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Reports on the legal and policy situation for sector coupling by participating country including administrative barriers

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Short Description
In this document the national legal and policy situation of the participating countries on Power-to-Gas is outlined and barriers are identified for the respective countries.

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The following document is developed as a compilation of the analyses of the legal situation by participating countries, which have been made by the respective partners with accompanying support of PP3 EI-JKU in the development of the reports. The EI-JKU assumes no liability for the correctness and completeness of these country-specific analyses.

CONTENT

1. INTRODUCTION

According to the European Climate Law[1] the European Union has to reach climate neutrality until 2050.[2] After taking all the measures to increase energy efficiency, when switching to a renewable energy system, it is necessary to carry out electrification wherever it is possible. However, to use the full potential of electricity, it is often dependent on conversion and storage technologies like Power-to-Gas (hereafter P2G). By purchasing renewable electricity from the grid when there is surplus production (which would otherwise have to be curtailed) P2G is in particular beneficial for the electricity network and for including a higher share of renewables into the energy system. Additionally renewable electricity production is mostly dependent on specific weather conditions (e.g. sun, wind). When these are not given, which applies especially during winter, only a much smaller amount of renewable electricity can be produced. By converting it into hydrogen (seasonal) storage is enabled which is crucial for shifting the energy system to a renewable one. Furthermore there are "hard-to-abate" sectors where electrification is not possible. In order to decarbonize these, renewable gases are needed. P2G is the sector coupling technology that meets all these requirements and therefore have a huge impact on the energy transition and on reaching the climate targets. Thus, the advantages of P2G are evident. However, these are often not adequately manifested in the legal framework and are therefore a barrier to its development. P2G purchases (renewable) electricity to subsequently convert it into hydrogen via electrolysis, which in turn can be processed into other renewable gases. These can be used directly, in the industry or in the transport sector etc., but they can also be stored for later use or converted back into electricity and then used again as such. The DanuP-2-Gas project focuses on supporting the diversification of energy sources and strengthening generation and storage strategies for renewable energy in the Danube region. Since an appropriate legal framework is crucial for the establishment of the technology it is analyzed at the national level of the participating countries, namely Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia and Slovenia. This analysis will present the legislative framework on P2G and focusses at the topics of definitions, classification, ownership of P2G plants, guarantees of origin, taxes, levies and network charges. At the end, barriers that arise with the implementation of P2G are outlined. These are representative of those technologies associated with system integration.

2. METHOD

The first step was to define the relevant topics to be assessed in the legal analysis. Since national legislation is often determined by overarching legal provisions, an overview of these was provided. Thereby, the provisions of the EU were looked at and then it was explained how they relate to Serbia, which is not an EU member state. In order to obtain the findings in the individual countries, a questionnaire was prepared by EI-JKU. The legal frameworks of the respective countries were screened for applicability to P2G and the selected topics were analyzed by the respective project partners in detail, whereas EI-JKU as work package leader provided support upon need. Stakeholders were also involved and consulted. Finally, barriers to the implementation of P2G were identified.

3. SCOPE OF THE LEGAL ANALYSIS

The project idea of DanuP-2-Gas is to process unused organic residue to biochar for an easy transport along the Danube River and to use it as a basis for synthesis gas generation. This syngas will be upgraded to renewable natural gas by adding hydrogen produced from surplus renewable energy (P2G), which enables

[1] Regulation (EU) 2021/1119 of THE European Parliament and of the Council of 30 June 2021 Establishing the Framework for Achieving Climate Neutrality and Amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') OJ 2021 L 243/1.
[2] Cf. Article 2 (1) European Climate Law.

storage of surplus energy in the existing gas distribution grid. DanuP-2-Gas strongly builds on the DTP project Energy Barge but complements it with another dimension, namely a storage concept for renewable energy that spans the entire Danube Region. In the project Energy Barge the political and regulatory framework concerning biomass production and logistics in the Danube region has been examined. Therefore in DanuP-2-Gas the focus of the legal analysis will be placed on the part not yet covered, namely P2G and related aspects. The legal analysis refers to the legal situation of ten countries (Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia, Slovenia). Of these, nine countries are members of the European Union and one is not (Serbia). The EU prescribes requirements that must be complied with. Therefore, an overview of the relevant European legislation is therefore provided. As Serbia is not a member state of the EU, the legal analysis of this country also includes a comparison of the Serbian legal situation with the requirements of the European Union. Subsequently, the national legal and regulatory framework will be presented, first indicating the current legal situation and then identifying the existing barriers. In the following, it will be outlined more detailed which topics will be examined in the legal analysis.

In the first step, it is necessary to assess how P2G is legally classified in the individual countries. This is not clear a priori due to the dual role that P2G takes on. Electricity is first purchased, then used to produce hydrogen via electrolysis and hydrocarbons. The electricity and gas sectors are therefore combined in this technology. How P2G is classified, whether it is to be classified as a consumer, producer or energy storage, plays a major role for the further legal assessment. This is because the provisions of energy law are usually linked to the classification into a category. Furthermore it will be determined whether P2G (plants) have been included in the provisions of the individual countries in the sense of a definition or by anchoring explicit corresponding provisions. Based on the classification of P2G in the respective countries, but also beyond that, it will be assessed who is allowed to own, develop, manage or operate P2G plants. A special focus is thereby placed on the operation by Electricity and Gas Transmission System Operators, Electricity and Gas Distribution System Operators, Gas storage operators and producers. Furthermore there will be a legal analysis concerning the legal and regulatory classification of the products (renewable hydrogen and 'renewable natural gas'[3]) in the respective countries. The situation to be evaluated is that the hydrogen is produced from water electrolysis, using renewable electricity, and the carbon source comes from biomass. Methanation is finally carried out to produce the 'renewable natural gas'. The next step is to analyse whether and, if so, which gas quality standards have to be complied with when feeding hydrogen and/or 'renewable natural gas' into the grid. It will be assessed if there are any restrictions regarding the feed-in. It will also be assessed whether hydrogen may/can be fed directly into the gas grid, or whether the specified quality standards must be met before feeding into the grid and the direct feed-in is not possible. The financial component plays a very important role. Therefore, both for the purchase of electricity and for the feed-in of hydrogen/'renewable natural gas', it is assessed whether and to what extent network charges, taxes and other levies have to be paid and whether there are any exemptions. Furthermore, it is analysed whether there are any (other) incentives during the project runtime for the production of renewable hydrogen and 'renewable natural gas'. It will be assessed whether there are investment subsidies, feed-in tariffs, CO_2 taxation, support schemes etc. It is also very important to have the possibility to label the product produced in an environmentally friendly way. It will therefore be investigated whether certificate systems (guarantees of origin) exist for renewable hydrogen and 'renewable natural gas'. Finally, the existing barriers are outlined.

4. OVERARCHING FRAMEWORK

The national legal frameworks are highly influenced by higher-level legislation in many areas. This also applies to energy law, where legal provisions are given at the European level for numerous topics, which set a

[3] Renewable natural gas means within this document gas that is produced by the production of renewable hydrogen in the first place (via electrolysis with renewable elektricity) and subsequent methanation.

legal basis and limits and often have to be transposed at the national level. This chapter therefore provides an overview of the relevant European framework conditions and, since one country from which a project partner is involved is not in the EU, namely Serbia, the relation of the EU legal situation to the Serbian legal situation is also explained. However, the subject of this deliverable is the national reports, which is why only an overview of particularly relevant provisions is provided in this regard.

4.1 EUROPEAN LEGAL FRAMEWORK

As far as the classification of P2G plants on a European level is concerned, a new provision in the Electricity Directive 2019 (hereafter ED 2019)[4] is of particular relevance. Previously, only producers/consumers were known in electricity law.[5] Now the term energy storage has been introduced and it has to be assessed whether a P2G plant or an electrolyzer falls under it. Energy storage in the electricity system means „deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored, the storing of such energy, and the subsequent reconversion of such energy into electrical energy or use as another energy carrier;“.[6] While the first case of the definition covers "classical electricity storage", the definition also covers cases where the electricity is converted into a form of energy that can be stored (note in this regard that conversion into e.g. chemical energy also takes place in classical electricity storage devices such as a battery, but here the focus is presumably on the change in the energy carrier, which in this case does not change), the storage of this energy, and finally the use as such or also the reconversion into electricity. P2G primarily uses electricity, which is subsequently converted into hydrogen by electrolysis. Hydrogen is another energy carrier that can be stored. Thus, the definition appears to basically cover the P2G chain if the energy is stored.

Regarding the classification as gas production, it should be noted that “production” is not defined in the Gas Directive 2009[7]. However, *Kreeft* argues that there is no valid reason not to classify SNG produced via electrolysis as production, “similar to the extraction of natural gas from underground reservoirs, or the production of (upgraded) biogas from biomass”.[8] In accordance with the unbundling provisions of the Gas Directive 2009, the classification of P2G as a gas producer results in network operators not being allowed to operate or own such facilities. Classification as an energy storage facility also entails the application of unbundling requirements, namely those of the ED 2019. Accordingly, electricity distribution system operators and transmission system operators are not allowed to own, develop, manage or operate energy storage facilities.[9] By way of derogation, however, the Directive grants Member States the right to allow distribution system operators and transmission system operators to own, develop, manage or operate energy storage facilities, but only in two cases. On the one hand, this is possible if the energy storage facility is a fully integrated network component[10] and the regulatory authority has granted its approval. The other option is that all of the following conditions are met:

[4] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU, OJ 2019 L 158/125 as amended by 2022 L 152/45.
[5] *Ennser/Gattringer*, Strommarkt re-designed: Neue Akteure – neue Regeln, ecolex 2019, 829.
[6] Article 2 (59) ED 2019.
[7] Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, OJ 2009 L 211/94 as amended by 2022 L 152/45.
[8] *Kreeft*, STORE&GO - D7.2 European Legislative and Regulatory Framework on Power-to-Gas (2017) 27.
[9] Cf. Article 36 (1) and 54 (1) ED 2019.
[10] Fully integrated network components are according to Article 2 (51) ED 2019 “network components that are integrated in the transmission or distribution system, including storage facilities, and that are used for the sole purpose of ensuring a secure and reliable operation of the transmission or distribution system, and not for balancing or congestion management”.

