in urban and regional transport. The region is home to **the Ostrava Public Transport Company, which** is one of the innovators in the field of clean mobility and has been monitoring the development of alternative fuels, including hydrogen buses, for a long time. The company is ready for testing and possible deployment of hydrogen vehicles in urban traffic. Also the legendary truck manufacturer **TATRA Trucks,** which has the potential to develop and operate hydrogen-powered heavy-duty trucks and which launched a prototype of the fuel cell e-Force Drive truck in 2023. In the truck sector**, HAGEMANN a.s.** is also a leading company, which in June this year launched the first Czech N1 category truck designed primarily for the municipal and logistics spheres. In the case of passenger vehicles**, Hyundai Motor Manufacturing Czech s.r.o. plays a key role in the region** (Nošovice). **Škoda Electric** is an important successor to the production of a number of trolleybuses and electric buses.

In the field of rail transport, hydrogen on non-electrified lines is a suitable alternative to internal combustion engines, especially for regional passenger trains. Here, hydrogen has the advantage of quiet operation, zero emissions and the possibility of adding infrastructure without the need for electrification of the line. Among the active players in the railway area in the region is **TraMoTech s.r.o.**, which provides technical services and development for rail technology, including the development of the combined railway vehicle HMU/HEMU. **Dražní revize s.r.o.** focuses on revisions, inspections and safety of rolling stock and is preparing a separate project for the establishment of a certification and development workplace within the region. Also **Rail Clinic (CZ Loko)** – specializes in the maintenance and repair of rail vehicles and is part of the **CZ LOKO** Group, which develops its own hybrid and alternatively powered locomotives. Last but not least, there is also **Railway Repair and Engineering Works**, which is a major company operating in the repair of railway vehicles.

Hydrogen is also starting to be used in aviation, either directly as a combustion fuel or through fuel cells. The development is mainly focused on regional and medium-term lines.
Within the region, there is a major aviation maintenance company**, JOB AIR Technic a.s.**, which has facilities at Ostrava's Mošnov Airport and could cooperate in the future on the introduction of hydrogen technologies in the field of aircraft maintenance and adaptation. Honeywell, which is involved in the development of hydrogen propulsion for aviation as part of the international NEWBORN project**, is also one of the major technology partners in the wider region.**

5.3. Industry and key players in the Moravian-Silesian Region

The Moravian-Silesian Region is one of the most important industrial centres in the Czech Republic, with a deep tradition in heavy industry, engineering, chemistry and energy. This is where the strong potential for industry transformation towards zero-emission technologies lies, with hydrogen potentially playing a vital role in the decarbonisation of key sectors.

One of the most promising uses of hydrogen is to replace coke in the reduction of iron ore. This approach, known as carbon-free steel production, makes it possible to significantly reduce CO_2 emissions in the metallurgical industry. The Moravian-Silesian Region is key in this respect – **Třinecké železárny – Moravia Steel** is one of the largest steel producers in the country and follows new trends in sustainable production. Another important company in the field of metallurgy was **Liberty Ostrava**, which, however, is bankrupt. Nevertheless, its infrastructure and technological background represent an important potential for new investors and the transition to greener technologies in the future.

Hydrogen is an essential raw material for the production of chemical compounds such as ammonia, methanol or hydrogen derivatives. At present, so-called grey hydrogen produced from natural gas is often used. In the future, it could be replaced by green hydrogen produced by electrolysis from renewable sources. There are a number of companies with ties to the chemical industry in the region. However, the main and key player is the chemical plant **BorsodChem MCHZ** – Czech Republic in Ostrava, as a producer of chemical raw materials, part of the global Wanhua group, but also **DEZA** – a major processor of chemical intermediates such as tar or benzene, **DUKOL,** focusing on chemical products and technologies in the field of industrial lubricants, and **AL INVEST Břidličná, a.s.** – a manufacturer of aluminium materials that could use hydrogen for emission-free melting and surface treatments.

The region is strongly represented in the field of engineering, where hydrogen can be used both as a fuel and as part of new technological solutions. Key players include: **Cylinders Holding** and **Vítkovice, a.s.** – manufacturers of pressure cylinders and technologies for hydrogen storage and transport, **Bonatrans Group** – a manufacturer of wheels and axles for rail vehicles, which can play a role in the transition of railways to hydrogen drives, **Hutní projekt Frýdek-Místek** – an engineering company involved in industrial projects with the potential to implement hydrogen solutions. **ANACOT Capital a. s.** covering a number of engineering companies with the same potential.

The automotive sector is also not negligible. Automakers are focusing heavily on zero-emission drives, where hydrogen can be an alternative to batteries in trucks and commercial vehicles. Among the stakelhoders in the region is the already mentioned **Hyundai Motor Manufacturing Czech s.r.o.** (Nošovice) – although it currently focuses on battery electric vehicles, the Hyundai Group also produces hydrogen-powered cars (Hyundai NEXO), as well as **ZEBRA GROUP s.r.o.** – a Czech manufacturer of municipal and commercial vehicles with the potential to develop lightweight hydrogen platforms. **DEVINN** – a technology company focusing on the development of mobile energy solutions including hydrogen, hydrogen generators, hydrogen application testing, and **Siemens, s.r.o.**, which has a branch in Ostrava and is involved in the development of hydrogen technologies within the group, especially in the field of energy and mobility.

Logistics is the backbone of the modern economy and plays a crucial role in the Moravian-Silesian Region due to its convenient location, developed infrastructure and proximity to industrial centres. With the advent of hydrogen technologies, new opportunities for decarbonisation and increased operational efficiency are opening up in logistics and warehousing. Hydrogen offers an attractive alternative for powering internal and external transport, especially in logistics centres where high demands are placed on speed, cleanliness and reliability:
Hydrogen-powered forklifts and manipulators enable continuous operation without the long charging cycles typical of battery-powered machines. Their quick refuelling and zero local emissions are particularly advantageous in warehouses and distribution centres. Supplying isolated areas

without access to the power grid is possible thanks to mobile hydrogen units, which can serve as an energy carrier to power technologies, cooling equipment or backup systems.
Key companies in the field of logistics and warehousing include, for example: **CHB Logistics, Transexpress, Central Warehouse Solution, ČEMAT, s.r.o., Raben Logistics Czech, ČEPRO a. s., ČD Cargo / Cargo Motion.**

In terms of military and strategic use, the quiet operation of fuel cells in particular allows for the noiseless movement of, for example, submarines, drones or reconnaissance vehicles. In this respect, it is possible to find potential in the state-owned enterprise Vojenské opravny **VOP CZ, s.p.** A separate development project within the TA CR involves the company **Drážní Vize s.r.o**., which also counts on possible testing of these technologies as part of the project of establishing a Centre for Certification and Testing of Prototypes in real conditions.

With the growth in demand for low-emission energy sources, the import of "green hydrogen" is becoming a strategic element for countries that do not have enough of their own renewable resources. In the future, the Czech Republic, including the Moravian-Silesian Region, is likely to be largely dependent on imports of hydrogen or its derivatives (e.g. green ammonia, methanol or synthetic gas) from abroad. The key players in the field of import and distribution in the Czech Republic are, for example: **NET4GAS, s.r.o.** – natural gas transmission system operator planning to switch part of its infrastructure to hydrogen blends or clean hydrogen, **GasNet, s.r.o.** – the largest gas distributor in the Czech Republic, which is actively participating in pilot projects for testing hydrogen admixtures in the gas network and is preparing for the future distribution of clean hydrogen, **Linde Gas, a.s.** as a major supplier of industrial gases, it has the know-how and capacity to produce, transport and store hydrogen on an industrial scale, **Air Products** – a global leader in hydrogen technologies – is involved in the preparation of hydrogen infrastructure in the Czech Republic, especially for transport and industry or **Hydrogreen, s.r.o.** – an innovative company focused on the development of green hydrogen, the development of distribution models and local solutions for industry and energy.

6. Low-carbon gases as a solution for the energy transition

Historically dependent on coal, the Moravian-Silesian Region faces the challenge of transforming its energy and industrial system towards low emissions while maintaining energy security and economic stability. Low-carbon gases — especially biomethane and hydrogen — are a key instrument for decarbonisation in sectors where direct electrification is not realistic or economically available.

The chapter summarises the region's emissions profile and highlights the main sources of emissions: metallurgy, chemical industry, heavy machinery and transport. These sectors are also the largest potential outlet for low-carbon gases. Obstacles to their wider deployment

are also identified — insufficient infrastructure, high costs, regulatory uncertainty, lack of business models and a skilled workforce.

The region has significant potential for the production of low-carbon gases (e.g. use of degassing gases, biogas, renewable sources for electrolytic hydrogen production) as well as their consumption in industry, transport, heating and agriculture. Low-carbon gases can thus be one of the pillars of a fair and sustainable transformation of the region.

The decarbonisation of energy systems is a key element of the European Green Deal and national climate policies. The Moravian-Silesian Region, historically dependent on coal, is undergoing a fundamental transformation. Thanks to the processes related to the reduction of coal in the Czech Republic's energy mix, the region must balance the disrupted social stability, economic competitiveness and, above all, its energy security, i.e. the provision of basal energy for its industry and households.

Low-carbon gases *(or low-carbon fuels)* including, but not limited to, biomethane, synthetic methane, hydrogen and mixtures thereof with other gases. The most commonly considered blends with natural gas offer a completely strategic opportunity and way to support this transformation through hydrogen technologies, especially in sectors where direct electrification is impractical, inefficient or not even realistically achievable for technical reasons.

However, the current state of European regulation sets a relatively unfavourable business environment in the context of natural conditions associated primarily with the potential for the development of renewable energy sources in the Moravian-Silesian Region and the Central European area in general, which at the same time makes promising hydrogen technologies a relatively difficult area for the development of business and business/business models in the Czech Republic and Central Europe in general. Sustainable prosperity related to the role of low-carbon gases and fuels to enable a just and sustainable energy transition in the Moravian-Silesian Region must focus on three key areas: hard-to-electrify sectors; overcoming barriers to decarbonisation based on zero-emission or low-emission energy carriers and exploiting specific regional opportunities for the adoption and effective implementation of low-carbon gas and fuel solutions.

6.1. Emission profile of the region in the areas of interest

With regard to the difficult-to-electrify sectors in the region, it must be stated that the industrial heritage, as well as the associated carbon "dependence", characterizes the Moravian-Silesian Region, which is one of the industrial centres of the Czech Republic with a privileged position in the field of primary iron production, aluminium processing with relevant related production fields with the orientation of the use of synergistic gaseous by-products from associated metallurgical production or their by-products (coke oven plants, coke oven gas rich in hydrogen), but last but not least, also for partial specific chemical production of input chemical components for subsequent chemical production.

The economy of the region is therefore mainly shaped by sectors such as metallurgy, heavy engineering, chemical industry, advanced engineering production, but also cement production nearby in the neighboring region. Many of these processes rely on high-temperature heat, fossil fuels, or raw materials derived from natural gas and coal. As a result, the direct electrification of these systems is technically demanding, economically costly or even unfeasible at present due to the state and known plans for the development of the electricity network or the source base of electricity in the Czech Republic. According to data from the Czech Hydrometeorological Institute and regional environmental assessments, the industrial sector in the Moravian-Silesian Region represents a majority component of regional CO_2 emissions, with high concentrations in large industrial complexes such as TŘINECKÉ ŽELEZÁRNY, until recently, the LIBERTY Ostrava* steelworks operated (the operation was terminated after a financial collapse due to the management of a foreign owner), OKK Koksovny, the chemical-technological company BORSODCHEM and other similarly oriented operations even located directly in the regional capital city of Ostrava. These plants consume large amounts of natural gas, coal and coke for processes exceeding 1,000 °C, making them prime candidates for alternative low-carbon gases and fuels. Furthermore, operations associated with the production of aluminium products by AL INVEST in Břidličná, which is a representative of a typical operation that uses natural gas as the basic input energy for its production. In a broader territorial context, we can also mention the cement production capacity of CEMENT Hranice, which is located only 10 km from the border of the Moravian-Silesian Region, as well as from the territorial reserve for the construction of a new nuclear power plant in the Moravian-Silesian Region.

To provide a basic illustration of the annual production capacities of the key products considered to target the deployment potential of hydrogen and low-carbon gases and fuels, the following are as follows:

- **TŘINEC IRONWORKS:** 2.5 million tonnes of steel
- **LIBERTY Ostrava:** 2.0 million tonnes of steel
- **OKK Coking Plants:** 560 thousand tonnes of coke
- **BORSODCHEM:** 86 thousand tonnes of aniline
- **AL INVEST:** 28 thousand tonnes of aluminium products
- **CEMENT Hranice:** 114,000 tonnes of cement

Transport and mobility, as potentially suitable segments for decarbonisation, account for approximately 18% of regional CO_2 emissions, and its decarbonisation has proven to be difficult after initial attempts carried out in the last few years, especially for public transport, despite the activities of both the Moravian-Silesian Region and the regional capital – the city of Ostrava. Both municipalities have shown great efforts to integrate hydrogen on specific selected lines or routes with the considered numbers of hydrogen buses in the range of considered applications in dozens of pieces, unfortunately, without successful implementation. Freight transport, which was also at the very beginning of the consideration of decarbonising the transport sector through hydrogen, has not gained the necessary interest from the private sector and no activities are being developed in this direction to implement it. The main cause is the non-existent market, i.e. the production capacity and price parity levels of emission-free or low-emission fuels and standard fossil fuels.

However, there are successes in the segment of the integration of hydrogen propulsion into the heavy and light trucks produced in the region, as well as in the segment of light commercial vehicles and work machines. These are mainly the production programs of the production companies TATRA TRUKCS, HAGEMANN and ZEBRA GROUP operating in the region.

While battery-electric vehicles are gaining popularity and are gradually taking their place in company passenger vehicle fleets, heavy-duty vehicles, urban and long-distance bus lines or even selected railway corridors without electrification currently remain dependent on diesel or compressed natural gas (CNG), which is very widespread in the region. Low-carbon gases and fuels – especially biomethane and hydrogen – offer feasible options for replacing fossil fuels in these segments.

The filling infrastructure has already been installed in two installations within the city of Ostrava in the Moravian-Silesian Region. These include the installation of a public filling station, which is available in the central part of the city with the possibility of filling passenger cars with hydrogen, and the second is the application of hydrogen refuelling infrastructure, which is part of the university campus and is used for experimental purposes.

The possibility of using hydrogen propulsion in drones is also potentially promising. Drones are nowadays used for many purposes, including professional ones, and it is also possible to use hydrogen propulsion to power them.

Central heating systems can be understood as urgent areas of decarbonisation. The Moravian-Silesian Region has one of the largest central heating networks in the Czech Republic operated in the Czech Republic within its metropolis and other large settlements. The most extensive central heat supply network of the city of Ostrava heats and supplies heat and cold to approximately 100 thousand households. Many of these systems traditionally rely on coal-fired cogeneration plants in the region, some of which are now gradually switching to natural gas. However, long-term decarbonisation requires renewable or low-carbon substitutes for natural gas in order to avoid future but still carbon dependence on fossil fuels used. Upgrading existing gas infrastructure to receive biomethane or hydrogen blends represents a practical and entirely realistic opportunity to develop hydrogen technologies with a high potential for the development of the relevant market.