- Following an open, transparent and non-discriminatory tender process (which must be reviewed and approved by the regulatory authority), no other party has been granted the right to own such facilities or to develop, manage or operate such facilities, or has been unable to provide such services at a reasonable cost or in a timely manner.
- Such facilities (and non-frequency ancillary services at transmission system operators) must be necessary for system operators to meet their obligations under the ED 2019 to maintain efficient, reliable, and secure operation of the systems, and such facilities (and services at transmission system operators) are not used to buy or sell electricity in electricity markets.
- Finally, the regulatory authority must have assessed whether such an exemption is necessary, evaluated the tender process, including its conditions, and granted its approval.[11]

A public consultation on existing energy storage facilities shall be carried out by the regulatory authority at regular intervals, at least every five years, in order to assess the possible interest of third parties and the possible availability of investments in such facilities. If these consultations indicate that third parties are in a cost-effective position to own such facilities or to develop, operate or manage such facilities, the regulatory authorities shall ensure that the related activities of the network operators are phased out within 18 months.[12]

The Gas Directive 2009 does not define (renewable) hydrogen and synthetic renewable gas (produced on the basis of renewable hydrogen). However, Article 1 (2) Gas Directive 2009 states that the provisions adopted by the Directive for natural gas (including LNG) shall also apply in a non-discriminatory manner to biogas and gas from biomass or other types of gas to the extent that it is technically possible and without compromising safety to inject these gases into and transport them through the natural gas system. Due to the similarity of the chemical composition of synthetic renewable gas to natural gas, the applicability of the Gas Directive 2009 appears to be affirmative.[13]

The Commission Regulation (EU) 651/2014[14] defines renewable hydrogen as "hydrogen produced through the electrolysis of water (in an electrolyser, powered by electricity stemming from renewable sources), or through the reforming of biogas or biochemical conversion of biomass, if in compliance with sustainability criteria set out in" Article 29 RED II[15].[16]

The hydrogen strategy[17] also contains definitions of terms that apply to the strategy. The terms electricity-based hydrogen, renewable hydrogen, clean hydrogen, fossil-based hydrogen, fossil-based hydrogen with carbon capture, low-carbon hydrogen and hydrogen-derived synthetic fuels are defined therein. According to that,

- electricity-based hydrogen means "hydrogen produced through the electrolysis of water (in an electrolyser, powered by electricity), regardless of the electricity source. The full life-cycle greenhouse gas emissions of the production of electricity-based hydrogen depends on how the electricity is produced",
- renewable hydrogen is "produced through the electrolysis of water (in an electrolyser, powered by electricity), and with the electricity stemming from renewable sources. The full life-cycle greenhouse

[11] Cf. Article 36 (2) and 54 (2) ED 2019.
[12] Cf. Article 36 (3) and 54 (4) ED 2019.
[13] *Veseli/Tichler*, Notwendigkeit der Regulierung von Wasserstoff und Power-to-X und Verankerung im europäischen Recht, ZTR 2020, 78.
[14] Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty, OJ 2014 L 187/1 as amended by 2021 L 270/39.
[15] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, OJ 2018 L 328/82 as amended by 2022 L 139/1.
[16] Article 2 (102c) Regulation (EU) 651/2014.
[17] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A hydrogen strategy for a climate-neutral Europe, COM(2020) 301 final.

gas emissions of the production of renewable hydrogen are close to zero 20. Renewable hydrogen may also be produced through the reforming of biogas (instead of natural gas) or biochemical conversion of biomass 21 , if in compliance with sustainability requirements" and

- clean hydrogen refers to renewable hydrogen.[18]

Furthermore, there are proposals to amend the Gas Directive 2009 and the Gas Regulation 2009[19].[20] In the former, the following definitions are proposed:

- Renewable gas is biogas as defined in Article 2 (28) RED II, including biomethane, and renewable gaseous fuels part of fuels of non-biological origins ('RFNBOs') as defined in Article 2 (36) RED II.[21]
- Low-carbon hydrogen refers to hydrogen the energy content of which is derived from non-renewable sources, which meets a greenhouse gas emission reduction threshold of 70%[22] and
- Low-carbon gas means the part of gaseous fuels in recycled carbon fuels as defined in Article 2 (35) RED II, low-carbon hydrogen and synthetic gaseous fuels the energy content of which is derived from low-carbon hydrogen, which meet the greenhouse gas emission reduction threshold of 70%.[23]

Regarding Guarantees of Origin, RED II defines them as electronic documents that serve exclusively as proof to an end customer that a certain share or amount of energy has been produced from renewable sources.[24] RED II extended the scope of guarantees of origin to renewable gases (including hydrogen) and heating and cooling. Article 19 of RED II contains detailed regulations for issuing guarantees of origin for energy from renewable sources. It is specified that a guarantee of origin is valid for 1 MWh by default. Member States must also ensure that the same unit of energy from renewable sources is only taken into account once.[25] The minimum information that a guarantee of origin must contain is also determined. Accordingly, information must be provided on the energy source from which the energy was produced, as well as on the start and end of its production, and on whether the guarantee of origin relates to electricity or gas, including hydrogen, or to heating or cooling. Furthermore, the name, location, type and capacity of the plant in which the energy was produced shall be indicated, as well as whether the plant has received investment support and whether the energy unit has benefited in any other way from a national support scheme, and the type of support scheme. Finally, the date of commissioning of the plant and the date of issue and as well as the issuing country and a unique identification number must be indicated.[26]

4.2 RELATION OF EU AND REPUBLIC OF SERBIA

Serbia is the only state involved in the project that is not a member of the European Union. This is of particular interest in this Workpackage because, in principle, the implementation of European legislation is not binding for Serbia. Therefore, this section briefly outlines, Serbia's relationship with the EU and what this means for Serbian legislation with regard to the energy issue.

[18] COM(2020) 301, pp. 3.
[19] Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005, OJ 2009 L 211/36 as amended by 2022 L 152/45.
[20] Proposal for a Directive of the European Parliament and of the Council on common rules for the internal markets in renewable and natural gases and in hydrogen, COM(2021) 803 final; Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and for hydrogen, COM(2021) 804 final.
[21] COM(2021) 803, Article 2 (2).
[22] COM(2021) 803 Article 2 (10).
[23] COM(2021) 803 Article 2 (11).
[24] Article 2 (12) RED II.
[25] Article 19 (2) RED II.
[26] Article 19 (7) RED II.

The Republic of Serbia applied for membership of the European Union on 19 December 2009. This application was endorsed by the European Commission and in a next step Serbia was granted candidate status by the European Council in March 2012. Accession negotiations finally began in early 2014.[27] At the end of 2021, the European Commission published the latest progress report on the accession process, which also mentioned the opening of the Green Agenda and Sustainable Connectivity Cluster.[28]

Since its foundation in October 2005 and enactment in 2006, Serbia has been part of the Energy Community which is an international organisation that was founded by means of a treaty. In addition to the European Union, nine other states were signatories. As some of them already joined the European Union the following are current contracting parties: Albania, Bosnia and Herzegovina, Kosovo, North Macedonia, Georgia, Moldova, Montenegro, Serbia and Ukraine. The aim of the Energy Community is to create a legally binding framework that extends the principles of the EU internal energy market to the contracting parties in order to enable, among other things, a stable common regulatory and market framework.[29] By signing and ratifying the Energy Community Treaty, the contracting parties, i.e. also the Republic of Serbia, have given legally binding consent to adopt the most important EU legislation in the energy sector, the so-called "aquis communautaire".[30] This is also expressed in particular in the fact that Serbia explicitly refers to the Energy Community and the specific EU standards which are to be transposed into national law in the publications of the National Renewable Energy Action Plan[31] and the Progress Report on Implementation of the NREAP[32]. Furthermore, Articles 24 and 25 of the Energy Community Treaty allow the Energy Community to adapt the "aquis communautaire" in order to ensure that it develops in line with changes in European Community law.

5. DEFINITION AND CLASSIFICATION

Definitions and classifications have an impact on the provisions to be applied and are important for creating legal certainty. This is of particular importance for P2G, due to the dual role it plays, on the one hand the purchase of electricity, and on the other hand the production of hydrogen as well as other hydrocarbons. This chapter therefore explains how P2G plants are defined and classified in the respective jurisdictions, as well as how renewable gas produced on the basis of renewable hydrogen (which in turn is produced on the basis of renewable electricity via electrolysis) is to be classified in the individual legal frameworks.

[27] Website of the Consilium of the EU, see https://www.consilium.europa.eu/de/policies/enlargement/serbia/ (accessed 28.07.2022).
[28] Website of the European Commission, see https://ec.europa.eu/commission/presscorner/detail/de/qanda_21_5281 (accessed 28.07.2022).
[29] Website of the Energy Community, see https://www.energy-community.org/aboutus/whoweare.html (accessed 28.07.2022).
[30] *Cf. Articles 10, 12, 20 Treaty establishing Energy Community; Website of the Energy Community, see https://www.energy-community.org/legal/acquis.html (accessed 28.07.2022).*
[31] *Ministry of Energy, Development and Environmental Protection*, National Renewable Energy Action Plan of the Republic of Serbia (2013) pp. 3 (see https://www.mre.gov.rs/sites/default/files/2021/03/national_renewable_energy_action_plan_of_the_republic_of_serbia_28_june_2013.pdf [accessed 28.07.2022]).
[32] *Ministry of Mining and Energy*, Report on the Implementation of the National Renewable Energy Action Plan of the Republic of Serbia for 2018 and 2019, pp. 3 (see https://www.mre.gov.rs/sites/default/files/2021/03/republic_of_serbia_res_progress_report_2018_2019.pdf [accessed 28.07.2022]).

5.1 P2G PLANT

5.1.1 AUSTRIA[33]

5.1.1.1 DEFINITION

The Electricity Act 2010 (in the following EA 2010, Elektrizitätswirtschafts- und -organisationsgesetz 2010 F.L.G. I NO. 110/2010 as amended by F.L.G. I No. 7/2022) and the Renewable Energy Expansion Act (in the following REEA Erneuerbaren-Ausbau-Gesetz F.L.G. I No. 150/2021 as amended by F.L.G I No. 13/2022) contain several provisions on "facilities for the conversion of electricity into hydrogen or synthetic gas" (in the following P2G plants). A definition of these facilities per se is not found in the EA 2010 and the REEA[34]. However, it must be noted that the term itself already provides a kind of definition. Furthermore, the Gas Labelling Ordinance (Gaskennzeichnungsverordnung F.L.G. II No. 275/2019 as amended by F.L.G. II No. 47/2022) explicitly refers to P2G plants.

5.1.1.2 CLASSIFICATION OF THE P2G PLANT IN THE ELECTRICITY-SIDE MARKET MODEL

The first step within the process of the P2G plant is the purchase of electrical energy in order to carry out electrolysis. Therefore in the following the classification of the technology in the current regulatory regime on the electricity side will be outlined. As stated above, P2G plants are named as "facilities for the conversion of electricity into hydrogen or synthetic gas". According to this terminology, a classification of the technology as a conversion technology would be appropriate, but such a category is not found in the relevant energy law provisions. Only selective provisions are anchored for such plants. Therefore the existing general energy law provisions will be described and a classification of P2G plants into them is made.

5.1.1.2.1 P2G PLANT AS CONSUMER

§ 7 (1) (12) EA 2010 defines an end consumer as a natural or legal person or a registered partnership that purchases electricity for its own use. Due to the purchase of electrical energy from the public grid and thus the use of the grid, it can be assumed that the P2G plant can be classified as an end consumer. This is also supported amongst others[35] by the transitional provision of § 111 (3) EA 2010 which provides an exemption for P2G plants from the system utilisation charge and the charge for system losses. Since the legislator exempts these plants from the system utilisation charge and the charge for system losses, i.e. components of the system charges that apply to end consumers, it can be concluded that it actually regards these plants as end consumers within the meaning of the EA 2010.

5.1.1.2.2 P2G PLANT AS WITHDRAWING PARTY

§ 7 (1) (14) EA 2010 defines a withdrawing party as a consumer or a system operator who withdraws electricity from a transmission or distribution system. Concerning the qualification of a pumped storage power plant as a consumer, the Supreme Court[36] has stated that there can be no serious doubt that this kind of power plant withdraws electrical energy from the grid and has therefore to be classified as a consumer. According to the

[33] Parts of the elaborations concerning the Austrian legal situation in this document are based on the research projects wind2hydrogen (Project-No. 843920), Sun Storage Lehen (Project-No. 840705), HyTruck (Project-No. 868790), HYTECHBASIS 4 WIVA (Project-No. 868833) and UpHy I (Project-No. 868835) and are further developed within this project.
[34] In the English translation of the REEA, they are referred to as »power-to-gas plants«.
[35] See below the exemption from further payment obligations that have to be paid by end consumers.
[36] OGH 04.03.2013, 8 Ob 7/13g.

Constitutional Court[37], this is not changed by the fact that a pumped-storage power plant plays an important role in the overall system (e.g. for balancing energy), which is likely to increase even more against the background of increasing electricity generation, e.g. from wind power The same applies to P2G plants, as they also have to purchase electricity from the public electricity grid before converting it into hydrogen or, subsequently, into renewable gas. Therefore, a P2G plant has to be classified as a consumer in terms of electricity law.

5.1.1.2.3 P2G PLANT AS SYSTEM USER

According to § 7 (1) (49) EA 2010, a system user is any natural or legal person or registered partnership that feeds electricity into a system or takes electricity from a system. As argued above the P2G needs for its operation electricity, generally from the public grid. Thereby, the P2G plant has to be classified not only as a withdrawing party but as a system user[38] as well.

5.1.1.2.4 P2G PLANT AS ELECTRICITY UNDERTAKING

An electricity undertaking is any natural or legal person or registered partnership which carries out, with the aim to make profit, at least one of the functions of generation, transmission, distribution, supply or purchase of electricity, and which is responsible for commercial, technical or maintenance tasks related to such functions, excluding consumers.[39] As examined before, when taking electrical energy a P2G plant has to be classified as a consumer.[40] Consumers are explicitly excluded from the definition of the legal basis of a electricity undertaking, and therefore a P2G plant cannot be seen as a electricity undertaking.

5.1.1.3 CLASSIFICATION OF THE P2G PLANT IN THE GAS-SIDE MARKET MODEL

After receiving the electricity, the P2G carries out electrolysis and produces hydrogen which can then be further processed into SNG and can be fed into the natural gas grid. Therefore, the gas-side classification of the plant is examined in the following.

5.1.1.3.1 P2G PLANT AS SYSTEM USER

A system user is a natural or legal person or registered partnership that feeds into or out of a system or is supplied by a system or whose facility is connected to a system.[41] Therefore, if the operator of the P2G plant is a natural or legal person or registered partnership feeding into a system or or whose facility is connected to a system it is to be regarded as a gas-side system user.

5.1.1.3.2 P2G PLANT AS PRODUCER

A producer is defined under § 7 (1) (52) NGSA 2011 as a legal or natural person or a registered partnership that extracts natural gas. Although the term extraction seems to be taken from mining law, which could argue against understanding the P2G plant as a producer according to the NGSA, § 7 (4) NGSA 2011 states that any references to natural gas, gas or biogenic gases in that Act, shall be taken to also refer to renewable gases, other gases and gas mixtures that comply with the applicable rules of technology for natural gas quality. Thus, provided that the corresponding gas is processed in such a way that it complies with the applicable rules for

[37] See also in detail VfGH 12.03.2013, V 63/12.
[38] This also applies to a pumped-storage power plant.
[39] § 7 (1) (11) EA 2010.
[40] See above P2G plant as consumer.
[41] § 7 (1) (41) NGSA 2011.

natural gas quality, the plant can be classified as a producer. This will be the case for the production of renewable SNG.

5.1.1.3.3 P2G PLANT AS INJECTING PARTY

Furthermore, on the gas side, the P2G plant could be considered an injector. According to § 7 (1) (9) NGSA 2011 an injecting party is a natural or legal person or registered partnership that feeds natural gas or biogas into the network at an entry point so that it can be transported. Based on the previous remarks in connection with § 7 (4), it must also be assumed here that the plant is to be classified as an injector when producing SNG that is handed over for transport at an injection point.

5.1.1.3.4 P2G PLANT AS A NATURAL GAS UNDERTAKING

A natural gas undertaking shall mean any natural or legal person or registered partnership which carries out, with a view to profit, at least one of the functions of transmission, distribution, supply, sale, purchase or storage of natural gas, including liquefied natural gas, and which is responsible for the commercial, technical and/or maintenance tasks related to such functions, excluding consumers; undertakings according to § 7 (1) (58) and §§ 13 and 17 NGSA 2011 shall be deemed natural gas undertakings.[42] The classification of a P2G plant as a producer can be affirmed, but not as a storage facility, since the operation of a P2G plant is based on a conversion process. For the classification of the plant as a natural gas undertaking, the fact that the P2G plant (or its operator) will sell its products profitably to a natural gas trader in the course of feeding them into the natural gas grid could be relevant. Thus, the qualification as a natural gas undertaking is likely to be confirmed. Of interest for the closer assessment and subsequent classification as a natural gas undertaking is the previously discussed issue of end-user status, as end-users are explicitly exempted from classification as natural gas undertakings. However, this part is lastly not relevant, as the exemption of end consumers was necessary with regard to the purchase of natural gas. A P2G plant is therefore a natural gas undertaking in the course of its production of hydrogen or synthetic gas and subsequently the profit-oriented sale of these products to a natural gas trader, regardless of whether it also obtains natural gas from the natural gas grid. Nevertheless, a legal clarification or extension would be recommendable.

5.1.1.3.5 P2G PLANT AS NATURAL GAS TRADER

It is questionable whether the P2G plant also becomes a natural gas trader. According to the legal definition in § 7 (1) (14) NGSA 2011, such a trader is a natural or legal person or registered partnership that buys or sells natural gas without performing a transmission or distribution function within or outside the network in which it is established. This wording of the law suggests that the operator of the P2G plant who feeds its products into the public grid - not in order to give it away (which would be economically unlikely), but in order to sell it to consumers or other natural gas traders or other natural gas undertakings (customers) against payment - is to be qualified as a natural gas trader.