On the contrary, agriculture and waste management can be understood in this context as complementary segments of the economy suitable for the application of decarbonisation approaches in the future, although they are not the dominant sources of emissions, the agricultural sector and waste management systems can produce methane and other biogenic emissions, which contributes to both the climate burden and the opportunities for the deployment of circular solutions. Anaerobic digestion and biogas recovery from landfills are already in operation in the region, but they remain insufficiently and unconceptually used. The development of current approaches to the integration of renewable sources through, for example, agro-photovoltaics or complex energy systems linked to agricultural production are not systematically supported and therefore not developed. For these reasons, there is not much awareness among key companies of the follow-up possibilities of using low-emission or even zero-emission fuels and energy to ensure the activities of agricultural enterprises, including their mobility, operation of heavy agricultural equipment or sophisticated food production such as greenhouse, hydroponic or aquaculture capacities. Waste management, which, thanks to the legislative postponement of the deadlines for the regulation of municipal waste landfilling, is also an unused or inefficiently used energy potential in the region.

Food processing and production companies are represented in the Moravian-Silesian Region in a relatively large proportion, but their processing and production capacities are available only at the level of pilot projects or building concentrated capacities for the production of low-emission gases and fuels rather than becoming centres of their application. However, in the future, these operations may become investors with the aim of bringing added value to their end customers of their products by minimizing their carbon footprint in general.

6.2. Obstacles and challenges

Technological and technical uncertainty, infrastructure constraints are one of the most significant barriers to the widespread adoption and implementation of low-carbon gases is their own technological/commercial readiness and maturity. While technologies for the production of biomethane and renewable hydrogen are advancing relatively rapidly, challenges remain in areas such as:

- a plant for the supply of biomethane/hydrogen to the distribution network;
- ensuring the intrinsic compatibility of gas networks with different gas compositions;
- investments in the identification and preparation of technological bases for the transition of industrial processes to the use of hydrogen or other low-emission gases and fuels;

Despite a robust natural gas network, existing pipelines and, above all, service infrastructure such as compressor stations and terminal equipment are not fully compatible with high concentrations of hydrogen (i.e. above 20% vol.) or modified biomethane and require coordinated modernization planning. The costs of modernization and coordination problems between multiple stakeholders (the state as the owner of the gas transmission system, utilities, municipalities, private operators) pose significant logistical and synchronization challenges, which are at the very beginning of the expert discussion.

Economic viability is the second obstacle announced. Low-carbon alternatives are currently more expensive than fossil-based options, especially in unregulated sectors. The lack of a mature carbon pricing mechanism, limited subsidies and high capital costs for gas treatment equipment or electrolysers hamper market adoption. In addition, the price volatility of gas markets and the shift from long-term contracts to market mechanisms in recent years have made long-term planning in the energy sector difficult.

Regulatory and political loopholes **cannot be left out either.** Although the Czech government supports the energy transition, there is still no centralized strategy or action plan for hydrogen hydrogen infrastructure, biomethane injection or guarantees of origin for renewable and low-emission gases or fuels. Regional actors often face bureaucratic hurdles and a lack of clarity regarding support schemes, permits and inconsistencies between the state administration and the authorities concerned, which operate at the national level, so their decisions are bound to their territorial scope. Furthermore, the current unpreparedness of certification authorities for the needs of the development of the market with emission-free and low-emission gases is also pressing, and at the same time a condition for any definition of positions and new business impulses.

In a certain sense, the partial mechanisms of localization of support, its "flexibility" in response to changing market or technological conditions and the general direction of funds intended for the transformation of not only post-coal regions, but generally those regions and operations that have long borne the main burden of payments to the EU-ETS and would therefore logically have the opportunity to draw on the funds of the national Modernisation Fund created in this way for their decarbonisation to the maximum, are also subject to criticism. In some cases, the incentive effect of such financial support is also very reduced on the part of the recipients, and in the case of the application of hydrogen technologies for real investors, this is mainly due to concerns about meeting the blanket conditions of European hydrogen legislation, which is usually a condition for this support, and which is not as economically efficient in the Czech Republic as in countries with more favourable conditions for renewable sources, etc. However, this contradiction also arises from the perception of the business sector in the sense that the decarbonisation of key segments of the national economy that are still in operation in the Moravian-Silesian region is not directed with the necessary dynamism and scope towards progressive technologies that currently cannot operate in the market environment of the still slowly forming hydrogen market.

Public perception and readiness of the workforce, willingness to invest and finance is the last indicated barrier, as the transition to low-carbon gases means the need for new skills in engineering, operations and maintenance, which are not yet widespread in the regional labour market. In addition, public acceptance of gas technologies, especially hydrogen storage and transport, is mixed and often influenced by outdated security concerns or misinformation.

It is also necessary to perceive the non-existent real business models of customer-supply chains as a very important aspect, increasing the perception of investor risk for the banking sector, with the effect of postponing final investment decisions and starting the deployment of hydrogen technologies. As a direct result, several announced projects that have also received a positive promise of EU funding have unfortunately announced the termination of their implementation, mainly due to the failure to find their business counterparts, whether on the part of hydrogen producers or its customers at the given time or logistically acceptable and economically justifiable distances.

6.3. Opportunities and potential

The Moravian-Silesian Region is one of three regions that can use funds from the JTF (OP ST) and other specialized sources strongly supporting renewable technologies such as targeted hydrogen technologies for its transition as a post-coal region. The initial infrastructure and investments from JTF funds are gradually starting to be implemented within the region, but for the time being they are mainly directed to R&D support infrastructure and innovation centres focused on the broader context of the use of hydrogen technologies. These are pilot projects in Třinec (Cirk Arena) and Ostrava a research centre focused on accelerating demonstration and safety of hydrogen applications and the economy.

An important development area of low-emission gases and fuels within the UNIFHY project, the segment of biomethane/biohydrogen use is newly identified in the context of the circular economy. Regional biological waste, wastewater and production residues of agricultural and food production are still marginally used sources for biomethane production. Anaerobic digestion plants can be expanded and upgraded to increase output and treat biogas to pipeline quality. Incentives for the collection of organic waste, joint digestion and injection of biomethane into the gas network appear to be particularly promising from the perspective of further development and recommendations for consideration in the context of action planning for the development of the hydrogen economy in the Moravian-Silesian Region, especially from the perspective of municipalities and agro-industrial entities.

The obligatory area of green hydrogen production and strategic storage has great potential in connection with the acceleration of the integration of new sources for the production of renewable electricity (i.e. from photovoltaics and wind), which will grow thanks to current political support or even with the support of a very appropriate change in the use and transformation of the function of land after mining.

The process of terminating mining throughout the region is also related to the approach of verifying the potential of hydrogen production from degasification gases within operations and mine workings after the end of mining activities, which is very supported by the regional government. This area is currently coming to the fore.

The following should be clearly considered as key areas of deployment of hydrogen technologies in general in the region on the consumption side:

- the use of renewable and low-emission gases (hydrogen) and emission-free derivative energy carriers *(ammonia)* in the steel industry by converting existing production capacities to Direct Iron Reduction (DRI) technology;
- the use of renewable and low-emission gases *(hydrogen);*
- Local mixing of renewable and low-emission gases *(hydrogen + biomethane)* into natural gas networks for use in industrial plants or public transport hubs;
- Demonstration of cogeneration based on the use of clean gases *(hydrogen + biomethane)* for industrial parks;
- Pilot projects for the use of zero-emission and low-emission gases and fuels *(hydrogen, biomethane, methanol)* in in-house mobility and public transport.

The key area of deployment and use of hydrogen technologies in general in the region can be identified reciprocally on the side of their production for accelerated development:

- the use of degasification gases for the production of low-emission gases (hydrogen) within the operations of mine workings that have reached the end of their service life after the end of underground mining activities of hard coal and with the production of methane suitable for use in the transition period;
- Production of low-emission gases (biogas + biohydrogen) from various sources in accordance with the concept of application of circular economy approaches in agriculture and waste management.

All of these initiatives must form the core of the regional dimension of industrial decarbonisation efforts, supported by pooled public and private investment.

6.4. Conclusions & next steps

Seek to change the DA´s conditions consisting in proving discriminatory technical conditions for the application of the "ONE SIZE FOR ALL" approach

Preference for projects with a multiplier effect – e.g., H2 buses operation, railway applications, low-emission heating plants supported by a program of targeted support to projects integrated into the hydrogen valley

Build green hydrogen production capacity based on electrolysers powered by RES (e.g., wind farms in the "Osoblažsko" area) and use brownfields or mining sites with specific local energy sources to build H2 production facilities or storage and, where appropriate CHP.

Hydrogen valley value chain matrix and stakeholder involvement in MSR

SEGMENT / STAKEHOLDER	ENERGY SUPPLIER	PRODUCER H2 DEVICES / SYSTEM INTEGRATOR	H2/DERIVATES PRODUCTION	PURIFICATION / CONVERSION	TRANSPORT / DISTRIBUTION	STORAGE	FINAL USE	R&D/EDUCATION / POPULARISATION	STRATEGIC PLANING / APPROVAL PROCEDURES / REGULATION
Moravian-Silesian Region							XXX		XXX
Moravian-Silesian Hydrogen Cluster, z.s.								XX	XXX
Technical university of Otrava	XX		XX					XXX	
University of Ostrava								X	X
GasNet, s.r.o.					XXX	XX		X	X
GreenGas DPB, a.s.	XXX		XXX	XX			X		
Alternative Energy Systems a.s.		XXX							
Green Power Investment s.r.o.	XXX	XX							
Reno Energie, a.s.	XXX	XX							
ORLEN Unipetrol RPA			XXX	X			XXX		
OKD a. s.	XX		X						
Moravian Oil Mines	XX				XX	XX			
Veolia Energie ČR, a. s.	XXX		XXX						
ČEZ Energetické služby, s.r.o.	X		X						
Ostrava City Transport Company							XXX		
TATRA TRUCS, a.s.		XX						X	
HAGEMANN a.s.		XX							
ZEBRA GROUP, s.r.o.		XX					X	XX	
Hyundai Motor Manufacturing Czech s.r.o		XXX	X				X		
Škoda Electric		X							
Třinecké železárny – Moravia Steel			XXX				XXX		
BorsodChem MCHZ , s.r.o.			XXX				XXX		
Hutní projekt Frýdek-Místek		XX							
Dražní revize s.r.o								XX	XX
AL INVEST Břidličná, a.s.							X		
ČEPRO a. s.	XX				XXX	XX			
Silesia HYDROGEN									X
Bochemie a.s.			X				X		
BONATRANS GROUP a.s.							X		

TYPE OF ACTIVITY	
XXX	MAIN
XX	SIDE
X	Potecial / Colateral

7. Low-carbon gases: market and innovation

The final chapter synthesizes the main challenges and opportunities associated with the development of low-carbon gases in the region. It stresses the need for a comprehensive approach that, in addition to reducing emissions, also takes into account energy security, social cohesion and economic stability.

Four key obstacles are identified:

- **Technological – the need for proven solutions for industry and energy.**
- **Infrastructure – the lack of hydrogen and biomethane networks and plants.**
- **Economic – high investment costs and limited business models.**
- **Legislative – complex authorisation processes and regulatory ambiguities.**

At the same time, the chapter shows that low-carbon gases bring significant opportunities – especially for the decarbonisation of industry, the modernisation of heating and the development of innovative sectors. They are thus one of the key tools for the fair transformation of the Moravian-Silesian Region towards a modern, low-emission and competitive economy.

The energy transition is one of the biggest challenges of our time, especially for regions with historically strong ties to fossil fuels. The Moravian-Silesian Region, as a traditional industrial region with a significant dependence on coal, is facing a fundamental transformation of its energy infrastructure and industrial base. In this context, zero-emission and low-carbon gases or fuels play a key role as prospective energy carriers that can make a significant contribution to the decarbonisation of the regional economy while maintaining its competitiveness. These energy carriers are not only energy carriers, but also carriers of new information, know-how and competencies.

Low-carbon gases (or fuels) include a wide range of gaseous or possibly liquid derivatives based on atomic hydrogen with a significantly lower carbon footprint compared to conventional fossil fuels. In the context of the Moravian-Silesian Region, the following commodities are considered for further development:

- renewable hydrogen (produced by electrolysis of water using electricity from renewable sources);
- low-carbon hydrogen (produced, inter alia, from fossil fuels using carbon capture and storage technologies; from electricity not from renewable sources);
- biomethane (produced from biodegradable waste);
- mine methane (extracted from closed or active mines).

These gases are flexible energy carriers that can be used in a wide range of applications from industry and transport to energy and heating.

The Moravian-Silesian Region was the first region in the Czech Republic to set a relatively ambitious goal of developing and building the so-called Hydrogen Valley – a complex ecosystem involving the production, distribution and consumption of hydrogen and other low-carbon gases or their derivatives. This plan is supported by a number of strategic documents, led by the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region for 2024-2034, which is in line with European and national strategies for the decarbonisation and development of hydrogen technologies. The Moravian-Silesian Region has a number of prerequisites for the development of low-carbon gases (fuels) (described in more detail in Chapter 6), in brief – a strong industrial base, a developed research infrastructure, the availability of potentially usable local energy sources (including "mine" methane) and the possibility of access to funds from the Just Transition Fund and other forms of support.

The UNIFHY project aims, among other things, to identify an overview of the current and potential market for low-carbon gases (fuels) in the Moravian-Silesian Region, tools for its development and links to research and innovation. The research team together with stakeholders focus on the entire value chain and future market and its possibilities are structured into three main areas.

- The first area analyses the situation and the current potential industrial and domestic use of low-carbon gases in the region, including the basic principles of recommended technologies.
- The second area maps planned and ongoing innovation and research projects across the value chain, including projects supporting the decarbonisation of industry.
- The third area focuses on existing and planned business models, specific services and products related to low-carbon gases in the region.

The aim of the information and inputs formulated below is to provide a general picture of the considered potential of low-carbon gases for the transformation of the Moravian-Silesian Region and to identify key opportunities and challenges associated with their development. Ideas and information on specific technologies are drawn from the latest available sources, including regional strategies, expert studies and project documents, and try to reflect current trends, legislation and developments in this dynamically developing area of hydrogen technology application in general.

7.1. Potentially applicable technological principles for the production of low-emission gases (fuels)

For the effective use of low-carbon gases and fuels in various applications, it is necessary to understand the basic technological principles of technologies that are usable for the production of low-emission or zero-emission gases (fuels). This part focuses on key technologies relevant for the Moravian-Silesian Region.

PEM/AEM electrolysis of water. PEM (Proton Exchange Membrane) or AEM (Anion Exchange Membrane) electrolysis is one of the most promising technologies for the production of renewable and low-emission hydrogen. These technologies use electricity to split water into hydrogen and oxygen, with a proton-permeable and non-proton-permeable polymer membrane serving as the main effective component The main advantages of PEM electrolysis are high efficiency (up to 70%), the ability to quickly manage production in response to changes in electricity supply (which is important when using renewable sources or in the function of network services), compact design and high purity of the hydrogen produced. The disadvantage is higher investment costs compared to alkaline AEM electrolysis and limited membrane life.

In the Moravian-Silesian Region, the use of electrolysis in general is planned in several projects, including, for example, the already mentioned two project initiatives of Veolia Energie and others. According to the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region, the potential for the development of electrolysers by 2030 is up to 633 MWe (according to the high scenario). For the effective use of PEM electrolysis, it is crucial to ensure sufficient electricity from renewable sources. Approximately 55 kWh of electricity is needed to produce 1 kg of hydrogen, which corresponds to 55 MWh of electricity per 1 tonne of hydrogen. To cover the planned hydrogen production in the region, it is therefore necessary to build significant renewable energy capacities or to enable the import of renewable energy primarily from Poland.

Pyrolysis of methane and waste materials. Methane pyrolysis (also historically referred to as "turquoise hydrogen") is an innovative technology for producing hydrogen without direct CO2 emissions.