5.1.1.3.1 P2G PLANT AS STORAGE FACILITY

The term storage facility is defined in § 7 (1) (57) NGSA 2011. It means a facility used for storing natural gas, owned and/or operated by a natural gas undertaking, excluding any parts used for activities pursuant to the Mineral Resources Act (Mineralrohstoffgesetz F.L.G. I No. 38/1999 as amended by F.L.G. I No. 60/2022),

[42] § 7 (1) (16) NGSA 2011.

and excluding facilities reserved exclusively for system operators in carrying out their functions.[43,44] Technically speaking, the P2G plant only serves to convert the surplus electrical energy into hydrogen or SNG. These products are not stored in the P2G plant itself. However, they can be stored in natural gas storage facilities or in the natural gas grid after being fed into the grid. The P2G plant as such does therefore not yet function as a storage facility.

5.1.2 BULGARIA

There is no straight forward definition in the Bulgarian legal system of P2G, but taking into account its specifics and components, overlaps with other legal definitions are in place. P2G plant can be most precisely categorized as a production facility of gas from renewable sources (PFGRS). It is its core functionality and most distinctive feature. There are other functionalities where the P2G hub has analogues on the market, e.g., producers of electrical energy from renewable sources (RS), etc. PFGRS is stipulated in the Bulgarian Energy Act. There again, "Producer" is defined as the entity that produces electricity, heating, and/or gas from renewable sources. A system of regulations applies to PFGRS/Producers, as well as to the interaction of PFGRS with other energy entities, recognized by the Energy Act, e.g., operators of grid networks, Sustainable Energy Development Agency (SEDA), etc.

5.1.2.1 CLASSIFICATION OF THE P2G PLANT IN THE ELECTRICITY-SIDE MARKET MODEL

In the first place, P2G plant will be investigated as a participant in the electricity market. The following categories are distinguished per the Bulgarian legislation:

a) *P2G plant as a consumer*

An "end-consumer" is defined in the Energy Act (Additional provisions, point 27d) as an entity which buys electrical energy or natural gas for its own consumption.

For its normal operation, P2G hub needs to be supplied with electrical energy. Looking at the facility from that perspective, P2G hub can be classified as consumer of electrical energy. In the case when that happens from the electrical grid, there should be a contract for accession between the grid operator and the P2G entity (Energy Act, art. 117, par. 1).

b) *P2G plant as a producer*

Due to its modular architecture, P2G plants can be designed to produce not only renewable natural gas, but also electrical energy and/or combined heat and power.

Of Electrical Energy

P2G plant is categorized as a producer of electrical energy from renewable sources (RS) in the case when GRS is utilized for production of electrical energy. Provisions for this hypothesis are made in the Energy Act with the regulation of a number of aspects that concern electrical energy produced by "RS" (e.g. art. 93a, point 1). In that reference, definition of a "producer" is introduced in point 46 of the Additional provisions of the Energy Act – "an entity that produces electrical and/or heat energy,

[43] Storage facilities that serve the grid and can be allocated to it are probably those facilities that maintain the necessary grid stability and security of supply. However, this does not include the use of the facility for competitive purposes, *Weyer/Lietz*, Entflechtungsvorgaben, ZNER 2014, pp. 241, 244.
[44] In contrast, storage on the electricity side is not considered part of the grid infrastructure.

or gas from RS, or extracts natural gas", which is combined with the case of RS, defined in the Renewable Energy Sources Act (RES Act), art. 1 point 2.

Production of electrical energy (and/or heating energy) is activity that should be licensed (Energy Act, art. 39, par. 1, point 1). For electricity production facilities of less than 5 MW and heating production facilities of less than 10 MW, license is not required.

In addition, the P2G hub is obliged to sign a contract for access with the operator of the electrical grid network. The contract regulates any necessary additional and/or dispatched services , as well as required quality parameters.

Considering that the electricity produced is from RS, art. 18, par. 1, point 1 of the RES Act stipulates that the access of the P2G hub to the electrical transmission/distribution grid is guaranteed. It is required that safety standards and grid operator's instructions must be obeyed. Following the same logic, art. 18, par. 1, point 3 of the RES Act guarantees the transmission and distribution service for the electrical energy from RS.

Of Combined Heat and Power (CHP)

P2G plant can also be categorized as a highly efficient CHP producer if the combined production of heat and electricity consumes at least 10% less fuel than scenario of separate production of heat and electricity, according to the Ordinance № РД-16-267 from 19.03.2008. The minimum 10% efficiency required does not apply for the case when the P2G hub is with electrical power capacity of less than 1MW. In such cases, it is only required that the CHP is more efficient.

Electricity produced from highly efficient CHP is accompanied by a certificate of origin and is accessible from the EWRC public registries (Energy Act, art. 24, par. 1, point 2).

Guaranteed access to the transmission/distribution grid, along with guaranteed transmission and distribution, applies in the same way for highly efficient CHP from RS as for energy from RS.

c) *P2G plant as a trading party – tertiary regulation services provider*

P2G plant has the capacity to provide tertiary regulation services for the needs of balancing the energy market. The operational rules of the electricity market are provided by the EWRC in Rules for trading with electrical energy (RTEE). Activities of tertiary regulation services providers are outlined therein (Chapter Two, Section IV).

In order to take part on the balancing market, P2G plant should declare to the independent transmission operator (ITO) the range of variance of its production of active power. That information allows the dispatcher on duty to use tertiary balancing services in the case when secondary balancing services providers need some time to restore their capacity. According to art. 147, par. 1, of the RTEE, the minimal dispatched capacity should be not less than 5 MW, and the offered variance should be not less than 1 MW upwards or downwards. Another requirement is that the offer from the P2G should span a period not less than 240 min., segmented into 15 min. intervals. In other words, the parameters of the offering may vary between each of these 15 min. intervals.

5.1.2.2 CLASSIFICATION OF THE P2G PLANT IN THE GAS-SIDE MARKET MODEL

Specifics of the P2G hubs technology provides the possibility of several classifications to be made when investigating it from natural gas market perspective.

a) *P2G plant as a consumer*

P2G hub can act as a consumer in several cases. The first one is when natural gas is consumed from the grid for production of electricity, heat, or combined. The second is when it acts as a producer and has to provide balancing service to the gas grid. In both cases, the provision of such services depends on the design of the P2G implementation, e.g. presence of gas turbine, gas storage facilities, etc.

b) P2G plant as a producer

This is P2G hub main functionality. Under the Rules for trading with natural gas (RTNG), issued and regularly updated by the EWRC, P2G hub is a supplying enterprise (SE). As such, P2G hub may sell renewable natural gas also with the purpose of providing balancing services to the gas grid.

P2G hub is obliged to sell its quantities of renewable natural gas through a licensed ES (an entity that sells natural gas to end users).

P2G hub can be classified also as a producer of biofuels. The definition of biofuels provided in the RES Act – "liquid or gas fuels for transport, produced from biomass", fully overlaps with the specifics of the product of the P2G hub. The renewable natural gas can be liquified and/or directly supplied to the transport fuels stations/vehicles as long as it meets the required quality and safety standards.

c) P2G plant as a storage operator

For the case when P2G hub is designed with a gas storage capability of industrial significance for the gas network, it can be classified as an operator of a gas storage facility. It is up to the investor to decide on the capacity of the P2G hub's gas storage module. The service is a subject of licensing under the provision of the Energy Act (art. 39, par. 1, point 4).

Rare will be the cases when P2G will play such a role on the energy market since storage container will be of a volume with no significance for the gas storage market. The storage capacity is mainly meant to balance fluctuations between GRS production and feed in the gas grid entry point.

Contracts and activity regulation of the gas storage service is found in the RTNG.

5.1.2.3 CLASSIFICATION OF THE P2G PLANT IN THE HEATING-SIDE MARKET MODEL

a) P2G plant as a producer

Due to its combined generation capability, P2G hub can act as a heating energy producer, which is regulated in the Energy Act, section X. There is no requirement for licensing in the case when facility capacity is under 10 MW.

P2G hub can connect to the heating grid network if it has signed a contract for accession with the heat transmission operator. A payment for connecting the hub has to be made, calculated according to the provision in art. 36, par. 3 of the Energy Act.

5.1.3 CROATIA

There is no specific definition of P2G plants or technology in Croatian legislation. However, hydrogen and biogas (biomethane) have been identified in the strategic documents, on which the national legislation relies on, but they are currently mostly associated with transport and heating sectors and reducing greenhouse gas (hereafter: *GHG*) emissions in those sectors.

In the national legislation, gas from renewable energy sources is considered as *"...gas from landfills, gas from wastewater treatment plants and biogas..."* (**Energy Act (Official Gazette (OG) 120/12, 14/14, 102/15, 68/18)**)

Based on the **Energy Development Strategy of the Republic of Croatia until 2030, with a view to 2050 (OG 25/2020)** (hereafter: *Energy Strategy*), energy policy and planning of energy development are defined. Energy Strategy refers to hydrogen as an alternative fuel in transport, to reduce GHG emissions. This requires constructing new infrastructure, which will be in synergy with the existing gas and electricity grid.

The P2G technology is referred to in Energy Strategy as a technology for producing hydrogen and methane, while using electricity produced from renewable sources, being important in the long run for achieving energy transition. Produced fuels by means of P2G will be considered as indispensable forms of energy in those areas where the direct use of electricity is limited (air, sea, road and freight transport and in certain industrial processes) even though this technology is currently only applied at the level of pilot and demonstration projects.

Guidelines for low-carbon development (by 2030) defined in the **Low-Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050 (OG 63/21)** (Low-Carbon Strategy) refer to hydrogen in production for power system regulation and use in gas and transport systems: *"Analyse the possibility of hydrogen and synthetic fuels production in the context of power system regulation and use in the gas system and transport."* (Chapter 6.2.3. Guidelines for the low-carbon development)

The Low-Carbon Strategy suggests the measures for low-carbon development in terms of hydrogen: *"The potential of hydrogen as a fuel is significant. Significant investments are needed in the hydrogen distribution network, which has been identified as one of the key means towards the wider adoption of hydrogen as a fuel for transport, while the availability of hydrocarbons is not considered an obstacle. The use of hydrogen in vehicles does not require special adjustments in terms of travel and charging habits of the vehicle. Although technologies for hydrogen production are already in place today, considerable efforts are needed to establish the infrastructure to fill vehicles with hydrogen. The advantage of hydrogen is that it is suitable for use in trucks and for the propulsion of ships due to its high energy value. Its widespread use helps to integrate renewable energy sources because surplus electricity from renewable sources can be stored to produce hydrogen."*

The heat market in Croatia is regulated by the **Act on heat market (OG 80/13,14/14)**. The energy sources of the heating system are *"input quantities of gas, petroleum products, coal, renewable energy sources, etc. for transformation into thermal energy".* Using renewable energy (RES) in heating systems is considered of a great interest for Croatia and *"encouraging the development and use of new, innovative and sustainable technologies in the energy sector. Through the procedure of public procurement of goods, services and works, care will be taken to open the market for innovative solutions".* There is room for improving this Act by including hydrogen/biomethane in terms of their storage and use in heating and cooling system.

New **Act on Renewable Energy Sources and High Efficiency Cogeneration** that has recently undergone public consultation, will soon be published[45]. This new Act considers the use of hydrogen in sector of heating and cooling as well: "*Article 8 (2): With regard to the calculation of the share of final gross energy consumption from renewable sources referred to in paragraph 1 of this Article, gas, electricity and hydrogen from renewable sources shall be taken into account* only once for the calculation of the share of final gross energy consumption from renewable sources. "

[45] Status during the creation of this document: November/December 2021

In terms of hydrogen and P2G classification, this can be done within two main legislative documents: **Electricity Market act (OG 111/21)** and **Gas Market Act (OG 18/18, 23/20)**.

Within the Electricity Market Act, P2G can be classified mainly as a consumer – due to need for electricity within the electrolysis plant – but also as a storage facility (Article 48, which specifically mentions electrolysers with hydrogen storage). However, according to Article 48 (4), "*Energy storage is not considered as electricity activity from Article 4 (3) of this Act if:*

- *the plant for energy storage is within the metering point of an active buyer;*
- *the storage plant is used mainly for own demand, where electricity is not fed into the electricity grid;*
- *transmission system operator uses energy storage for fulfilment of its obligations, in accordance with provisions within this Act;*
- *distribution system operator uses energy storage for fulfilment of its obligations, in accordance with provisions within this Act".*

Within this article, the term "*active buyer"* is defined as "*a buyer who consumes or stores electricity produced in its own space, located within the defined limits, or sells electricity which it produces or participates in flexibility of energy efficiency programs"*, with a specific condition that these activities are not its primary commercial or professional business. Considering the fact that P2Gs are producing hydrogen/biomethane, with the purpose of storing the surplus electricity[46], they can be considered as electricity consumers within this act and have to follow the legislation framework from consumer standpoint (bylaws determined within the Electricity Market Act).

Within the Gas Market Act, P2G can also be classified as a consumer, in case mixing of hydrogen/biomethane with natural gas is considered. In order to perform this activity, P2G needs to obtain natural gas from the gas grid, which is legally determined within the aforementioned act. Moreover, the P2G plant operator needs to follow the rules of transport and distribution systems – i.e., **Network codes for the transport system (OG 50/18, 31/19, 89/19, 36/20, 106/21)** and **Network codes for the gas distribution system (OG 50/18, 88/19, 36/20, 100/21)**. Both network codes have an Annex, which determines the general conditions – respectively: General conditions for utilizing the gas transport service (Annex 1 within the Network codes for the transport system) and General conditions for utilizing the distribution system (Annex 3 within the Network codes for the gas distribution system).

However, P2G cannot be classified as a gas producer, due to **General conditions for gas supply (NN 50/18, 88/19, 39/20, 100/21)**, since Table 3 in Annex 2 only determines the standard gas quality for natural gas and liquefied petroleum gas. Additionally, in terms of the Gas Market Act, specifically in Articles 30 and 31, which are focused on gas storage, there is no mention of hydrogen or biomethane, which is another reason why P2G cannot be considered as a storage or producer plant within the gas system.

In the end, it is important to mention that the aforementioned classifications are presumed, based on the DanuP-2-Gas project activities and purpose of P2G utilization within it. None of the aforementioned acts specifically mentions P2G or hydrogen production/utilization/storage activities specifically, no provides the possibility to implement it.

[46] Within the scope of DanuP-2-Gas project.

5.1.4 CZECH REPUBLIC

There is no legal provision referring to P2G in Czech Republic. There is no legal basis for P2G in Czech Republic at the moment. P2G, as well as any other method of energy/electricity storage, is not included in the legal system of the Czech Republic. Business in the field of energy production and distribution is regulated (in particular) by laws 382/2021 and 458/2000, while the circumstances of energy production from supported energy sources are (in particular) regulated by laws 362/2021 and 165/2012. If the gas is subsequently injected into a pipeline, this entity can be interpreted as gas supplier. However, if the gas is converted back into electricity by a single entity, this activity could be interpreted as electricity generation and supply. Under such cases, these business activities could also be interpreted as "provision of electricity system services" (section 2, paragraph 2), point a), item 11 of law 458/2000), or "use of stored energy as control energy" (section 2, paragraph 2), point a), item 13 of law 458/2000). However, even after repeated requests, the Energy Regulatory Office is not able to issue a clear opinion on the subject and thus the above is rather just a compilation of professional opinions of independent experts.

5.1.5 GERMANY

The German law does not provide any legal definition for the term P2G or P2G plants. However, definitions in different laws can be applied to the P2G technology and it is mentioned in some laws.

The main laws that regulate energy plants are the Renewable Energy Act (Erneuerbares-Energien-Gesetz, EEG 2021) and the Energy Industry Act (Energiewirtschaftsgesetz, EnWG 2005).

According to the Renewable Energy Act, biomass plants are defined as plants that produce electricity from biomass.[47] Therefore, this definition does not apply for a number of P2G plants, if they convert electrical energy into biomethane or hydrogen without converting it back to electricity.

The Energy Industry Act provides the term “energy storage plant”[48] (“Energiespeicheranlage”)[49]. All facilities that consume electrical energy for the purpose of electrical, chemical, mechanical, or physical intermediate storage and generate it as electrical energy or release it in another form of energy, are summarized under this term, that is, it applies to P2G plants as well. In the Energy Industry Act, the term is only used for unbundling measures (see 2.2) and does therefore not impact the financial and other legal regulations of P2G plants.

Another term in the Energy Industry Act is “energy plant” (“Energieanlage”)[50]. Since they include all “installations for the generation, storage, transmission or delivery of energy”, the term applies for P2G plants. The term is mainly connected to § 49 Energy Industry Act, which provides regulations for technical security and security standards of the plants, as well as information on how to implement and prove the compliance with the regulations.

The Energy Industry Act explicitly uses the term “power-to-gas” only once in § 28q which obligates operators of hydrogen networks and operators of transmission networks to report on the state of development of the hydrogen grid, beginning in 2022. The reports shall also include “requirements for a future determination of locations for P2G plants as well as sources and regions of demand for hydrogen”[51]. Other than that, “power-to-gas” is not explicitly mentioned in any of the relevant laws.

[47] § 3 No. 12 EEG
[48] All translations of legal terms and law/directive citations were done by the author.
[49] § 3 No. 15d EnWG
[50] § 3 No. 15 EnWG
[51] § 28q (2) EnWG

The German law distinguishes between consumers of electrical power, which are defined as "end users" of the electricity ("Letztverbraucher"), "producer" ("Erzeuger") and "storage facilities" ("Speicher", "Speicheranlage"). Depending on the classification, different fees and taxes or financial incentives apply. A plant can be defined as storage facility and producer or as storage facility and end user at the same time. The classification of a plant has to be assessed individually, since many different factors impact the classification.

- "End user" ("Letztverbraucher"): "any natural or legal person who consumes electricity"[52], "natural or legal persons who purchase energy for their own consumption"[53];
- "Producer" ("Erzeugungsanlage"): "facilities for the production of electrical energy"[54];
- "Storage facilities" ("Energiespeicheranlage"): "facilities that consume electrical energy for the purpose of electrical, chemical, mechanical or physical intermediate storage and generate it as electrical energy or release it in another energy form"[55].

According to the definition of end users, P2G facilities are, in general, defined as end users and are therefore obliged to pay end user fees (e.g. grid fees, EEG contribution, electricity taxes etc, for more details see 2.5, 2.6 and 2.7). This applies especially in those cases that the converted electrical power is not reconverted, but used in a different energetic form (gas, LNG etc.).[56]

If a plant stores electrical energy from renewable sources in form of biogas, biomethane or hydrogen in order to reconvert the stored gas into electricity, the plant is treated as an electricity storage facility ("Stromspeicher").[57] According to the Energy Industry Act, electricity storage facilities are generally treated as end users ("Letztverbraucher") of the electricity they store. In case of reconversion into electrical power, the storage facilities can also be considered to be generator ("Erzeuger", "Erzeugungsanlage").[58] In some cases, this provides privileges and can lead to a remission of end user fees. Electricity generators profit from financial incentives for the production of renewable electricity (see 2.8).