The process breaks down methane into its constituent elements, hydrogen and solid carbon (CH4 → C + 2H2). Carbon is not burned in this process, so there is no need for a CO2 separation step or its subsequent storage. Methane pyrolysis has been around for decades, but due to high energy requirements and other technical challenges, it is not as mature as steam methane reforming (SMR). However, the technology is gaining importance as a bridge technology between fossil fuels and a fully renewable hydrogen economy.

Pyrolysis, especially of industrial waste, is also being developed in the region by specific industrial partners. The most effective is the pyrolysis of organic waste such as plastics, tyres, biomass, textile waste or mixed municipal waste with a high proportion of organic components. Each type of waste has specific pyrolysis parameters and hydrogen yield. Environmental benefits include a reduction in the amount of waste sent to landfills, the elimination of methane emissions from landfills and a reduction in overall CO_2 emissions compared to conventional waste management methods. In addition, pyrolysis does not produce dioxins and furans, which are produced during incineration.

Steam reforming methane or biogas. Steam reforming is an industrial and large-scale process of hydrogen production by reacting methane or natural gas, biogas, biomethane or these components contained in by-product gases (or other hydrocarbons, as the case may be) with water vapor at high temperatures and pressure, usually in the presence of a catalyst. This produces hydrogen and carbon monoxide, which can then be converted into hydrogen and carbon dioxide in further reaction steps. The basic reaction is the reaction of methane, which reacts directly with water vapor at high temperatures (700-900 °C) and pressure (2-4 MPa) through the catalysts present in the reactor itself ($CH_4 + H_2O \rightleftharpoons 3H_2 + CO$). The subsequent reaction or production step following the steam reforming itself is the reaction of carbon monoxide, which reacts again with water vapor to form carbon dioxide and hydrogen ($CO + H_20 \rightleftharpoons CO_2 + H_2$). A specific advanced variant of the steam reforming method is "autothermal reforming", which is beginning to assert itself and can be very advantageous for use in the production of low-emission gases from various primary energy raw materials containing methane. In principle, steam methane reforming must always be co-deployed with CCS or CCU technologies. Without the integration of this carbon dioxide capture technology into the steam reforming production chain, the gases produced cannot be used for decarbonization or technically labeled as low-emission in any of the feedstock configurations.

The potential of hydrogen production from biomass. In addition to electrolysis, the production of hydrogen from biomass represents another promising way to produce low-carbon gases. This technology uses thermochemical processes such as gasification or pyrolysis to convert biomass into syngas that contains hydrogen, carbon monoxide, and other components. The hydrogen is then separated and purified. The advantage of this technology is the possibility of using locally available biomass sources, including agricultural and forest residues or biodegradable and non-degradable waste. The disadvantage is lower overall efficiency compared to electrolysis and the need for more complex purification processes for the low-emission gas produced. The future necessity of using a certain degree of principles and technologies for the capture or subsequent use of greenhouse gases (CCS+CCU) also seems critical.

In the Moravian-Silesian Region, there is potential for the use of biomass to produce hydrogen, especially in the context of existing heating plants that could be adapted for this production technology. A specific but special example of the use of biomass for the production of low-emission hydrogen is Veolia Energie's planned project in Sviadnov, which envisages the use of biomass as one of the primary energy sources, its conversion into electricity and its use for electrolytic production of hydrogen, which could be used under certain circumstances according to the rules for low-emission gases (fuels).

Potential for the use of mine methane and possibly other extracted gases in the region. Thanks to its mining history, the Moravian-Silesian Region has a unique potential for the use of mine methane as an energy source suitable for the production of low-carbon gases – hydrogen. Mine methane is a gas that occurs naturally in the coal seams of underground mines and is spontaneously released during coal mining, but also after the end of mining. This release or accelerated "mining" for safety reasons is available for a period of 10-15 years after the end with a gradual reduction of the released mine methane in the degasification gas.

Capturing and using mine methane has the dual benefit of reducing direct emissions of this greenhouse gas into the atmosphere (methane has a global warming potential 25-28 times higher than CO_2) and providing a valuable local energy source. Mine methane can be used directly as fuel or as a feedstock for hydrogen production.

In addition to mine methane, there is also potential for the use of other waste gases in the region, including industrial process gases or biogas from wastewater treatment plants and landfills. These gases can be used as energy sources or as raw materials for the production of low-carbon hydrogen after appropriate purification.

Potential of coke oven and blast furnace gas. Thanks to the still active primary iron production operations associated with the operation of two coke production capacities within the Moravian-Silesian Region, the use of two relatively specific input raw materials is possible. It is a "coke oven gas" produced during the production of coke, which is directly composed of up to 60% hydrogen, 20-30% methane, approx. 10% carbon monoxide, carbon dioxide and residual hydrocarbons. Approximately 280 million m3 of this gas is produced in the operation operating directly in the metropolis of the Moravian-Silesian Region, the city of Ostrava.

The second alternative usable energy by-product in the region is the "blast furnace gas" produced in the blast furnace during the reduction of iron ore. This is composed of the reaction logic of up to 60% nitrogen, 30% carbon monoxide, approx. 15% carbon dioxide, residual hydrogen and methane as well as particulate matter.

However, the use of these specific by-products is not promising, mainly for two reasons. On the one hand, these by-products have so far been fully used for energy production within the framework of the integrated energy management of the production companies or cooperating energy plants concerned, and therefore they are not actually available on the market as such. Furthermore, their use would be unequivocally conditional for use in the production of low-emission gases with CCS or CCU technologies. However, a technologically rather unpleasant feature of these by-products is their variable composition depending on the input raw material production of coke (coal) and pig iron production (charge of iron ore and other auxiliary materials). This property would also mean increased demands on the operational variability of carbon dioxide capture technology, which would very likely lead to a real low economic efficiency of the entire process of production of potential low-emission gases by any of the above methods. However, the given technological alternative may make sense during the energy and decarbonisation transition of these entities over the next decade, which, depending on their decarbonisation activities of their operations and future prices of ETS allowances, may consider deploying such complicated approaches.

7.2. Planned and ongoing projects

7.2.1. Industry

The Moravian-Silesian Region concentrates energy-intensive industries, especially the metallurgical industry, engineering and heating industry. These sectors are both major energy consumers and producers of greenhouse gas emissions. To illustrate, the total annual emissions under the EU-ETS in the Moravian-Silesian Region are on average 15,700 kt CO2/yr. Low-carbon gases offer a promising way to decarbonise these sectors while maintaining their competitiveness, precisely through the savings achieved by purchasing emission allowances. However, these savings must be commensurate with the capital expenditures to be made by the companies.

The metallurgical industry is one of the largest energy consumers and CO_2 emitters in the region. The key players today are the compact metallurgical agglomeration of TŘINECKÉ ŽELEZÁRNY, which employs 7,000 people and another 8,000 people in related companies and still forms the backbone of the regional economy in the given parameter of the workforce. However, due to the interconnectedness of technological processes, the transition to low-carbon technologies in such process-closed metallurgical industrial centres is a complex challenge that requires significant investments and technological innovations. In the event of the failure of these decarbonization efforts, a failure of the market model of the operations can be expected, potentially leading to a domino effect in the downstream supply chains - e.g. in the region of a very wide portfolio of the arms industry, which may lead in extreme scenarios to the threat or dysfunction of some strategic industrial areas of the Czech Republic.

There is also a similar metallurgical complex LIBERTY Ostrava in the region, but it is currently in bankruptcy, and therefore we do not consider it as a relevant entity for further development. In the event that the operation of this company is at least partially restored, then the approaches below would certainly be relevant for the application within this operation as well. LIBERTY Ostrava is mentioned here mainly because it announced a long-term and ambitious decarbonization plan before declaring its bankruptcy and has already started to implement this investment transformation program with the goal of achieving carbon neutrality by 2030. This program included the modernization of the steel plant based on the construction of two hybrid furnaces to replace the current tandem furnaces. This modernization will allow the mill to use a higher volume of local scrap and significantly reduce its dependence on imported coal. At the same time, a connection to the very high voltage grid was planned, thanks to which it would be possible to produce steel from up to one hundred percent scrap. In the long term, the company has also explored the possibility of using hydrogen as a reducing agent in iron production, which could lead to further significant emission reductions or the maintenance of primary iron production.

TŘINECKÉ ŽELEZÁRNY is also intensively involved in reducing the carbon footprint and replacing coal in production processes. The company is gradually preparing to move away from coal in the energy sector and is exploring the possibilities of using hydrogen both in metallurgical processes and primarily in its power plants that supply the entire industrial complex with energy. In 2024, the first of a series of planned investments began in the autumn. The ironworks began to build a briquetting line for the treatment of iron ore before it was inserted into the blast furnace. This year, the construction of a steam-gas cycle began at the Energetika Třinec power plant, where it replaces a coal-fired source. The traditional production of the input for the blast furnace is based on hot sintering of iron ore. The briquetting line ensures the replacement of such a method of production by the production of briquettes by a basically cold process. This was supposed to save about 70,000 tons of CO2 emissions per year equivalent to, for example, the emissions of up to 19,000 passenger cars.

However, in April 2025, the company unfortunately postponed all implementation dates for measures, including those initiated, stating that, due to the development of the situation of European regulation – including the use of hydrogen – it had reached a pragmatic decision conditioned by at least three major uncertainties that did not allow it to continue with the implementation of the planned investments. The following can be described as the most pressing:

- insufficient level of subsidy support from the state and relevant subsidy programs;
- uncertainty about the direction of the "Green Deal" parameters;
- last but not least, the unclear rules on market protection against imports of steel and products from countries without regulations and with lower steelmaking costs, referring to the current reassessment of the regulation on the introduction of the CBAM;
- and the key approach of managing the company only with regard to the decarbonization of operations by forced investments, not benefits in the areas of production or business added value.

According to the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region, the installation of electrolysers with a capacity of up to 320 MWe (according to the high scenario) for steel production is planned by 2030, which should lead to the consumption of up to 35 thousand tonnes of hydrogen per year in this sector.

Its use in the heating and energy sectors represents another important area of potential use of low-carbon gases in the Moravian-Silesian Region, not only in terms of the decarbonisation of energy sources themselves, but above all because it has direct impacts up to the final effects of decarbonisation of individual inhabitants. VEOLIA ENERGIE ČR, which is a key supplier of heat in the region (especially within the district heating system of the city of Ostrava, as the largest central heat supply system – CHS), plans to use a combination of natural gas and local sources in the form of residual waste or biomass for the operation of its heating plants. The company has its main heating plants in other cities of the region (Karviná, Nový Jičín, Frýdek Místek and Sviadnov) with a total supply of heat and energy of 16,500 TJ.

A specific example of the direct use of hydrogen technologies in the field of heating is the project successfully developed with a planned launch in 2028, which envisages the integration of hydrogen production capacities into the system of the existing Krnov heating plant operation. The aim of the project is to cover the local hydrogen needs for hydrogen transport, primarily train vehicles. The project includes the implementation of hydrogen production by PEM electrolysis with an output of 2-3 MW (with an eventual expansion to 6 MW) from renewable sources (biomass, photovoltaics), including the construction of a hydrogen filling station for filling hydrogen trains in Krnov. However, despite securing its funding from the EU Innovation Fund, the project will have to be postponed in its implementation phase, mainly due to complications in setting up customer-supplier relationships, simply put, the absence of follow-up sales of this fuel (low-carbon hydrogen).

Current approaches to decarbonizing the district heating network and the associated high-efficiency cogeneration of electricity are currently leading to the replacement of coal with natural gas. It is in this segment that it is rightly assumed that further reduction of the carbon footprint of heat production can be achieved thanks to the active development of the use of low-emission gases in the region, which would become part of the energy mix of the input fuel base of these extensive CHP production capacities. The supply of these concentrated productions would then be ensured through the use of nearby natural gas distribution networks or then networks and routes available in the region, where new pipelines for renewable or low-emission hydrogen could be created. Such new pipelines are being considered to support the construction of a regional strategy for the development of hydrogen technologies up to 100 km by 2030.

Replacing "grey" hydrogen with renewable or low-carbon hydrogen in other industrial processes. At present, industrial processes in the region mainly use so-called "grey" hydrogen, which is produced from fossil fuels without capturing the CO_2 produced. This hydrogen has a significant Carbon footprint and its replacement with low-carbon alternatives represents an important opportunity to reduce emissions. According to the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region, the installation of electrolysers with a capacity of up to 108 MWe (according to the high scenario) intended to replace grey hydrogen is planned by 2030. This should lead to the replacement of up to 12,000 tonnes of grey hydrogen per year with low-carbon alternatives. This transformation will require not only technological innovation, but also the creation of adequate infrastructure for the production, storage and distribution of renewable and low-carbon hydrogen.
The primary area of this substitution of grey hydrogen with renewable or at least low-emission hydrogen is considered to be the substitution within the aniline production process at the chemical technology company BORSODCHEM. The basic principle of this production is the use of natural gas both as a fuel for thermal processes and directly as a source of hydrogen molecules, which is released as part of the steam reforming process of natural gas. The amount of aniline produced in this way is on average around 86 thousand tonnes per year.

Experimental use in other technological processes. Other experimental applications of hydrogen applications may include applications in the production of synthetic fuels or in waste treatment processes by plasma processes. These applications are still in the research and development phase, but they represent promising directions for the future use of low-carbon gases in the region, but only under the conditions that the technology can be applied according to the conditions of low-carbon gas production and their real impact on reducing the carbon footprint. All pyrolysis processes are investigated both through the CEET Research Centre at VSB-TUO – here especially plasma pyrolysis. Commercial activities related to the classical concept of pyrolysis of industrial waste (e.g. tires), which are already being supplied to the European market by companies operating in the region, such as ALERNES, are also being developed.

Pyrolysis conventional and plasma pyrolysis are technologies with a high potential for development and expected favorable regulation and possible ecological-economic multiplier effects!

7.2.2. Transport

Transport is one of the key sectors for the use of emission-free and low-carbon gases, especially in the form of hydrogen. The Moravian-Silesian Region has shown its ambition to apply hydrogen propulsion by 2030 in public transport, which it organizes on its territory, across various transport modes.

Hydrogen buses in urban and suburban public transport. Urban and intercity public transport is an ideal area for the deployment of hydrogen technologies, especially thanks to regular routes, centralized facilities and the possibility of planned refueling. According to the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region, up to 300 hydrogen buses are planned to be deployed by 2030 (according to the high scenario), which should consume up to 1,800 tons of hydrogen per year. The implementation of hydrogen buses will take place gradually, with an initial focus on urban agglomerations, where there is the highest potential for reducing emissions and improving air quality. A key prerequisite for the successful deployment of hydrogen buses is the construction of an appropriate infrastructure, especially hydrogen filling stations.

Hydrogen railway. Rail transport represents another promising area for the use of hydrogen, especially on non-electrified regional lines. The Moravian-Silesian Region is actively exploring the possibilities of deploying hydrogen trains, with the Bruntál Region operating set on defined and pre-tested lines being identified as a pilot area, which have been subjected to comprehensive research and modelling of suitable and usable drives to ensure the planned decarbonisation.

According to available studies by the state-owned company Správa železnic and other research entities, the use of hydrogen on these lines is comparable in terms of investment to other non-fossil methods of propulsion. The advantage of hydrogen trains is their flexibility, range and the possibility of operating on the existing railway infrastructure without the need for electrification. A specific example of the planned project described above is the cooperation of VEOLIA ENERGIE ČR with rail transport operators to ensure the supply of hydrogen for hydrogen trains in the Krnov region.