§ 3, N. 19c EnWG defines "gas storage facilities" ("Gasspeicheranlage") as facilities, excluding that part that is being used for "Gewinnung". The difficulty here is that the German term "Gewinnung" is not legally defined and can be translated both as "exploitation" and "production". According to § 3 N. 36, "supply" ("Versorgung") is defined as "Erzeugung oder Gewinnung von Energie" („production or exploitation of energy"). Since the term "Gewinnung" is only used in the European Gas Directive (2009), Lietz argues that the term "Erzeugung" applies to electricity, while "Gewinnung" applies to gas. If a plant is classified as "Gasgewinnungsbetrieb" ("gas production/gas exploitation facility"), it might benefit tax exemptions (see 2.7). According to Lietz, P2G plants can be considered as "Gasgewinnungsbetrieb" since the definition in the Energy Tax Law (Energiesteuergesetz) clearly lists plants "in which natural gas is extracted or processed (produced)"[59].[60] Still, it is not without doubt whether this assessment is correct. Therefore, legal clarification for the terms used above is absolutely necessary.

The term "power-to-gas" is, as mentioned, only used once in the Energy Industry Act, the technology, however, is described several times. The definitions of "biogas" in § 3, No. 10f and "gas" in § 3, No. 19a of the Energy Industry Act include hydrogen produced from electrolysis and synthetic methane produced through usage of hydrogen from electrolysis. Further, the process is described in § 118 (6) of the same law and provides

[52] § 3 No. 33 EEG
[53] § 3 No. 25 EnWG
[54] § 3 No. 18d EnWG
[55] § 3 No. 15d EnWG
[56] Cf. Thomas 2017, p. 7
[57] Cf. Lietz 2017, p. 53
[58] Cf. Zapf 2017, p. 105
[59] § 44 (3) EnergieStG
[60] Cf. Lietz 2017, p. 425-428

information on financial incentives for P2G hubs. While biomass plants are defined as plants that reconvert the gas into electrical power, § 118 Energy Industry Act does not require reconversion.

The law applies for plants which operate with or without reconversion. In theory, a P2G plant can do both – reconvert part of the produced gas into electrical power and inject some of the produced RNG into the gas grid for storage or distribution purposes. It is questionable which of the above described laws and terms apply in such cases.

Conclusion: There is no legal term that clearly defines "power-to-gas" or "power-to-gas plants". The term "power-to-gas" is not used at all. A number of other terms can apply to those plants, but which definition exactly does, depends on the concrete operating system of the plant. Therefore, each plant has to be assessed individually. With the further development of the P2G technologies and their broader dissemination and market uptake, more specific legal definitions are needed. Further, legal definitions of the same term vary in different laws. Standardisation would make the interpretation of laws much easier.

5.1.6 HUNGARY

Although becoming carbon free by 2050 is an important policy goal for both the EU and Hungary, the formulation of the necessary legal framework to achieve it is still underway.

Several Hungarian government policies and programs define P2G technology as an essential asset in establishing a sustainable energy industry which is a prerequisite for meeting the climate targets, however the Hungarian legislator has not updated the legal framework for P2G technologies yet.

The „National Energy Strategy 2030" introduces the following long-term goals for the Hungarian government in connection with P2G:

- to encourage the installation of innovative seasonal electricity and heat storage solutions that can store large amounts of energy for a longer period of time (up to months),
- to promote the development of these technologies, in particular "seasonal energy storage" with P2G technology produced by feeding methane, biogas, and hydrogen.

To establish seasonal energy storage capacities, a pilot project is to be commenced to build a 2.5 MW unit, which shall be scaled up in three stages to 10, 50 and then 100 MW.

As P2G technologies are not legally classified yet on the whole. In order to shed light on the current legislative environment, we shall examine the different technological stages, these processes comprise of and explain them in detail. Although this compartmentalizing approach might be the best available, it might not match the future legal solution, since the combination of the separate stages could result in a process which is different in essence.

By the method mentioned above, the first stage of any P2G technology is to acquire electrical energy. Electrical energy can be obtained from the grid on TSO or DSO level, or from a power plant directly.

The next stage is the production of different gases, such as hydrogen, oxygen and methane. These can be vented (oxygen), sold and fed into the grid (hydrogen, methane), or used for electricity generation (hydrogen).

Energy trader

The definition of the energy trader is not yet declared in the Natural Gas Supply Act nor in the Electricity Act, although in provision 3. § section (2) point 9. of the Act LXVIII. of 2006 on excise duty (hereinafter: Excise Duty Act) the energy trader is classified as the following: a person who regularly and commercially purchases and sells natural gas, electricity or coal for non-own use, who holds a natural gas trade permit in accordance

with the Natural Gas Supply Act for natural gas and an electricity trade permit in accordance with the Electricity Act for electricity.

Although the overall P2G cycle could result in both buying and selling electricity and both buying and selling natural gas, in essence, the application of these technologies in not trading. P2G plants provide significant added value in both cases, time difference in electricity and hydrogen content in gas, therefore they are not traders and not obliged to acquire a trader permit.

The classification of P2G plants under the scope of the Electricity Act

In Hungary, electrical energy is regulated by Act LXXXVI of 2007 on electricity (hereinafter: Electricity Act)

User

Due to the provision 3.§ 17. section of the Electricity Act, User is the one who receives electricity for its own use from a public network or via a private line without intention of further transmission.

The first stage of the P2G process is to obtain electrical energy by purchasing it from a public grid or from a power plant. Regardless of the method the electricity is obtained, the second main step of the P2G process would be to produce hydrogen through electrolysis.

As electrolysis is interpreted as a technology which produces oxygen and hydrogen while consuming electricity, electricity cannot be transmitted in its original form, therefore the P2G plants use electricity without transmission. As a result, P2G plants can be classified as a User regarding the first main stage of the technology.

The Hungarian legal framework defines several obligations for Users. As it is stated in provision 56. § (2) section of the Electricity Act, Users shall enter into an electricity-trading agreement as a party and within the scope of the agreement user is entitled to purchase electricity from an electricity trader, from a producer or from an aggregator from the organized electricity market or through delivery from foreign electricity markets.

Fees and charges are regulated by the decree of MEKH XII. 14. of 12/2020 on a framework for the setting of tariffs for the use of electricity, connection charges and separate charges for the price regulation cycle starting on 1 April 2021. (hereinafter: Regulation on charges regarding the electricity market)

Based on the provisions of the Regulation on charges regarding the electricity market, Users are not obligated to pay for system charges directly, as these fees are covered by the universal service providers or the electricity traders.

System User

Due to the provisions 3. § 50. section of the Electricity Act, a System User is the one who is directly or indirectly connected to the public network for the purpose of supplying or receiving electricity, including the charging station operator and the electricity storage licensee.

A System User do not acquire energy for its own use and is allowed to transmit the energy, therefore this actor need to be classified with another legal definition.

P2G plants may be connected to the public network to receive electricity, based on these facts the technology can be classified as a System User as well.

The charges applied for every user of the electricity network are based on the Regulation on charges regarding the electricity market, which declares that system users are obligated to pay a transmission fee, distribution fee and public lightning distribution fee. The exact regulation of the fees mentioned will be discussed later.

Withdrawing Party

The Withdrawing Party is defined in provision 3. § section 66b. of the Electricity Act. The Withdrawing Party is the one who obtains electrical energy from a user through a private cable or from a universal service provider from a public network and does not qualify as a user.

We can distinguish User and Withdrawing Party along several aspects:

User

- receives the electricity for its own use
- receives electricity without the intention of further transmission
- can obtain electricity from a public network or via a private line

meanwhile, Withdrawing Party

- obtains electricity not only for its own use
- can obtain electricity solely from a user through a private cable or from an universal service provider from a public network

We can distinguish Users and Withdrawing Parties by the fact that Users are not allowed to transmit the purchased electricity, while Withdrawing Parties can trade it and transmit it.

As P2G plants would use the purchased electricity, they are classified as Users.

Producer

Producer is defined in provision 3. § section 58. § Electricity Act as a natural or legal person who produces electrical energy. As the P2G produced hydrogen or methane can be used to produce electricity – for example as part of a grid-scale electricity storage unit - P2G plants can be classified as electricity producers as well.

The classification of P2G plants under the scope of the Natural Gas Supply Act

In Hungary, the only legal source which regulates the legal aspects of any type of gases appearing on the energy market is the Act XL of 2008 of natural gas supply (hereinafter: Natural Gas Supply Act). While the Natural Gas Supply Act does not include such provision which provides that the provisions of the act shall apply to other type of gases as well, regarding the absence of any applicable legal source, the gas-related stages of P2G technology and gas markets may fall under the scope of the Natural Gas Supply Act.

After creating hydrogen and oxygen via electrolysis, hydrogen can be directly sold or - by methanation - turned into methane. The end-product can be then turned into electricity again.

User

The definition of User is stated in provision 3. § section 17. in the Natural Gas Supply Act. User is a legal or natural person who purchases natural gas or LPG through a pipeline for its own use. As in the P2G plant's methane is produced from hydrogen and added carbon-dioxide, it is not purchased. However, in order to feed the acquired hydrogen into the existing grid, we need to mix the hydrogen with other gases, for which natural gas shall be bought.

The quality standards for the gas that are to be fed into the grid are defined in the Hungarian legal framework and will be discussed later in chapter 4.1.