Freight transport is a significant source of emissions and at the same time an area with high potential for the use of hydrogen technologies. In the Moravian-Silesian Region, TATRA TRUCKS is a pioneer in this area, which, in cooperation with DEVINN, has developed a prototype of a hydrogen fuel cell truck. Other manufacturers of hydrogen vehicles and work machines are the companies HAGEMENN and ZEBRA GROUP operating in the region. However, the supply plans for these vehicles are not established at the time and relationships and suitable applications for the use of these first series of hydrogen-powered vehicles are still being built.

According to the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region, up to 100 hydrogen trucks are planned to be deployed by 2030 (under the high scenario), which should consume up to 1,160 tonnes of hydrogen per year. These vehicles will primarily be used in applications where long ranges, short filling times and high payloads are required, which are parameters that current battery-electric drives cannot effectively meet.

An interesting example of a project in development in the field of hydrogen use for in-house transport of materials and possibly transport for the optimization of storage capacities, which is being developed by HYUNDAI CZECH. This company is the second largest manufacturer of passenger cars in the Czech Republic after Škoda Auto and is considering using the plant's buildings to build renewable energy production capacities and to convert it into renewable hydrogen for mobility purposes through water electrolysis and is considering using its production complex in Nošovice, Moravia-Silesia. Of course, HYUNDAI is also a manufacturer of hydrogen-powered passenger cars, so this idea is also supported because of the expansion of its own production capacity of hydrogen vehicles to the EU and the possibility of their production finalization and pre-sale preparation directly in Nošovice.

Passenger car transport represents the largest segment of the transport market in terms of volume, and therefore a significant potential for the use of hydrogen technologies. According to the Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region, up to 2,400 hydrogen passenger cars (according to the high scenario) are ideal for deployment by 2030, which should consume up to 400 tons of hydrogen per year.

A key prerequisite for the development of hydrogen mobility in passenger transport is the construction of a network of public hydrogen filling stations. In this respect, the opening of the first public hydrogen filling station in Ostrava by Vítkovice, a.s. in June 2022 is an important milestone. This station is designed for hydrogen passenger cars and offers filling to a pressure of 700 bar. This basic infrastructure is also one of the recommended good practices of the Moravian-Silesian Region, as it is a low-cost application that has its unique features for initiating and accelerating hydrogen activities in other regions. The filling station in question was recommended as a European good practice within the implementation of the UNIFHY project and was included in the catalogue of good practices of the Interreg Europe programme. Further development of the infrastructure is planned by VÍTKOVICE TESTING CENTER in cooperation with VÍTKOVICE IT SOLUTIONS, which plan to build a combination of two hydrogen filling stations by 2028 - one for passenger cars and the other for buses and freight transport. This application is also considered as an extension of the existing filling station capacities mentioned above.

Potential for the use of hydrogen at the regional airport – Mošnov, Leoš Janáček Airport. In addition to land transport, there is also potential for the use of hydrogen in the field of air transport in the Moravian-Silesian Region, specifically in ground operations at the Leoš Janáček Regional Airport in Ostrava-Mošnov. The Strategy for the Development of Hydrogen Technologies in the Moravian-Silesian Region mentions the preparation of conditions for the application of hydrogen infrastructure at the airport for the use of hydrogen in ground handling means.

This application could include the use of hydrogen to power ground handling vehicles, material handling equipment or as a backup power source. In the long term, there is also potential for using hydrogen as a fuel for aircraft, especially for regional flights, but this would require significant technological innovation and changes in the aviation industry.

A future and logical alternative to the use of hydrogen technologies in connection with renewable or low-emission hydrogen is advanced fuels for aviation operations, which could be integrated at this important "cargo" transport hub.

Use of surplus renewable energy for hydrogen production and seasonal renewable energy storage. Hydrogen production by electrolysis is an efficient way to use excess electricity from renewable sources that would otherwise not be used. This concept, known as Power-to-Gas, makes it possible to store, among other things, renewable or uncontrollable electrical energy in the form of hydrogen and then use it at times when energy demand is high but production from renewable sources is low.

This principle of storing electricity gives hydrogen an advantage over other storage technologies in terms of supply strategy to such an extent that it is the possibility of its long-term storage, which makes it possible to bridge seasonal fluctuations in energy production and consumption. This feature is particularly important in the context of the growing share of renewable energy sources, the production of which is often dependent on weather conditions and, in the future, de facto on climatic phenomena that can be deflected into extreme and short-term time windows. In the Moravian-Silesian Region, there is potential for the use of hydrogen as a medium for seasonal energy storage, especially in the context of the planned development of wind and solar power plants. Hydrogen produced during periods of surplus electricity can be stored and then used during periods of shortage, either directly as fuel or for electricity regeneration. However, to realize this potential, it is necessary to build an adequate infrastructure for the storage and distribution of hydrogen. In this respect, the project and initiative under consideration is the state-owned company ČEPRO, which is developing the idea of building local distribution capacities and a system for distributing hydrogen as a standardized fuel with technologies for multimodal transport. It is these storage capacities that could also be used in a shared mode for future seasonal storage of renewable energy.

7.3. Business models of hydrogen technology application in the Moravian-Silesian Region

The Moravian-Silesian Region is undergoing a transformation from a traditional industrial region to a modern centre of clean technologies. Hydrogen technologies represent a key opportunity to decarbonise local industry and create new sustainable business models. According to the Czech Hydrogen Strategy, the region is in the first phase of development (2023-2030), focused on building local islands of the hydrogen economy and creating hydrogen valleys.

The region has unique advantages for the development of hydrogen technologies – a strong industrial base, the availability of renewable energy sources and its own specific sources such as mine gases from discontinued mining. This text analyzes specific business models applicable in the region with an emphasis on low-carbon gases and their economic potential.

7.3.1. PRODUCTION

Use of mine (degasification) gas for hydrogen production

Mine gas contains a significant amount of methane (CH_4), which can be used for hydrogen production through reforming. The Steam Methane Reforming (SMR) process with integrated Carbon Capture and Storage/Use (CCS/CCU) or Autothermal reforming (ATR) technology, also with CCS/CCU, with a considered capture of at least 95% CO_2, enables the production of low-carbon hydrogen
with minimal CO_2 emissions that have a higher potential. The reaction proceeds according to the equation:

SMR/ATR: $$CH_4 + H_2O \rightarrow CO + 3H_2 \;/\; CH_4 + O_2 \rightarrow CO_2 + CO + 6H_2 + H_2O$$

Subsequent Water-Gas Shift reaction: $$CO + H_2O \rightarrow CO_2 + H_2$$

The given technological principle can also be ensured for standard natural gas, in accordance with the considered application of the delegated act regulating the production of low-emission gases, or low-emission hydrogen. These rules then set a total carbon footprint for the entire production chain not exceeding 28.2 g of CO_2 per 1MJ of low-emission gas (fuel) or hydrogen produced.

The key advantage of using degasification gas is its own availability as a feedstock (secondary) material compared to conventional natural gas from the gas network, and it is also possible to consider a lower carbon footprint of the so-called "upstream", which, due to the principle of its local extraction, uses spontaneous development and release with possible pumping, but without means labelled as extraction and also taking into account the minimization of transport of such locally obtained energy medium. Coal mine gas is currently used as a secondary energy source in areas where black coal mining has already been terminated and is used for cogeneration of electricity and heat in cogeneration units located in coal mining sites. However, this method of use seems to be outdated by current standards, as it is very difficult to use cogenerated heat. To give you a better idea, the investment cost of a CCS reformer is estimated at EUR 15-25 million for the production of 1000 tons of hydrogen per year.

A potential business model could then include:

- revenues from the sale of hydrogen to industrial customers;
- revenues from the sale of CO_2 for industrial use;
- potential revenues from emission allowances (if the balance between the state of release of degasification methane into the atmosphere is allowed to be traded);
- Reduction of investment intensity / distribution of investments in the necessary infrastructure Disposal of mine gas as part of the obligatory costs for the termination of mining and its further commercial use.

The key players in the region are mainly the state-owned OKD **a.s.** as the main mining company in the region, which has the infrastructure for degassing the mine areas. The company could integrate its activities to include hydrogen production as a natural continuation of its business activities, at least for the period of expected production of degasification gas in volumes enabling energy use. Furthermore, **DIAMO** – the DIAMO state enterprise mainly carries out the elimination of the consequences of mining activities, which includes liquidation, remediation and reclamation work in the areas of plants and facilities associated with the mining and processing of minerals and other industrial activities, mitigation of environmental damage caused by these activities and administration and maintenance of the associated burdens in the Czech Republic. **Vítkovice Heavy Machinery** – a supplier of mining technologies with the potential for the production of reforming equipment and **NEW WORLD RESOURCES** – an international mining group with the possibility of applying the technology in various locations and coordinating large-scale technological projects.

<u>Market potential/motivation:</u> The initial implementation would focus on a pilot project in the Karviná-Ostrava district with an expected capacity of 100-200 tonnes of hydrogen per year. Subsequently, it would be expanded to other locations with terminated mining. Coordination with

mining phase-out plans and the availability of distribution infrastructure, which is already available in the given locations, is crucial.

Pyrolysis Processes for Hydrogen Production

Pyrolysis in general, and hence methane pyrolysis, is an endothermic reaction that proceeds according to the equation:

$$CH_4 \rightarrow C + 2H_2$$

The process requires high temperatures (800-1200°C) and can be realized in various ways: thermal pyrolysis, plasma pyrolysis, catalytic pyrolysis and electrolytic pyrolysis. The production of renewable hydrogen by electrolysis is more energy-intensive compared to pyrolysis processes. This property makes the pyrolysis of methane or other substances potentially competitive with electrolysis.

Thermal pyrolysis:

- Temperature: 1000-1200 °C;
- Energy requirements: medium
- Suitable for continuous operation

Plasma pyrolysis:

- Temperature: 2000-10000 °C
- Energy requirements: high
- Fast response, high conversion

Catalytic pyrolysis:

- Temperature: 500-900 °C
- Lower energy requirements
- Requires catalyst (Ni, Fe, Co)

Electrolytic pyrolysis:

- The electrification of this reaction is very significant, it allows the use of renewable energy sources
- Better process control
- Potential for integration with grid services

<u>Market potential/incentive:</u> on the one hand, it is about zero direct CO_2 emissions: In contrast to conventional hydrogen production methods, methane pyrolysis produces hydrogen in principle without any CO_2 emissions. The only by-product is solid carbon, which can be used as a valuable raw material. Furthermore, the use of solid carbon: The carbon produced can be used in carbon fiber production, electronics (as a conductive material), construction (as an additive to concrete), or batteries (as an anode material) and, last but not least, lower energy requirements, as pyrolysis requires less than one third of the electricity consumed by electrolysis, which significantly reduces operating costs.

The compatibility of pyrolysis processes with biogas production is naturally ensured by the fact that carbon dioxide is usually generously co-produced in normal biogas production in biogas plants, which is directly reducible to methane thanks to hydrogen, which is also directly reducible to methane through the so-called "Sabatier process", which together increases the production capacity of the entire biogas application. This synergy can also be used for separate hydrogen production at the biogas production site. *(discussed in more detail within the Power to Gas processes).* Compatibility with existing infrastructure: The technology is modular, scalable and does not require new pipelines, which significantly reduces investment costs. Additional Carbon Revenue: The solid carbon produced in the process can be used as a valuable raw material, creating an additional source of income.

Low-emission hydrogen from biomass and biogas / biomethane

Czech Republic's National Energy and Climate Plan, December 2024 (NEKP): Defines the target of achieving a 30.1% share of renewable energy sources (in gross final energy consumption), including biomethane, by 2030. Update of the National Action Plan for Clean Mobility, 2024 (NAP CM): Focuses on promoting the use of biomethane as a transport fuel, primarily in the form of bioCNG and bioLNG and, where appropriate, RFNBO. State Energy Policy, draft 2024: Contains long-term goals for ensuring energy security and reducing greenhouse gas emissions, with biomethane featured as a key element of decarbonization. Czech Republic Climate Protection Policy, draft 2024: Mentions biomethane as an important element of the transition to a climate-neutral economy.

The update to the national clean mobility action plan considers biomethane to be a key tool for decarbonizing heavy goods transport and reducing greenhouse gas emissions in urban public transport. The plan also includes measures to support the development of refueling infrastructure. In order to meet the target of ensuring a minimum share of advanced biofuels and biomethane contained in the RED III Directive, a gradual increase in biomethane consumption in transport is necessary. In the case of bioLNG, this should be 5.9-7 PJ, or approximately 110-130 thousand tons of bioLNG, and in the case of bioCNG, 4.5 PJ, or approximately 130 million m^3 of biomethane.

Biomass and biogas are renewable sources for hydrogen production through:

Steam reforming biogas: CH_4 (from biogas) + $H_2O \rightarrow CO + 3H_2$

Biomass pyrolysis: Biomass $\rightarrow H_2 + CO + CH_4 + C$

Biomass gasification: Biomass + $O_2 + H_2O \rightarrow H_2 + CO + CO_2$

Market potential/motivation: The Moravian-Silesian Region has relatively significant biomass/biogas resources, whether they are agricultural residues (straw, maize residues), forest biomass, including residual biomass from forestry production or processing activities, organic waste from the food industry, growing of energy crops (corn, rapeseed) and fast-growing trees or landfills – as a special type of biogas production.

There are currently **35 biogas plants** in operation in the region with a total installed roughly capacity of 21 MWe with biogas plants segmentation: **11WWT (Waste Water Treatment); 6 landfill plants; 18 agricultural; 0 biomethane.** Furthermore, biogas is produced within 20 landfills with an install power equivalent of 1,5 MWe by the biogas station. These plants can be upgraded to produce hydrogen from surplus biogas/biomethane, inject hydrogen/biomethane into the gas network, or supply biohydrogen directly for industrial applications.

The key players in the region are in particular **RenoFARMY –** the owner and operator of biogas plants, which is directly involved in the development of the Hydrogen Valley concept of the Moravian-Silesian Region within the holding group. **Local agricultural cooperatives** – biomass providers and operators of smaller biogas plants and the municipal company **OZO – a** waste company owned by the City of Ostrava and an operator of a mixed waste landfill.

Hydrogen produced through nuclear energy

Nuclear energy, and especially the integration of its production into the energy mixes of EU countries, makes it possible to achieve the necessary limits or decarbonization goals and, from a systemic point of view, the production of low-emission gases or fuels, which will be an important part of strategic approaches to the support and development of applied hydrogen economies. Due to the natural technical affinity of the technology and the availability of high-potential heat, low-emission hydrogen is considered in the context of the use of nuclear energy, especially in connection with high-temperature electrolysis of water.

High-temperature technology enables the production of hydrogen with lower electricity consumption (approx. up to 25%), so that it uses, among other things, "waste" heat from a nuclear source. Such hydrogen is not generally considered renewable, but under certain conditions, it can at least be considered low-emission hydrogen production if it meets the condition of connecting directly to this source. It is also possible to consider the production of low-emission hydrogen from nuclear energy through contractual obligations between such electrolytic production capacity and a nuclear source, but here with urgent treatment and demonstration of the exclusion of the so-called double counting effect of the energy production of such a nuclear source in the overall energy mix in the relevant bidding zone. At the time, there are already regulations and calculation methodologies for the treatment of the given effect, but there is no directly related certification system for renewable hydrogen in the Czech Republic or the EU, which would further demonstrate all relevant energy and material flows so that technically low-emission hydrogen can be produced from nuclear energy

Market potential/motivation: The Czech Republic is a strong supporter of nuclear energy, mainly because as a landlocked country it cannot achieve the intensity of renewable energy production as coastal or even more climatically oriented EU countries by abandoning the use of local fossil fuels and sources. In general, the Czech Republic has a high potential, such as France or Slovakia, to achieve a majority share of the energy mix through nuclear sources, which would make it possible in terms of achieving the criteria for the production of low-emission gases.

The Moravian-Silesian Region counts on the potential use of two nuclear sources of different capacities as part of its Territorial Energy Policy. On the one hand, the region has a long-term territorial reserve for the construction of the third "strategic" nuclear power plant of the Czech Republic, and on the other hand, the region is a great supporter of the idea of using modular reactor technology. Modular reactors are being considered for deployment in the Dětmarovice site, within the area of the recently closed hard coal power plant with an original technological output of 800 MW. It is rightly assumed that both variants of the use of nuclear energy in the Moravian-Silesian Region would be implemented with the contribution of hydrogen technologies in order to decarbonize a wide range of industrial and transport applications through hydrogen technologies.

The key players in the region are **ČEZ** – a state-owned company operating strategic nuclear sources in two locations in the Czech Republic (Temelín NPP, Dukovany NPP)

Power-to-Gas using excess renewable energy

Power-to-Gas technology allows excess electricity from renewable sources to be converted into hydrogen through electrolysis and, possibly, through subsequent methanization of hydrogen:

$$2H_2O \rightarrow 2H_2 + O_2$$

$$4H_2 + CO_2 \rightarrow CH_4 + 2H_2O \text{ (methanation)}$$

The hydrogen/methane produced can be stored for later use, injected into the gas pipeline network, or converted to synthetic methane (methanization).

Market potential/motivation: The Moravian-Silesian Region has significant potential for the production of renewable electricity, which can be used to produce emission-free hydrogen, but today without a valid economic model of how to realize profit on the relatively complex application of complex equipment and connection points with a gas network. The indicative potential of RES production in the Moravian-Silesian Region is at the following performance levels:

The key players in the region are **GasNet** – a supra-regional operator of a gas distribution network with the possibility of adaptation to natural gas/hydrogen blends (up to 10% hydrogen), **NET4GAS** – an operator of a gas transmission network with plans for hydrogen infrastructure, **RenoENERGIE –** a local developer and operator of renewable energy projects, **GP Investment** – local developer of renewable energy projects and investor in hydrogen technologies or **Silesia HYDROGEN** – business developer and investor in hydrogen technologies.

7.3.2. CONSUMPTION – end consumers

Hydrogen in fertilizer production

Hydrogen is an essential raw material for the "Haber-Bosch" process for the production of ammonia (NH3), which is the basis for the production of nitrate fertilizers. The process requires hydrogen of high purity (min. 99.9%) and proceeds according to the reaction:

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The current global production of ammonia consumes a significant part of current hydrogen production, which also represents a future important market for low-carbon hydrogen. Because traditional fertilizer production is highly energy-intensive due to the use of fossil raw materials (natural gas) and therefore produces a significant amount of CO_2. The transition to renewable or at least low-carbon hydrogen allows for a reduction in the carbon footprint of 70-80% of ammonia production, the entry of local agricultural operations into premium market segments with sustainable agricultural production, the fulfilment of regional decarbonization goals in areas of interest with upcoming stricter emission EU standards.

Market potential/motivation: Switching to low-carbon hydrogen and fertiliser production instead of fossil inputs could help correct future decarbonisation requirements for the hitherto marginally undiscussed agricultural sector, while reducing regulatory risks or future environmental penalties for end farmers by funding institutions or banks.

The key players in the region are **AGROFERT HOLDING** – it has several production plants for basic fertilizer components in the Czech Republic and Slovakia and has a fully integrated vertical of the production chain from production to distribution, **LOVOCHEMIE** – a traditional fertilizer manufacturer with the potential for conversion to low-carbon technologies, which could potentially invest in the Moravian-Silesian Region, and **SYNTHESIA** – a chemical company with the possibility of diversification into the production of special fertilizers in the Moravian-Silesian Region.

Hydrogen in the food industry

Hydrogenation of vegetable oils is the traditional use of hydrogen in the food industry to produce "sustainable" food with a lower carbon footprint. The process allows liquid oils to be converted into semi-solid fats according to the reaction:

$$C_{18}H_{34}O_2 \text{ – oleic acid} + H_2 \rightarrow \text{(Ni catalyst) } C_{18}H_{36}O_2 \text{ stearic acid}$$

The process of hydrogenation of fats is not only a production process of e.g. hydrogenated fats, so-called margarines, but also serves to hydrolyze proteins: hydrogen is used in enzymatic hydrolysis for the production of protein hydrolysates, reduction of aldehydes: in aromatic chemistry for the production of flavours, enhancement of antioxidant properties of food (preservation): hydrogen as a selective antioxidant in packaged foods.

Market potential/motivation: The use of low-carbon hydrogen in the food industry brings premium product positioning to impact new target groups of responsible customers, compliance with the EU taxonomy and the resulting reduced risk of regulatory application, access to sources of funding for ESG activities.

The key players in the region are **OLMA** – a major dairy company with the possibility of integrating hydrogen technologies into the production of dairy products, **MADETA** – a dairy company with potential for sustainable production, **PENAM/ILLÍK** – bakery chains where hydrogen could be used in the production of special fats.

Decarbonising industry

Low-emission hydrogen/methane coming from both mine gas/biomass/PtG technologies can substitute natural gas for large industrial consumers.

Market potential/incentives: monetization of surplus renewable electricity; provision of grid ancillary services (regulation, backup); reduction of import dependence on natural gas; creation of relatively large flexibility capacities for the energy system and the market.

The key players in the region are **TŘINECKÉ ŽELEZÁRNY** – a major consumer with potential for hydrogen application in direct iron reduction processes, **VÍTKOVICE STEEL** – a medium-sized steel producer with the possibility of pilot application of hydrogen technologies, **AL Invest** – a medium-sized local aluminium processor with the production of foils and other products, **BONATRANS** – a producer of train wheels with global market potential using fossil fuels for the needs of heat treatment of metals, "high-tech" forging and rolling, and **BOCHEMIE** – a producer of "household chemicals", disinfectants, biocides and other plant protection chemicals.

Low-emission hydrogen in transport and logistics

Hydrogen trucks and passenger trains are solutions for the decarbonisation of heavy road transport and regional and interregional passenger train transport.

Market potential/motivation: limiting the availability of conventionally powered vehicles; optimizing costs related to emissions from fossil fuel combustion processes; optimizing service costs for vehicle operation; setting up ESG activities of global companies and developing environmentally responsible brands.

The key players in the region are **TATRA TRUCKS** – a manufacturer of trucks with the possibility of developing hydrogen variants for heavy goods transport and services, **Zebra GROUP** and **HAGEMANN** – manufacturers of light work machines and hydrogen-powered last-mile hydrogen vehicles, **DB Schenker** – a logistics company with potential for a hydrogen fleet, **DACHSER** – another logistics company with the possibility of a pilot project, **Zásilkovna/DPD/GLS/PPL** – local operators of "last mile" transport, **Czech Railways/RegioJer/Leo Express/ARRIVA/GW Train** – the possibility of deploying hydrogen trains on non-electrified lines in the region where major passenger train operators operate, **Osoblaha Narrow-Gauge Railway** – operator of the regional narrow-gauge railway in the Czech-Polish border region, **VÍTKOVICE TRANSPORT** – industrial transport with potential for hydrogen locomotives.

7.4. Conclusion and recommendations

The Moravian-Silesian Region has unique prerequisites for the development of a hydrogen economy based on low-carbon gases. The combination of traditional sources (mine gas), renewable resources (biomass, electrolysis) and a strong industrial base creates an opportunity for building an integrated hydrogen valley. The key recommendations include: Preparation of investments in pilot projects using coal mine gas, Coordination of decarbonization efforts of large industrial plants (Třinecké železárny, BorsodCHEM, AL Invest) and Development of regional infrastructure for distribution and storage.

8. Funding opportunities

The development of the hydrogen economy in the Moravian-Silesian Region is based on a combination of European, national and regional financial instruments. The EU, through programmes such as Horizon Europe – Clean Hydrogen Partnership (budget €184.5 million for 2025) and the Innovation Fund, supports research, pilot projects and infrastructure building, while it can cover up to 60% of investment and operating costs.
At the national level, the National Recovery Plan (CZK 179 billion) and the National Environment Programme play an important role, channelling funds into hydrogen mobility and innovation, among other things. The Operational Programme Fair Transformation provides a specific opportunity for coal regions, including the Moravian-Silesian Region, which aims at supporting technological projects and restructuring the economy.
Key message: The Region has a wide range of financial resources that it can use to develop the hydrogen ecosystem — from research and production to practical applications in industry and transport. However, success will depend on the ability to strategically combine these instruments and to draw on them effectively.
Support for the emergence of ecosystem of low carbon gases is in the conditions of the Czech Republic mainly by the state itself. Through EU structural and investment funds or directly EU programmes managed by the European Commission.

8.1. Union programmes

Clean Hydrogen Partnership (Horizon Europe). These public-private partnerships under Horizon Europe offer grants for research, innovation and pilot deployment of technologies for the production, storage and use of hydrogen. A call with a budget of around **€184.5 million** is announced for 2025, targeting inter alia "Hydrogen Valleys", renewable hydrogen production, storage and distribution systems.

Innovation Fund (Europe). One of the largest funds to support low-carbon technologies. It specifically supports demonstration projects in the field of renewable hydrogen, its production, storage, industrial or energy applications. It offers up to 60% grant for capital and operating costs, with the possibility of upfront payments even for less mature projects (PDAs).

European Hydrogen Bank (EU project). The mechanism to support renewable hydrogen production in the EU is based on an auction system where projects bid for a fixed premium in €1/kg of certified hydrogen produced (RFNBO). A third auction is planned for Q3 2025 with a budget of up to € 1 billion.

Connecting Europe Facility (CEF). CEF-Energy: support for EU infrastructure including interstate hydrogen pipelines and large electrolysers (>100 MW); CEF-Transport: finance infrastructure for hydrogen refuelling stations in road, rail or shipping.

Important Projects of Common European Interest (IPCEI). The EU has supported several project packages: **IPCEI Hy2Tech**, **Hy2Use**, **Hy2Infra** or **Hy2Move**, which offer state subsidies of up to billions of euros for hydrogen infrastructure, electrolysis, storage or industrial integration in cross-border cooperation.

InvestEU and Just Transition Mechanism. InvestEU: provides guarantees and funding for riskier hydrogen projects, including production, storage, infrastructure and transport. Just Transition Fund: support for the transformation of regions affected by the phase of the carbon era, suitable to finance hydrogen projects in regions like the Moravian-Silesian Region.

LIFE programme (Clean Energy Transition). Around **€5 billion** will be allocated over the period 2021-2027 to clean energy transformation projects, including pilot and government projects to use renewable hydrogen in cities and communities .

European Innovation Council (EIC). For start-ups and technology SMEs, the fund provides funding opportunities of up to **€2.5 million** grant + up to **€15 million** from the EIC Fund for the commercialisation of hydrogen innovation (TRL 5-9)

8.2. EU funds at national level

The Fair Transformation Operational Programme. It is a programme aimed at addressing the negative impacts of the shift away from coal in the most affected regions. In the Czech Republic, it concerns the Karlovy Vary, Moravian-Silesian and Ústí Regions. The objective of the support is to enable regions and people to address the social, economic and environmental impacts of the transformation, which is aimed at achieving the Union's energy and climate goals for 2030 and the Union's climate-neutral economy by 2050. The programme announces thematic calls aimed, among other things, at the development of new renewable resources and related technologies, such as hydrogen valleys encompassing the complete chain from research and development, through production and storage, to the use of green hydrogen in industry and transport. The

Operational Programme Transport. The programme is divided into three substantive priorities. The first priority consists in particular of interventions on rail and on the TEN-T road network, complemented by interventions in the field of interoperability or intelligent transport systems (ITS). The second priority focuses on road projects outside the TEN-T network. The third priority supports projects in the field of urban transport (tram and trolleybus lines) and alternative fuel infrastructure. The development of infrastructure for electromobility and other alternative fuels (i.e. including hydrogen) is addressed in total under Priority 3 €1,099,816,869. Integrated Regional

Operational Programme (IROP). The main objective of the programme is to strengthen regional competitiveness and the quality of life of the population with a view to balanced development of the territory and taking into account the diversity of needs in the different types of territory. The programme is divided into seven priorities including improved state administration performance, green infrastructure of towns and municipalities, nature and biodiversity protection, transport infrastructure development, social services, health, culture. The purchase of road emission-free vehicles for public transport using alternative fuels or hydrogen and the construction of hydrogen refuelling stations, among others, are also supported under the priority which is intended for the development of urban mobility.

Modernisation fund. The Modernisation fund draws funds mainly from the monetisation of emission allowances in the EU ETS for the period 2021-2030. The funds from the Modernisation fund are directed to several priority areas which are applied in the following support programmes:

- RES+ – New renewable energy sources - Support for projects of new non-fuel renewable energy sources
- HEAT – Modernisation of thermal energy supply systems - Support for projects for the use of RES and low-carbon sources for heating, such as the modification of the fuel base and the modernisation of thermal energy distribution.
- ENERG – Energy efficiency and reduction of energy consumption - Support for measures to increase energy efficiency and reduce greenhouse gas production in industry, business, public buildings and the residential sector
- TRANSPORT – Modernisation of transport - Support for the acquisition of emission-free vehicles and the construction of the necessary infrastructure
- GREENGAS – Renewable gaseous and liquid fuels - Support for the production and use of gaseous and liquid fuels produced from renewable sources.
- SMARTNET – Modernisation of energy systems - Support for the modernisation of public energy systems and increasing the resilience of the electricity system
- KOMUNERG – Community energy - Support for energy communities established to meet their energy needs (the main purpose is not to generate profits).
- I+ – Innovative and comprehensive (individual) projects - Support for projects supported by the Innovation Fund and comprehensive projects exceeding the individual programmes of the Modernisation Fund.

National Recovery Plan. The National Recovery Plan (NPO) is the plan of reforms and investments of the Czech Republic to mitigate the effects of the COVID-19 pandemic and to restart the economy using the financial means of the Recovery and Resilience Facility (RRF) from 2021. As a result of the energy crisis and in view of the geopolitical situation, the NPO was updated in 2023. The Czech

Republic plans to draw down funds amounting to approximately 179 billion CZK in the form of grants and 19.4 billion CZK in the form of loans in the period 2021-2026 through the National Recovery Plan. The NPO is divided into several components, three of which are focused on energy savings, renewable resources and the promotion of clean mobility, including support of H_2 vehicles (component 2.4 Development of clean mobility).

8.3. National Programmes National Environment Programme

The aim of the National Environment Programme (NPEP) is the long-term effective protection of the environment in the Czech Republic, support for efficient and environmentally friendly use of natural resources, remediation of negative impacts of human activities on the environment, mitigation and adaptation to the impacts of climate change and effective prevention through environmental education, education and awareness of the inhabitants of the Czech Republic. The specific objective of the NPEP is the support of projects and activities in favour of the environment implemented in the Czech Republic, which are proposed as complementary to other subsidy titles, namely the Operational Environment Programme, the New Green Savings Programme and programmes administered directly by the Ministry of the Environment. Among the ten areas of support, priority 7 - Innovative and Demonstration Projects, within which, among other things, innovative projects for the use of hydrogen technologies in the area of mobility are supported. Priority 9 - Preparation of Projects includes pre-project and follow-up project preparation of projects funded by EU funds. This support is focused specifically on projects implemented on the territory of structurally affected regions, including the Moravian-Silesian Region.

8.4. Regional programmes

At present, unfortunately, in the Moravian-Silesian Region or in other regions of the Czech Republic, there is no financial instrument at regional level under which hydrogen projects can be financed. Thus, investors have to rely only on national programmes (Cap. 8.3), EU funds through operational programmes (Cap. 8.2) or complementary EU programmes managed directly by the European Commission (Cap. 8.1).