Natural gas producer

The definition of natural gas producer is stated in provision 3. § section 33. in the Natural Gas Supply Act. The natural gas producer is declared as the following: a business organization that carries out natural gas mining activities in the territory of Hungary or carries out the production of biogas and gases from biomass and other types of gas on a commercial basis.

In P2G processes, hydrogen is produced through electrolysis, and from it, methane is made. As these steps involve gas production in the territory of Hungary and since bio-based carbon-dioxide is used in the methanation process, the produced methane could be considered biogas, therefore the plant itself could be a natural gas producer.

System user

System users are also defined in the Natural Gas Supply Act. System user, under the provision 3. § section 51a. is defined as a user, a natural gas producer, a natural gas trader - including a limited natural gas trade licensee and a universal service provider - or a system operator, including a foreign-based transmission system operator who transports natural gas through a cross-border gas pipeline or is using the Hungarian natural gas system for feed-in or withdrawing natural gas from it.

P2G technology could feed-in gas at the end of the process, therefore it can be classified as a system user as well.

5.1.7 ROMANIA

At the time of this research and the writing of this article there is no clear definition of the concept of Power to Gas, or the principle by which gaseous fuel can be obtained from renewable energy, but rather how electricity can be produced from other renewable sources. (biomass, wind or solar power). However, Law No. 220 of 2008 for the establishment of the renewable energy promotion system defines some key terms of renewable energy including aerothermal, geothermal, hydrothermal energy but also some essential terms in the DanuP-2-Gas project, including biomass and bioliquid. . Renewable energy sources are also defined as - *"non-fossil energy sources, respectively wind, solar, aerothermal, geothermal, hydrothermal but also ocean energy, hydraulic energy, biomass, waste fermentation gas, also called landfill gas and waste gas fermentation of sludge from wastewater treatment plants and biogas. "*

Unfortunately in the Romanian legislation the concept of power to gas is not defined which is a minus because this makes investments in this field very difficult.

Therefore, although there are certain definitions and regulations regarding renewable energy sources, where most non-fossil energy sources are mentioned, there are no strict regulations that correspond to the Power to gas concept.

Renewable sources are mentioned from which the gas is produced, among which we extract from the above definition the biogas, but also the gases obtained from the fermentation of other residues. It is also mentioned that the gas that can be obtained by introducing installations for its acquisition from landfills. However, there is no information on the further use of this gas, much less its use to produce electricity.

Therefore, the main problem in Romania regarding Power to gas technology is the lack of mention of this process. Several sources of gas are mentioned. There are no specified ways to obtain electricity that can be obtained from renewable gas and thus be clean, green electricity.

In the Romanian legislation there are laws on electricity, Law 123/2012, which stipulates basic elements about electricity, suppliers, operators, transmission infrastructure, distribution and delivery to consumers. There is

also a law that has as a key point hydrogen more precisely, the installation of infrastructure for alternative fuels.

Unfortunately, there is no law that combines the two according to the Power to Gas concept.

In law 123/2012, the most interesting chapter is Chapter 5, which refers to "Promotion of electricity produced from renewable energy resources and high efficiency cogeneration" where renewable energy produced using hydrogen or the process of hydrogen production from other sources are not mentioned, but the law has an ambiguous point that where as renewable energy source is mentioned *"energy obtained from other renewable sources, not currently exploited."*

As for the law where hydrogen is mentioned in the most detail, law 34/2017, this is in fact a law on alternative fuels, among which is mentioned hydrogen – "*alternative fuels - fuels or energy sources that serve, at least in part, as substitute for fossil fuel sources in the supply of energy for means of transport and which have the potential to contribute to their decarbonisation and to improve the environmental performance of the transport sector. These mainly include:*

- electricity; - ***hydrogen;*** *- biofuels, as defined in art. 2 lit. d) of Law no. 220/2008 for establishing the system for promoting the production of energy from renewable energy sources, republished, with subsequent amendments and completions; - synthetic and paraffinic fuels; -natural gas, including biomethane, in gaseous (compressed natural gas, hereinafter referred to as CNG) and liquefied natural gas (liquefied natural gas, hereinafter referred to as LNG); - liquefied petroleum gas, hereinafter referred to as LPG;"*

Also, as stipulated in Law 123/2012, in the case of natural gas producers, mentions that they can be *"natural or legal persons whose purpose is the production of natural gas of biogas / bioliquid, hydrogen or other types of gas"*

However, this is a law dedicated mainly to urban and short-distance mobility as Chapter 3 refers to the supply of electricity, hydrogen and natural gas for transport. With law 155 on 2020, which amends law 123 of 2012, are specified several elements regarding hydrogen, among which the attributions of the relevant ministry which *"elaborates, in collaboration with ANRE, the legislation for the promotion of electricity production from renewable sources, unconventional sources and high-efficiency cogeneration, as well as technologies on hydrogen use, energy storage promotion and electromobility "*and" *monitors and evaluates the adequacy of resources in Romania, develops programs on diversification of primary energy sources, especially for energy recovery from renewable sources, unconventional sources, biomass, hydrogen, proposing measures to the Government in this regard; "*

Also on this occasion were mentioned the hydrogen production installations in the section of authorizations and licenses.

The conclusion is that there are definitions about hydrogen and renewable energy but they are not put together, which creates ambiguities and difficulties in developing programs and projects regarding the concept of power to gas.

5.1.8 SERBIA

Parliament of Serbia, at its session held on 20 April 2021, adopted the Law on Amendments to the Energy Law (OJ RS 40/2021). Amendments did not include specific definition of P2G plant, however, the Law, for the first time, introduced electricity storage into the Serbia's energy legislation. It should be noted that bylaws, which should specify the rules, regulations and requirements for implementation of the Energy Law have not been drafted/adopted yet.

5.1.8.1 CLASSIFICATION OF THE P2G PLANT IN THE ELECTRICITY-SIDE MODEL

According to the provisions of the Energy Law, P2G plant in the electricity-side market model can be classified as:

- Electricity storage
- Consumer / Final consumer
- System user
- Electricity Market participant.

A) P2G plant as electricity storage

In case when P2G plant performs reconversion to electricity, it can be considered as electricity storage. Electricity storage is defined in the Energy Law (art.2 para 67a) as a facility for deferring the final use of electricity to a moment later than when it was generated, i.e., the facility for the conversion of electrical energy into other form of energy, the storing of such energy, and the reconversion into electrical energy[61].

According to the Energy Law, electricity storage is entitled to perform following activities (art.210a):

1. Buying and selling of electricity
2. Provision of electricity storage services for the third parties
3. Provision of ancillary services to electricity DSO's and TSO's based on contractual agreement.

Electricity storage facilities are obliged to arrange balancing responsibility with DSO or TSO, comply with the provisions of distribution/transmission grid code, and to submit required data to DSO/TSO.

Storing of electricity is defined as energy activity (art.16 para 8a), and requires license issued by AERS (Energy Regulatory Agency of the Republic of Serbia). Rulebook on issuance of licenses and certification (prepared and adopted by MoME) still needs to be amended, to include specific conditions for issuance of license for electricity storage.

Energy permit is not required for the operation of electricity storage facility (art.30).

As stipulated in art.37a, facilities for storing electricity can be assigned the status of strategic projects, PECI or PMI project (Energy Community), by the decision of the GoS. Conditions for getting the status of strategic project will be prescribed by the bylaw which should be adopted by the GoS (Decree).

Key benefit for getting the status of strategic energy project is provided support of state institutions in the implementation of the project (e.g., fast-track permitting procedure, land use agreements, etc.)

Art.140 defines that facilities for energy storage connected to the distribution grid does not require construction permit, but distribution grid connection approval only, issued by DSO. DSO is obliged to connect energy storage facilities within 7 days from the day of fulfillment of following conditions:

1. Issued connection approval by DSO
2. Acquired facility usage permit (issued as a proof of meeting technical and safety requirements)
3. Concluded supply contract with the electricity supplier
4. Arranged access to the electricity system and balancing responsibility with DSO.

[61] Transposition of the Directive (EU) 2019/944

It should be noted that grid connection procedure for energy storage facilities connected to the transmission grid will be defined in the separate legislative document (Decree), which should be prepared by MoME and adopted by the GoS. This procedure is still pending.

Energy storage is also defined as system user (art.2 para 30) and participant in the electricity market (art.169 para 11).

B) P2G plant as consumer or final consumer

Due to fact that P2G plant requires purchasing of electricity for its operation, it can be considered as a consumer (a legal or natural entity that purchases energy for its own use or for further sale), or final consumer, which is defined in the Energy Law (art.2 para 31) as legal or natural entity that purchases electricity for its own use.

Final consumers are obliged to use electricity in line with conditions defined in a supply contract, and for the purpose defined in the grid connection approval.

Final consumers are entitled to freely choose their supplier at the market and have right to a supply contract or full supply contract. In case of a supply contract, final consumer can sign the supply contract with more than one supplier, while in the case of full supply – final consumer can sign the supply contract with one supplier only.

Full supply of electricity means that amount of electricity supplied is not determined by the supply contract but depends on the metered consumption. Final consumer with the signed contract for a full supply of electricity are transferring their balancing responsibility to a supplier.

Besides of having right to be supplied through transmission or distribution line, final consumers have right to electricity supply via direct line - when access to the grid is not approved by the operator.

C) P2G plant as system user

According to the provisions of the Energy Law, P2G plant can also be considered as a system user due to fact that P2G plant requires connection to electricity transmission or distribution grid.

System user (art.2 para 30) is defined as electricity or natural gas generator, final consumer whose facility is connected to the system, prosumer, electricity storage, aggregator, supplier, wholesale supplier of electricity, and other system operators.