9. Conclusions and recommendations

The Moravian-Silesian Region is on the threshold of a fundamental transformation of its energy and industrial model. The initial situation is characterized by high energy demands, historical dependence on heavy industry and fossil fuels (especially black coal), but at the same time by growing innovation potential, strong industrial infrastructure and academic background. In this context, low-carbon gases, especially hydrogen, play a key role in the decarbonisation and economic diversification of the region, provided that hydrogen is primarily used with a certification other than RFNBO.

9.1. Findings:

- The Moravian-Silesian Region has a developed industry with high energy consumption, while a significant part of production is still fossil fuels.
- The share of renewable energy sources, especially biomass and other gases from industrial processes, is growing, which increases the potential for green hydrogen production.
- The region is actively involved in building a hydrogen ecosystem – Strategy for the Development of Hydrogen Technologies until 2034 and the Hydrogen Valley project create a framework for the integration of hydrogen into industry, transport and heating.
- Educational and research institutions (especially VSB-TUO) form a strong professional background for the development of competences and innovations in the field of hydrogen.
- The key challenge remains the transformation of existing structures – both technological, organisational and legislative – towards greater flexibility, synergy and openness to new solutions.

9.2. Recommendation:

1. Ensuring a stable policy and regulatory framework

The region should actively adapt its regional strategies to current changes in European legislation (RED III, Fit for 55, gas decarbonization package) and strengthen the region's role in negotiating national rules for the promotion of low-carbon gases, including hydrogen. It should also support national mechanisms such as CfDs and first movers. In the case of the delegated act for the production of RFNBO hydrogen, it is necessary to seek its amendment of the conditions on the following points:

- postponement of the effectiveness of the additionality rule to 2030 (for direct connection of EH and ELY) and 2035 (for so-called "PPA contracts");
- maintaining monthly time correlation as a permanent standard or postponing the introduction of hourly correlation until after 2035;
- extension of the geographical correlation to the least adjacent bidding zones, both for free trade and the purchase of renewable electricity (guarantees of origin) and for the considered limit of 20 €/MWh[22] set as the lowest marginal settlement price of electricity in the reference period of temporal correlation allowing the production of RFNBOs, which corresponds to the principles of an interconnected European electricity system and the declaratively supported development of the single energy market, as a pillar of the EU's energy security.

2. Support for pilot projects and demonstration plants

Priority should be given to specific projects with a multiplier effect – e.g. hydrogen bus operation, rail applications, low-emission heating plants – and to develop a targeted support programme for

[22] also according to the parameter 0.36 6 times the price of the allowance for the release of one tonnes of carbon dioxide equivalent over a given period for the purpose of meeting the requirements of Directive 2003/87/EC of the European Parliament and of the Council

projects integrated into the Hydrogen Valley – with an emphasis on the interconnection of hydrogen production, distribution and use.

3. **Development of infrastructure and technological capacities**

Build green hydrogen production capacities based on electrolysers powered by RES (e.g. wind sources in the Osoblaha region) and use brownfields and mining sites (e.g. OKD) for the construction of storage facilities and possible combined production of energy and hydrogen.

4. **Deepening education and cooperation with research**

Support the expansion of educational programs focused on hydrogen technologies at secondary schools and universities in the region and strengthen cooperation between industrial companies and research institutions on the development of new technologies, including certification and safety.

5. **Financing and business support**

Use the Just Transition instruments, the Modernisation Fund and Horizon Europe to finance key infrastructures and innovation and set up a regional investment platform or a fund dedicated to low-carbon technologies.

6. **Cross-sectoral and interregional coordination**

To ensure effective management and coordination between the public, academic and private sectors through the Moravian-Silesian Hydrogen Cluster and to share experience with other regions involved in the UNIFHY project. To support the creation of interregional cross-border hydrogen projects.

Challenges

Political challenges

- Lack of political will to develop the hydrogen market at national level, which slows down the development of the Hydrogen Valley of the Moravian-Silesian Region and creates uncertainty for the future development of hydrogen technologies.

Economic challenges

- High dependence on investment support from national or EU sources (e.g. IPCEI, Sovereignty Fund, Horizon Europe).
- Risk of slowing down the growth of the hydrogen market without sufficient financial resources.

Socio-cultural challenges

- High unemployment rate in the region (2nd highest in the Czech Republic).
- Lack of skilled labour for the development of hydrogen technologies
- Risk of deepening unemployment without retraining measures.
- Need to ensure a socially equitable transformation in order not to deepen the differences in society.

Technological challenges

- Need to repurposing the existing gas infrastructure for the distribution of hydrogen in the region.
- Technical and financial cost of rebuilding pipelines and equipment.

Legislative challenges

- Gaps in European legislation for the practical use of hydrogen.
- Legal uncertainty for investors, producers and consumers.

Environmental challenges

- Risk of insufficient decarbonisation in slow or uncoordinated transformation.
- Possible negative impacts when building new infrastructure (e.g. hydrogen leaks, interventions in the landscape).

Conclusion:

The Moravian-Silesian Region has a unique opportunity to become a leader in low-carbon technologies in the Czech Republic and Central Europe. The combination of industrial tradition, political will and growing know-how creates the right conditions for the successful implementation of the hydrogen strategy. Implementing the above recommendations will enable the region not only to meet the objectives of the Green Deal, but also to strengthen its economic resilience and social cohesion.

CONTACTS

10. Attachments

Attachment 1: Selected indicators by region in Q1 – Q4 2024.

1 Vybrané ukazatele podle krajů v 1. až 4. čtvrtletí 2024

	ČR celkem	v tom kraje							v tom kraje							
		Hl. město Praha	Středo-český	Jiho-český	Plzeňský	Karlo-varský	Ústecký	Liberecký	Králové-hradecký	Pardubický	Vysočina	Jiho-moravský	Olomoucký	Zlínský	Moravsko-slezský	
ZÁKLADNÍ ÚDAJE (k 1. 1. 2024)																**ZÁKLADNÍ ÚDAJE (k 1. 1. 2024)**
Rozloha (km^2)	78 871	496	10 929	10 058	7 649	3 310	5 339	3 163	4 759	4 519	6 796	7 188	5 272	3 963	5 431	Rozloha (km^2)
Obce	6 258	1	1 144	624	501	134	354	215	448	451	704	673	402	307	300	Obce
OBYVATELSTVO[1)]																**OBYVATELSTVO[1)]**
Živě narození	84 311	12 085	10 981	5 082	4 569	1 814	6 132	3 253	4 142	4 201	4 184	9 868	4 943	4 447	8 610	Živě narození
Zemřelí	112 211	11 792	13 754	6 938	6 256	3 401	9 493	4 730	5 882	5 442	5 408	12 239	6 967	6 306	13 603	Zemřelí
Přistěhovalí	121 823	62 689	44 511	9 853	16 277	6 527	11 109	8 414	10 151	10 479	10 043	25 138	8 923	7 102	11 033	Přistěhovalí
Vystěhovalí	84 978	49 834	31 463	9 275	13 324	6 822	10 561	8 171	9 437	9 329	9 132	20 173	8 263	6 989	12 631	Vystěhovalí
Počet obyvatel[2)]	10 909 500	1 397 880	1 466 215	653 227	614 640	293 195	808 356	449 494	555 923	530 469	517 647	1 229 343	631 500	578 998	1 182 613	Počet obyvatel[2)]
ZAMĚSTNANOST A NEZAMĚSTNANOST (VŠPS)[1,3)]																**ZAMĚSTNANOST A NEZAMĚSTNANOST (VŠPS)[1,3)]**
Zaměstnaní v hlavním zaměstnání podle VŠPS (tis. osob)	5 192,4	717,4	696,5	312,2	298,9	144,3	367,2	204,1	259,9	247,6	247,4	581,6	291,9	275,5	548,0	Zaměstnaní v hlavním zaměstnání podle VŠPS (tis. osob)
z toho podnikatelé (bez pomáhajících rodinných příslušníků)	812,4	140,3	129,0	47,3	33,9	16,1	56,2	31,5	38,8	32,2	35,7	85,8	43,7	44,4	77,5	z toho podnikatelé (bez pomáhajících rodinných příslušníků)
Míra ekonomické aktivity[4)] (%)	60,6	67,5	61,7	60,1	61,7	63,1	58,3	57,6	59,2	58,8	59,7	60,4	58,1	58,4	57,9	Míra ekonomické aktivity[4)] (%)
Obecná míra nezaměstnanosti (%)	2,6	1,7	1,3	2,9	1,8	4,1	4,1	3,2	3,4	2,1	1,9	2,7	3,2	2,0	4,1	Obecná míra nezaměstnanosti (%)
ZAMĚSTNANCI A MZDY[1)]																**ZAMĚSTNANCI A MZDY[1)]**
Zaměstnanci[4)] (tis. přepočtených osob)	4 021,8	867,7	417,3	215,0	217,6	80,8	238,4	141,7	195,2	180,2	169,6	469,7	216,6	200,4	408,5	Zaměstnanci[4)] (tis. přepočtených osob)
Průměrná hrubá měsíční mzda[5)] (Kč)	46 165	57 232	46 951	42 171	43 551	39 415	42 834	41 691	42 678	41 337	41 786	45 300	41 378	41 188	41 639	Průměrná hrubá měsíční mzda[5)] (Kč)
NEZAMĚSTNANOST (MPSV)[2)]																**NEZAMĚSTNANOST (MPSV)[2)]**
Uchazeči o zaměstnání v evidenci úřadu práce	306 478	28 113	33 770	15 912	13 881	9 900	34 630	14 048	13 255	12 211	12 285	39 439	18 587	13 279	47 168	Uchazeči o zaměstnání v evidenci úřadu práce
Pracovní místa v evidenci úřadu práce	246 573	73 744	45 948	12 697	15 757	4 816	10 969	5 334	9 837	13 534	7 716	18 100	7 262	8 430	12 429	Pracovní místa v evidenci úřadu práce
Podíl nezaměstnaných osob[6)] (%)	4,10	2,80	3,36	3,60	3,26	4,85	6,21	4,46	3,56	3,44	3,49	4,74	4,43	3,41	5,82	Podíl nezaměstnaných osob[6)] (%)
Uchazeči o zaměstnání na 1 pracovní místo v evidenci úřadu práce	1,2	0,4	0,7	1,3	0,9	2,1	3,2	2,6	1,3	0,9	1,6	2,2	2,6	1,6	3,8	Uchazeči o zaměstnání na 1 pracovní místo v evidenci úřadu práce
EKONOMICKÉ SUBJEKTY[2)]																**EKONOMICKÉ SUBJEKTY[2)]**
Registrované subjekty	2 836 017	672 224	345 959	154 509	137 926	67 730	164 198	105 477	128 727	116 280	107 897	321 073	135 024	132 315	246 678	Registrované subjekty
fyzické osoby	1 988 387	367 010	273 234	116 188	102 995	48 774	125 604	80 242	99 829	88 360	83 320	220 756	100 830	100 401	180 844	fyzické osoby
obchodní společnosti	584 485	258 608	44 087	20 177	19 280	10 246	21 362	14 544	16 568	15 468	12 295	70 353	19 803	19 529	42 165	obchodní společnosti
družstva	11 985	4 715	797	521	261	110	376	331	370	352	420	1 464	490	230	1 548	družstva
ZEMĚDĚLSTVÍ																**ZEMĚDĚLSTVÍ**
Výroba masa v jatečné hmotnosti (t)	280 541	34 416		55 906	22 681	637	1 700	1 890	35 070	25 005	32 372	29 032	16 285	9 717	15 830	Výroba masa v jatečné hmotnosti (t)
hovězí a telecí	68 831	4 942		1 592	9 411	i. d.	1 113	1 123	5 048	18 226	14 567	3 249	1 898	i. d.	2 203	hovězí a telecí
vepřové	211 588	29 441		54 310	13 259	i. d.	i. d.	i. d.	30 019	6 770	17 789	25 777	i. d.	i. d.	13 625	vepřové
PRŮMYSL[1,7)]																**PRŮMYSL[1,7)]**
Tržby z prodeje výrobků a služeb průmyslové povahy (mil. Kč)	4 914 864	526 422	1 102 321	203 239	274 690	49 025	462 953	203 830	199 537	340 339	185 866	301 111	174 707	227 451	663 375	Tržby z prodeje výrobků a služeb průmyslové povahy (mil. Kč)
STAVEBNICTVÍ[1,8)]																**STAVEBNICTVÍ[1,8)]**
Základní stavební výroba (mil. Kč)	230 564	101 342	13 050	12 415	9 028	1 150	13 477	3 410	2 766	11 788	8 095	28 639	8 138	6 533	10 733	Základní stavební výroba (mil. Kč)
pozemní stavitelství	86 662	33 800	5 241	3 781	1 611	859	2 387	1 605	1 666	3 313	5 060	13 320	4 406	3 708	5 905	pozemní stavitelství
inženýrské stavitelství	135 554	64 293	7 802	8 451	6 953	272	10 733	1 706	1 000	7 524	3 035	13 389	3 527	2 350	4 519	inženýrské stavitelství
STAVEBNÍ POVOLENÍ[1,9)]																**STAVEBNÍ POVOLENÍ[1,9)]**
Vydaná stavební povolení	72 061	2 709	14 032	5 986	5 005	1 928	4 249	3 029	3 852	3 888	4 663	7 521	3 917	3 978	6 658	Vydaná stavební povolení
Orientační hodnota staveb (mil. Kč)	580 367	63 781	75 261	28 920	24 825	13 457	23 876	13 134	24 027	17 133	25 612	62 876	21 535	20 778	50 860	Orientační hodnota staveb (mil. Kč)
BYTOVÁ VÝSTAVBA[1)]																**BYTOVÁ VÝSTAVBA[1)]**
Zahájené byty	36 612	8 191	5 322	1 868	2 698	548	1 000	898	1 269	1 452	1 777	5 722	1 694	1 330	2 839	Zahájené byty
Dokončené byty	30 267	6 489	4 951	1 571	1 845	575	995	964	1 328	1 584	1 431	3 349	1 910	1 293	1 982	Dokončené byty
CESTOVNÍ RUCH																**CESTOVNÍ RUCH**
Hosté	22 809 595	8 063 367	1 363 907	1 749 686	900 439	1 390 673	632 829	1 173 053	1 541 616	528 133	688 447	2 179 291	753 338	819 930	1 024 886	Hosté
z toho nerezidenti	10 477 528	6 502 298	292 460	514 861	312 509	755 297	209 949	206 609	325 102	68 376	88 662	735 729	137 169	116 005	212 502	z toho nerezidenti

1) předběžné údaje

2) stav k poslednímu dni sledovaného období

3) přepočet na celou populaci vychází ze struktury obyvatel dle pohlaví a věku k 31. 12. předchozího roku; viz Metodické vysvětlivky

4) podíl počtu zaměstnaných a nezaměstnaných (pracovní síly) na počtu všech 15letých a starších

5) podle místa pracoviště v podnikatelské i nepodnikatelské sféře; údaj za ČR včetně pracujících v zahraničí

6) podíl počtu dosažitelných uchazečů o zaměstnání ve věku 15–64 let ze všech obyvatel ve stejném věku

7) podniky se 100 a více zaměstnanci se sídlem v kraji (sekce CZ-NACE B – Těžba a dobývání, C – Zpracovatelský průmysl, D – Výroba a rozvod elektřiny, plynu, tepla a klimatizovaného vzduchu)

8) podniky s 50 a více zaměstnanci se sídlem v kraji

9) údaj za ČR včetně povolení územně nerozdělených

Source: CZSO, https://csu.gov.cz/produkty/statisticky-bulletin-moravskoslezsky-kraj-1-az-4-ctvrtleti-2024

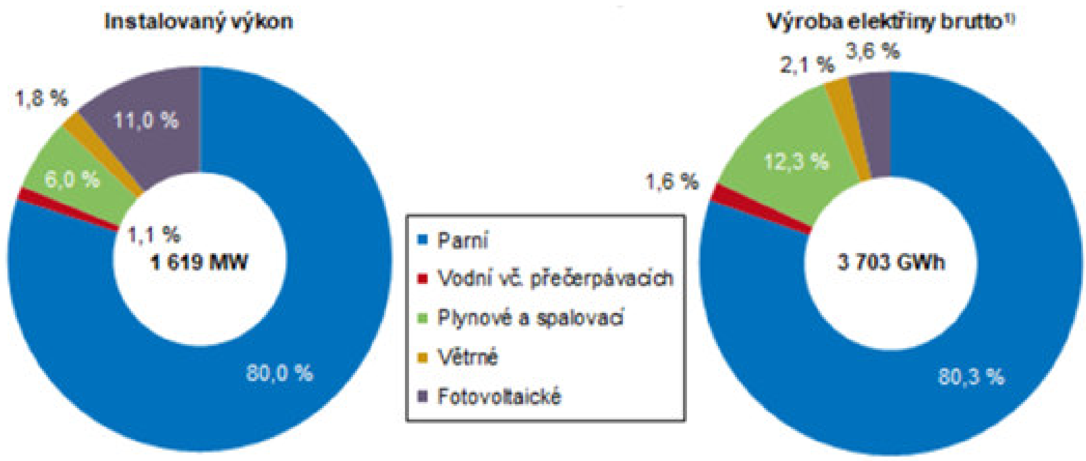
Attachment 2: Selected employment indicators by region in Q4 2024.

Vybrané ukazatele zaměstnanosti podle krajů ve 4. čtvrtletí 2024 Zdroj: Výběrové šetření pracovních sil – VŠPS	ČR celkem	v tom kraje: Hl. město Praha	Středo-český	Jiho-český	Plzeňský	Karlo-varský	Ústecký	Liberecký	v tom kraje: Králové-hradecký	Pardubický	Vysočina	Jiho-moravský	Olomoucký	Zlínský	Moravsko-slezský	
Zaměstnaní v hlavním zaměstnání (tis. osob)	**5 204,0**	**721,2**	**699,9**	**309,7**	**299,7**	**146,2**	**366,6**	**201,7**	**262,1**	**247,7**	**249,7**	**578,9**	**299,3**	**275,7**	**545,7**	**Zaměstnaní v hlavním zaměstnání (tis. osob)**
muži	2 840,1	385,6	381,7	168,8	165,5	78,7	205,7	111,9	145,1	137,1	137,9	316,5	159,3	151,2	295,0	muži
ženy	2 363,9	335,6	318,2	140,9	134,1	67,5	160,9	89,8	117,0	110,5	111,8	262,4	140,0	124,5	250,7	ženy
z toho podnikatelé (bez pomáhajících rodinných příslušníků)	799,6	137,6	122,9	49,4	34,3	15,4	56,3	28,8	39,9	30,0	38,1	89,3	43,0	41,5	73,0	z toho podnikatelé (bez pomáhajících rodinných příslušníků)
podíl na počtu zaměstnaných (%)	15,4	19,1	17,5	15,8	11,6	10,6	15,5	14,1	15,3	12,2	15,6	15,2	14,6	15,1	13,4	podíl na počtu zaměstnaných (%)
bez zaměstnanců	685,9	120,0	105,5	43,2	28,9	13,4	47,2	24,8	33,3	25,2	34,3	74,5	35,8	37,2	62,7	bez zaměstnanců
se zaměstnanci	113,7	17,6	17,4	6,3	5,4	2,0	9,1	4,0	6,6	4,8	3,9	14,8	7,2	4,3	10,4	se zaměstnanci
Skutečně odpracované hodiny týdně v hlavním zaměstnání	33,9	34,3	34,2	33,3	33,2	33,6	34,5	32,7	34,8	34,7	34,8	33,9	34,0	34,0	32,6	Skutečně odpracované hodiny týdně v hlavním zaměstnání
zaměstnanci včetně členů produkčních družstev	33,3	34,2	33,4	32,7	33,0	33,6	33,8	32,5	34,0	34,1	33,8	33,3	33,5	32,9	32,0	zaměstnanci včetně členů produkčních družstev
podnikateli a pomáhajícími rodinnými příslušníky	37,1	35,1	38,0	36,1	34,7	34,1	38,3	34,1	39,4	38,4	40,7	37,4	36,8	40,7	36,5	podnikateli a pomáhajícími rodinnými příslušníky
Pracující v dalším zaměstnání (tis. osob)	166,2	29,6	16,1	9,7	10,3	6,4	3,4	5,0	13,7	6,0	7,6	21,8	9,5	9,9	17,1	Pracující v dalším zaměstnání (tis. osob)
muži	89,6	16,2	7,3	5,0	5,7	4,2	2,5	2,1	7,2	3,4	4,3	11,5	4,8	5,7	9,6	muži
ženy	76,6	13,4	8,7	4,7	4,6	2,2	1,0	2,9	6,5	2,5	3,4	10,3	4,7	4,3	7,4	ženy
Pracující na kratší pracovní dobu (tis. osob)	483,3	103,6	47,2	23,2	28,8	16,3	15,9	17,9	29,1	21,4	22,8	54,6	29,5	24,4	48,5	Pracující na kratší pracovní dobu (tis. osob)
muži	143,3	33,0	13,0	6,1	7,6	6,2	4,9	4,2	10,3	3,3	6,8	18,3	9,7	6,0	13,9	muži
ženy	340,0	70,6	34,2	17,1	21,2	10,1	11,0	13,7	18,7	18,1	16,0	36,3	19,8	18,4	34,6	ženy
Míra ekonomické aktivity (%) (osoby ve věku 15 let a více)	**60,6**	**67,6**	**62,0**	**59,5**	**62,0**	**63,6**	**57,9**	**57,1**	**59,5**	**58,4**	**60,2**	**60,2**	**59,6**	**58,3**	**57,7**	**Míra ekonomické aktivity (%) (osoby ve věku 15 let a více)**
muži	67,9	72,7	68,9	67,0	69,3	70,1	65,8	65,6	67,3	66,3	68,0	67,6	65,9	66,9	65,3	muži
ženy	53,8	62,7	55,4	52,4	54,9	57,4	50,3	49,2	52,2	50,9	52,7	53,2	53,8	50,4	50,8	ženy
Míra zaměstnanosti (%) (osoby ve věku 15 let a více)	**59,1**	**66,7**	**61,2**	**57,9**	**60,7**	**61,3**	**55,8**	**55,1**	**57,6**	**57,6**	**59,1**	**58,5**	**57,6**	**57,2**	**55,2**	**Míra zaměstnanosti (%) (osoby ve věku 15 let a více)**
muži	66,5	72,0	68,2	65,3	68,4	67,6	64,2	63,2	65,9	65,4	66,8	66,1	64,1	65,8	62,7	muži
ženy	52,2	61,5	54,6	50,9	53,4	55,3	47,8	47,4	49,9	50,1	51,8	51,4	51,6	49,5	48,4	ženy

Údaje vycházející z počtu a struktury obyvatel podle pohlaví a věku k 31. 12. předchozího roku.

Source: CZSO, https://csu.gov.cz/produkty/statisticky-bulletin-moravskoslezsky-kraj-1-az-4-ctvrtleti-2024

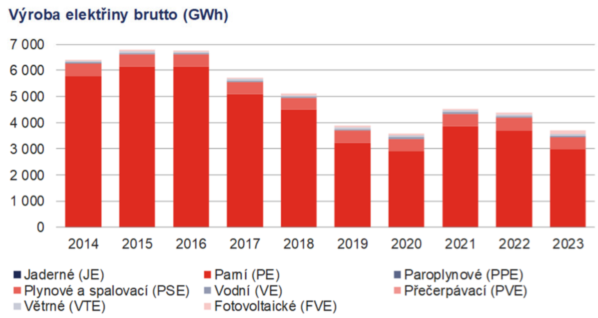
Attachment 3: Installed capacity and electricity production by power plant technology in the Moravian-Silesian Region in 2023.

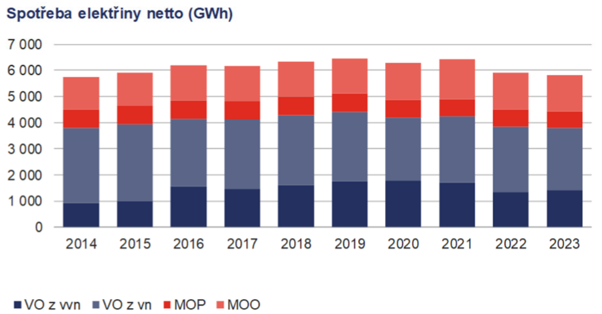


Attachment 4: Installed capacity, electricity production and consumption in the Moravian-Silesian Region in 2023.

Instalovaný výkon, výroba a spotřeba: Moravskoslezský kraj

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Instalovaný výkon [MW$_e$]	**1 785,7**	**1 787,8**	**1 787,0**	**1 788,4**	**1 792,7**	**1 706,8**	**1 484,0**	**1 462,1**	**1 503,5**	**1 619,4**
Jaderné (JE)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Parní (PE)	1 607,8	1 607,8	1 606,1	1 606,1	1 606,1	1 513,1	1 283,1	1 260,2	1 260,2	1 296,2
Paroplynové (PPE)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Plynové a spalovací (PSE)	78,5	80,0	80,7	82,3	82,3	87,2	92,8	93,1	93,9	97,9
Vodní (VE)	16,8	17,4	17,5	17,3	17,3	17,3	17,9	17,8	18,3	18,3
Přečerpávací (PVE)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Větrné (VTE)	21,8	21,8	21,8	21,8	26,2	28,4	28,4	28,4	28,4	28,4
Fotovoltaické (FVE)	60,8	60,8	60,9	60,8	60,8	60,8	61,8	62,6	102,7	178,7
Výroba elektřiny brutto [MWh]	**6 401 605,7**	**6 787 120,5**	**6 759 540,3**	**5 720 810,8**	**5 102 697,0**	**3 892 398,0**	**3 583 956,6**	**4 532 221,9**	**4 386 166,8**	**3 703 062,7**
Jaderné (JE)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Parní (PE)	5 774 875,4	6 136 524,7	6 139 308,6	5 079 772,2	4 488 402,0	3 230 374,7	2 913 255,5	3 857 034,6	3 707 051,5	2 975 032,2
Paroplynové (PPE)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Plynové a spalovací (PSE)	477 240,3	478 861,4	467 600,3	479 226,3	447 867,3	466 813,9	462 938,3	488 206,4	483 699,4	456 777,4
Vodní (VE)	42 778,3	50 922,6	46 244,4	45 401,3	49 330,2	52 203,0	64 455,7	59 943,2	42 782,4	58 968,2
Přečerpávací (PVE)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Větrné (VTE)	46 487,9	57 748,8	47 343,9	56 794,3	54 839,1	78 690,8	80 270,5	66 057,5	67 517,4	77 980,8
Fotovoltaické (FVE)	60 223,8	63 063,0	59 043,2	59 616,7	62 258,5	64 315,6	63 036,5	60 980,2	85 116,0	134 304,2
Spotřeba elektřiny netto [MWh]	**5 733 192,2**	**5 910 405,3**	**6 178 725,0**	**6 168 506,6**	**6 330 803,0**	**6 440 808,1**	**6 272 426,5**	**6 417 843,6**	**5 900 371,4**	**5 805 429,7**
VO z vvn	940 270,7	1 010 328,9	1 567 157,4	1 469 470,4	1 603 238,9	1 762 340,8	1 777 279,0	1 710 688,3	1 367 430,0	1 415 414,2
VO z vn	2 844 057,4	2 920 386,3	2 582 812,8	2 644 028,8	2 694 144,1	2 641 885,6	2 423 977,5	2 521 805,6	2 478 640,0	2 383 407,0
MOP	707 390,6	712 406,3	707 463,0	712 150,6	699 509,4	698 513,0	672 406,6	657 131,3	663 432,9	631 658,6
MOO	1 241 473,4	1 267 283,8	1 321 291,7	1 342 856,9	1 333 910,7	1 338 068,7	1 398 763,3	1 528 218,4	1 390 868,4	1 374 949,9





Source: Annual report on the operation of the electricity system of the Czech Republic, Moravian-Silesian Region, 2023, Energy Regulatory Office.

Attachment 5: Production, supply and consumption of heat in the Moravian-Silesian Region.

8.8 Výroba, dodávky a spotřeba tepla: Moravskoslezský kraj

	I. čtvrtletí			II. čtvrtletí			III. čtvrtletí			IV. čtvrtletí			Celkem	Podíl
	Leden	Únor	Březen	Duben	Květen	Červen	Červenec	Srpen	Září	Říjen	Listopad	Prosinec		v ČR
Celkový instalovaný výkon [MW$_t$]	6 123,5	6 122,9	6 122,9	6 122,2	6 122,0	6 122,0	6 115,2	6 115,2	6 115,2	6 115,2	6 114,9	6 114,9	6 114,9	16,1%
Výroba tepla brutto [TJ]	3 169,1	2 914,9	2 831,0	2 471,6	1 935,7	1 559,5	1 536,1	1 466,3	1 462,2	1 831,2	2 589,7	3 022,0	26 789,2	19,0%
Dodávky tepla podle paliv [TJ]	1 795,2	1 760,8	1 532,1	1 221,5	725,0	442,8	415,2	392,3	405,3	772,0	1 382,5	1 691,5	12 536,2	16,5%

Source: Annual report on the operation of heating systems of the Czech Republic, Moravian-Silesian Region, 2023, Energy Regulatory Office.

Attachment 6: Electricity production and consumption in the regions of the Czech Republic and RDS.

VÝROBA A SPOTŘEBA ELEKTŘINY V KRAJÍCH ČR A RDS

Výroba elektřiny brutto v krajích ČR podle technologie elektráren [MWh]

	JE	PE	PPE	PSE	VE	PVE	VTE	FVE	Celkem
Celkem ČR	**30 410 463,9**	**33 711 141,4**	**2 088 870,1**	**3 706 873,4**	**2 362 978,0**	**1 064 433,6**	**701 641,0**	**2 892 065,6**	**76 938 467,0**
Hlavní město Praha	0,0	102 509,39	0,0	84 841,1	46 772,1	0,0	0,0	37 172,3	271 294,8
Jihočeský kraj	16 082 865,6	457 656,28	0,0	303 045,4	281 699,6	0,0	1,7	315 696,3	17 440 964,8
Jihomoravský kraj	0,0	410 123,17	241 332,9	331 558,7	75 413,2	0,0	13 960,9	590 067,8	1 662 456,6
Karlovarský kraj	0,0	1 582 135,42	183 112,7	72 779,6	23 662,2	0,0	148 297,3	26 380,2	2 036 367,3
Kraj Vysočina	14 327 598,3	64 380,88	0,0	490 262,5	69 691,3	412 579,6	23 475,0	139 330,5	15 527 318,2
Královéhradecký kraj	0,0	550 419,61	0,0	344 296,1	105 451,3	0,0	20 589,8	135 337,7	1 156 094,5
Liberecký kraj	0,0	26 285,98	0,0	96 934,7	75 887,0	0,0	110 889,3	130 815,9	440 812,9
Moravskoslezský kra	**0,0**	**2 975 032,19**	**0,0**	**456 777,4**	**58 968,2**	**0,0**	**77 980,8**	**134 304,2**	**3 703 062,7**
Olomoucký kraj	0,0	180 434,40	0,0	296 328,8	40 387,2	601 175,6	96 249,7	158 968,8	1 373 544,5
Pardubický kraj	0,0	3 964 093,43	0,0	335 040,7	75 534,5	0,0	16 533,4	137 919,9	4 529 122,1
Plzeňský kraj	0,0	649 964,47	0,0	251 809,6	84 959,3	0,0	10 612,7	262 856,9	1 260 202,9
Středočeský kraj	0,0	4 659 983,01	0,0	390 439,8	1 087 200,1	50 678,4	7 475,5	398 715,0	6 594 491,8
Ústecký kraj	0,0	17 809 693,50	1 664 424,5	145 954,5	307 676,5	0,0	175 314,3	205 105,4	20 308 168,7
Zlínský kraj	0,0	278 429,67	0,0	106 804,5	29 675,5	0,0	260,6	219 394,7	634 565,0

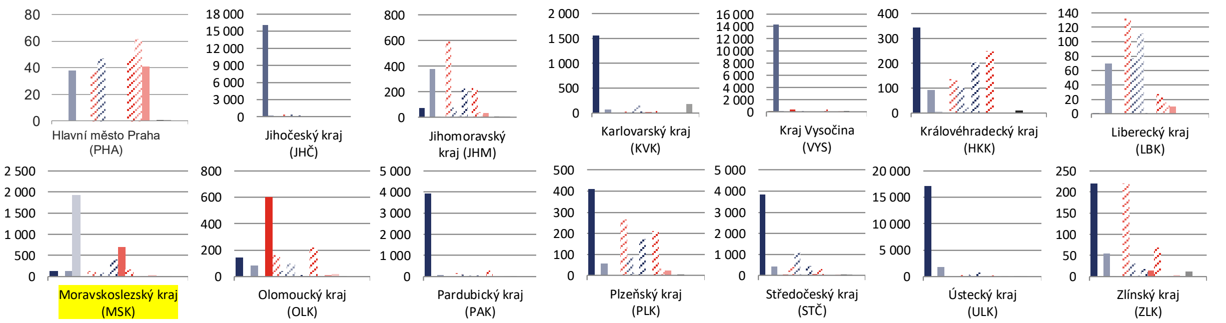
Source: Annual Report on the Operation of the Electricity System of the Czech Republic, 2023, Energy Regulatory Office.

Attachment 7: Share of fuels and technologies in gross electricity production in the regions of the Czech Republic.

Podíl paliv a technologií na výrobě elektřiny brutto v krajích ČR [GWh]

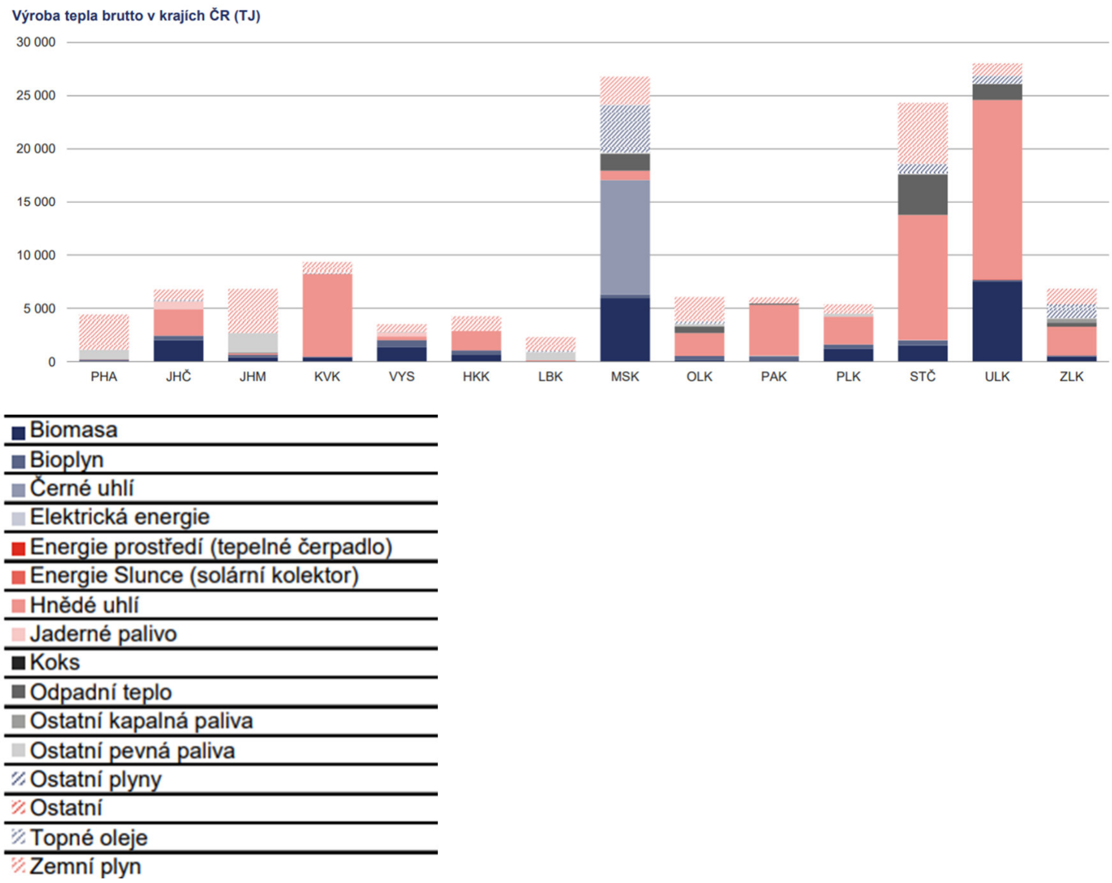
	PHA	JHČ	JHM	KVK	VYS	HKK	LBK	MSK	OLK	PAK	PLK	STČ	ULK	ZLK	Celkem
Výroba elektřiny brutto	**271,3**	**17 441,0**	**1 662,5**	**2 036,4**	**15 527,3**	**1 156,1**	**440,8**	**3 703,1**	**1 373,5**	**4 529,1**	**1 260,2**	**6 594,5**	**20 308,2**	**634,6**	**76 938,5**
Hnědé uhlí	0,0	119,8	73,6	1 553,6	13,3	342,9	1,1	133,6	140,9	3 931,4	409,2	3 825,9	17 035,9	219,2	27 800,5
Jaderné palivo	0,0	16 082,9	0,0	0,0	14 327,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	30 410,5
Obnovitelné zdroje energie (OZE)	193,1	1 073,5	1 175,9	252,9	711,7	711,0	360,1	817,1	519,2	529,0	773,3	2 243,6	1 452,8	333,2	11 146,4
Zemní plyn	37,4	164,3	377,0	56,5	60,8	89,4	69,5	127,6	83,2	52,4	54,6	403,3	1 763,0	53,0	3 392,1
Černé uhlí	0,0	0,0	0,8	0,0	0,0	3,2	0,0	1 910,8	0,1	0,0	0,0	0,0	3,5	0,2	1 918,6
Přečerpávací	0,0	0,0	0,0	0,0	412,6	0,0	0,0	0,0	601,2	0,0	0,0	50,7	0,0	0,0	1 064,4
Ostatní plyny	0,0	0,0	0,0	2,0	0,0	0,0	0,0	686,0	0,0	0,0	0,0	61,5	51,5	14,6	815,7
Ostatní pevná paliva (mimo BRKO)	40,8	0,0	33,4	0,0	0,0	0,0	10,1	1,1	8,5	0,0	22,9	0,0	0,5	0,5	117,8
Odpadní teplo	0,0	0,0	0,0	0,0	0,1	0,0	0,0	26,1	19,6	12,9	0,0	0,4	0,0	2,3	61,4
Topné oleje	0,0	0,5	1,4	0,0	1,2	9,6	0,0	0,7	0,8	3,4	0,2	6,1	0,9	0,2	25,0
Ostatní kapalná paliva	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	3,0	0,1	11,3	14,6
Ostatní	0,0	0,0	0,3	171,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	171,6
Koks	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Celkem OZE [MWh]	**193,1**	**1 073,5**	**1 175,9**	**252,9**	**711,7**	**711,0**	**360,1**	**817,1**	**519,2**	**529,0**	**773,3**	**2 243,6**	**1 452,8**	**333,2**	**11 146,4**
Biomasa	0,0	221,6	224,9	16,6	51,0	203,1	0,1	392,6	7,4	7,5	170,4	450,7	676,2	16,5	2 438,5
Bioplyn	47,9	254,5	231,7	38,0	428,2	246,5	27,3	153,3	216,3	291,6	210,4	299,5	88,5	67,3	2 601,0
Vodní	46,8	281,7	75,4	23,7	69,7	105,5	75,9	59,0	40,4	75,5	85,0	1 087,2	307,7	29,7	2 363,0
Fotovoltaika	37,2	315,7	590,1	26,4	139,3	135,3	130,8	134,3	159,0	137,9	262,9	398,7	205,1	219,4	2 892,1
Větrné	0,0	0,0	14,0	148,3	23,5	20,6	110,9	78,0	96,2	16,5	10,6	7,5	175,3	0,3	701,6
BRKO	61,2	0,0	39,9	0,0	0,0	0,0	15,1	0,0	0,0	0,0	34,0	0,0	0,0	0,0	150,2
Podíl OZE [*)]	**71,2%**	**6,2%**	**70,7%**	**12,4%**	**4,6%**	**61,5%**	**81,7%**	**22,1%**	**37,8%**	**11,7%**	**61,4%**	**34,0%**	**7,2%**	**52,5%**	**14,5%**

[*)] prostý podíl výroby elektřiny brutto z OZE a celkové výroby elektřiny brutto

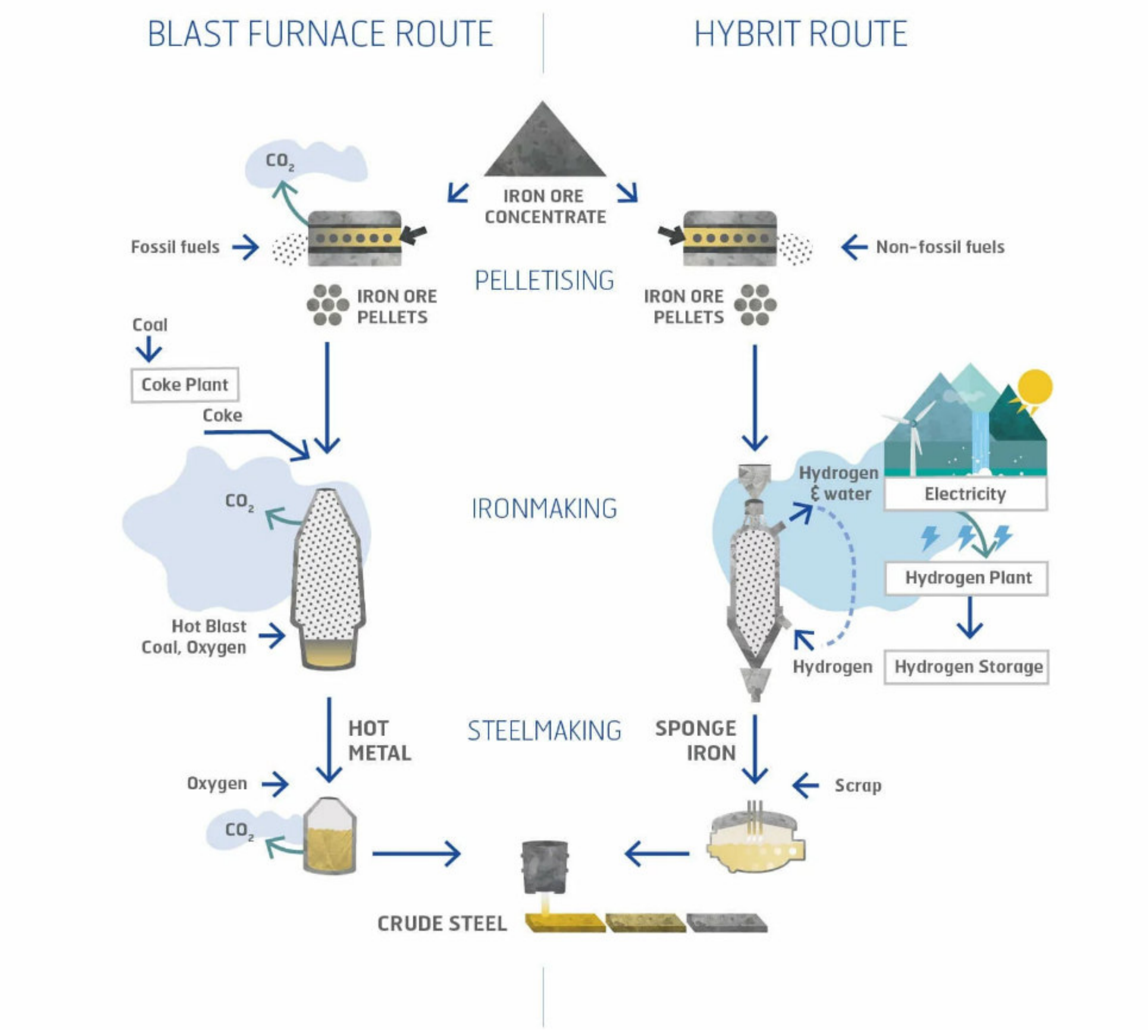


Source: Annual Report on the Operation of the Electricity System of the Czech Republic, 2023, Energy Regulatory Office.

Attachment 8: Heat production in the regions of the Czech Republic.

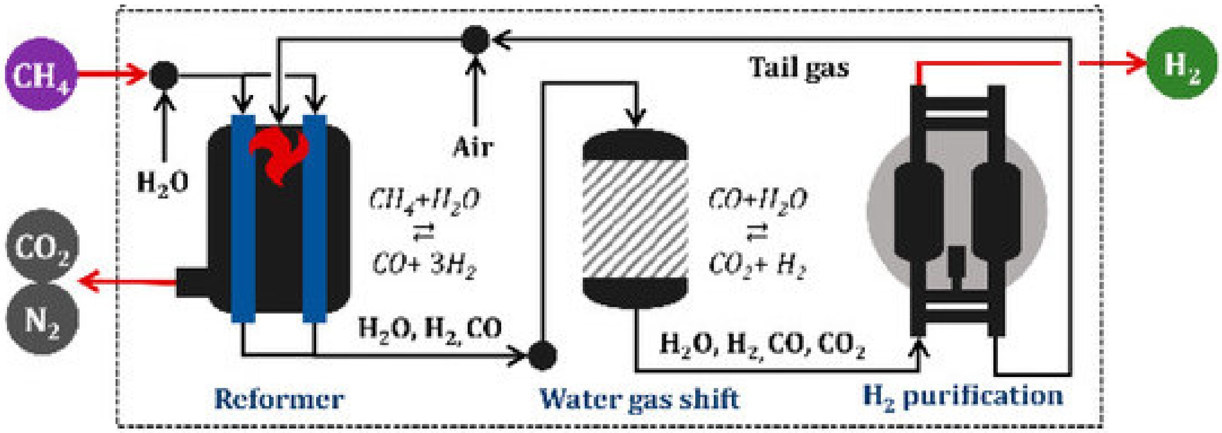


Attachment 9: Comparison of iron production by reduction in blast furnaces and iron production by reduction by hydrogen.



Source: https://www.en-former.com/en/hydrogen-revolution-steel-production/

Attachment 10: The principle of steam reforming.



Source: https://www.mdpi.com/2076-3417/11/13/6021