D) P2G plant as electricity market participant

P2G plant has right to participate in the organized electricity market i.e. institutionally arranged relation between demand and supply of electricity, as defined in the Energy Law.

The art.210a of the Energy Law defines that electricity storage can offer services in the organized electricity market, to the third parties i.e. other market participants, and ancillary services to DSO's and TSO's based on contractual agreement. This is also applicable to P2G plant.

5.1.8.2 CLASSIFICATION OF THE P2G PLANT IN THE NATURAL GAS-SIDE MARKET MODEL

According to the provisions of the Energy Law, P2G plant in the natural gas-side market model can be classified as:

- Consumer / Final consumer
- System user

- Market participant.

A) P2G plant as consumer or final consumer

In order to feed the hydrogen or synthetic gas into gas grid, they should be mixed with natural gas (natural gas blending) according to Serbian legislation. For the reason of purchasing natural gas for blending, P2G plant will be classified as consumer or final consumer.

Consumer is a legal or natural entity that purchases energy for its own use or for further sale, and final consumer, which is defined in the Energy Law[62] (art.2 para 31) is legal or natural entity that purchases natural gas for its own use.

B) P2G plant as system user

According to the provisions of the Energy Law, P2G plant can also be considered as a system user due to fact that P2G plant requires connection to natural gas grid, to feed hydrogen or synthetic gas into gas grid.

System user (art.2 para 30) is defined as natural gas generator, final consumer whose facility is connected to the system, public supplier of natural gas, wholesale supplier of natural gas, and other system operators.

C) P2G plant as natural gas market participant

P2G plant has right to participate in the natural gas market, as natural gas producer or supplier, where natural gas is traded between participants based on the contracts, given that organized and institutionally arranged natural gas market is not yet established in Serbia.

5.1.9 SLOVAKIA

There is not a legal definition for P2G in place. Based on the information from the Ministry of Industry of Slovak Republic, there is no classification for P2G because there was no real demand for creating rules explicitly for P2G technology yet. So far, the closest classification that can be used is a hydrogen utilization technology - "P2G" technology that uses electricity to produce gaseous fuel. In June 2021, the Ministry of Economy, which is responsible for the development of an implementation strategy for renewable energy and the overall decarbonisation of the Slovak industry and transport, finalized a non-legislation document “National Hydrogen Strategy”.

The information provided in this document will therefore be based on several laws**:** the Energy law 251/2012 Coll.[63] and on the amendment of certain laws, Act no. 250/2012 Coll. [64] on regulation in network industries and supplemented by the 309/2009 Coll. on the promotion of renewable energy sources and high-efficiency of electricity cogeneration and amending certain laws which specifies the rules and conditions for supporting the rights and obligations of producers of 1. electricity from renewable energy sources, 2. electricity from cogeneration, 3. electricity from high-efficiency cogeneration and 4. biomethane.

P2G is not legally classified at the moment. However, based on the law 251/2012, we can clasify P2G plant as:

1. Electricity consumer

Based on the explanation within the valid existing law no. 251/2012 Coll. and Act no. 250/2012 Coll. "Final (vulnerable) electricity customer" means a domestic or non-domestic electricity customer or an electricity

[62] Definition of the final consumer in the Energy Law (art.2 para 31) applies to both electricity and natural gas consumers
[63] 251/2012 Coll On Energy And On Amendments To Certain Acts https://Www.Slov-Lex.Sk/Pravne-Predpisy/SK/ZZ/2012/251/#Predpis.Clanok-6
[64] 250/2012 Coll On Regulation In Network Industries https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/250/

customer for the operation of social services facilities registered in the social services register or for the operation of social protection facilities for children and social guardianship, as well as electricity generation facilities, facilities used to convert various energy sources into electricity; which includes the construction and technological part, intended for own consumption of electricity.

Within the P2G concept, it is necessary to use an electric source to provide energy for biological methanation. Ideally, this would be ensured by a surplus from renewable energy sources. In any case, a P2G hub can be classified as a consumer of electricity.

2. Gas producer

Based on the explanation within the § 2 section c) law no. 251/2012 Coll. gas producer: includes the extraction of natural gas or the production of biogas, the production of gas from biomass or the production of gas from another gaseous hydrocarbon, natural gas, operates a production network for the extraction of natural gas or produces biogas, gas from biomass or gas from gaseous hydrocarbons according to this Act.

Since the main product of the P2G hub is biomethane, which can be mixed or fed into the gas distribution network, we can classify the P2G hub as a gas producer. Biogas is legally defined in accordance with § 2 Act no. 309/2009 Coll.[65] as a gas for energy use, produced from biomass by fermentation. It is not the same as biomethane, which is defined as treated biogas that has technical parameters comparable to the technical parameters of natural gas. However, a gas producer is also defined as a producer of gas from biomass, which is specified in more detail in 309/2009 Coll. as biomethane as one of the options.

5.1.10 SLOVENIA

Currently, there is no independent act or regulatory provision in Slovenian legislation that addresses P2G plants directly. Information linked to P2G will be mainly sourced from the Slovenian key energy-related acts that are listed below; however, the energy legislation is under an ongoing change, and new regulatory acts are expected to be passed soon.

Key energy-related laws in the Republic of Slovenia:

- Energy Act 2014 *(Energetski zakon)*,
- Electricity Supply Act 2021 *(Zakon o oskrbi z električno energijo/ZOEE)*,
- Gas Supply Act 2021 (Zakon o oskrbi s plini/ZOP),
- Act on Energy Efficiency 2020 *(Zakon o učinkoviti rabi energije/ZURE)*,
- Act on the Promotion of the Use of Renewable Energy Sources 2021 *(Zakon o spodbujanju rabe obnovljivih virov energije/ZSROVE)*.

For the purposes of this report, the research will be based on an existing act and regulatory provision as well as on the overview of current energy-related bills that were recently open for public feedback but have not been passed yet. Namely, the Energy Act – the energetics framework legislation – will be due to its extensiveness and to transponse EU legislation to national legislation, divided into several laws: Electricity Supply Act (Zakon o oskrbi z električno energijo), Energy Policy Act (Zakon o energetski politiki), Heat Supply Act (Zakon o oskrbi s toploto) and Gas Supply Act (Zakon o oskrbi s plini). Call for public feedback on these bills was open until 12th November 2020 for Electricity Supply Act and until 10th June and 1st September for rest of above-mentioned acts. While Electricity Supply Act has been passed at the end of October and has entered into force on 13 November 2021 and the Gas Supply Act entered into force on 12th

[65] 309/2009 Coll On The Promotion Of Renewable Energy Sources And High-Efficiency Cogeneration And On The Amendment Of Certain Laws https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/309/20210101

January 2022, the date for the rest of the bills it's not known yet, but it is expected that soon these acts will be passed in accordance with the regular legislative procedure.

Note: The solutions in the proposal versions of individual draft regulations that were reviewed for this report, will not necessarily be part of the adopted regulation.

Since P2G technologies are at the interface between the electricity and gas sectors, both the Electricity Supply Act and the part of the Energy Act related to natural gas and electricity sectors as well as additional energy-related legislation related will be reviewed.

5.1.10.1 CLASSIFICATION OF THE P2G PLANT IN THE ELECTRICITY-SIDE MARKET MODEL

Below is presented the list of some definitions from general provisions of the The Electricity Supply Act[66] that could be linked to P2G plant on electricity side market model:

- electricity distribution system operator (hereinafter: the electricity DSO),
- electricity transmission system operator (hereinafter: the electricity TSO),
- electricity system operator,
- final customer,
- customer,
- operator,
- energy storage,
- energy storage facility.

As mentioned in the previous chapter, the currently valid Energy Act and the implementing regulations issued on its basis do not contain provisions that would directly regulate P2G technologies; however, further provisions related to energy storage can be found in the recently adopted Electricity Supply Act 2021.

The Electricity Supply Act lays down the rules for the operation of the electricity market, production, transmission, distribution, **storage** and supply of electricity, together with provisions for the protection of final customers, methods and forms of public utilities in the field of electricity transmission and distribution and the electricity market, principles and measures to achieve security of electricity supply, regulates measures to prevent energy poverty and other issues of electricity supply. Compared to the previously valid electricity-related provisions of the Energy Act, in the Electricity Supply Act some definitions with adding words or word phrases linked to energy storage were expanded. In the Electricity Supply Act, an "electricity undertaking"[67] means a legal or natural person carrying out at least one of the following functions: generation, transmission, distribution, aggregation, adjustment of consumption, **storage of energy**, electricity market operator function, electricity system operator, supply, or purchase of electricity, and is responsible for the commercial, technical and maintenance tasks related to those functions, but does not include final customers. It also expands the definition of the "system user", which by this bill means a producer, final customer, or **energy storage operator**. To the list of electricity activities, Electricity Supply Act among others adds the activity of energy storage. The Electricity Supply Act additionally defines ***"energy storage facility"***, which means in an electricity system, a device in which energy is stored and ***"energy storage"*** as the postponement of the end use of produced electricity, the conversion of electricity into a form of energy that can be stored, the storage of such energy and the subsequent conversion of that energy into electricity or use as another energy carrier.

[66] Article 1, Electricity Suppl Act 2021
[67] Article 4, Electricity Supply Act 2021

The word storage in the first part of Energy Act, namely the Article 28 that concerns the Renewable sources Action Plan stipulates that: *»The renewable sources action plan shall also cover appropriate measures for the development of network infrastructure for the transmission and distribution of intelligent network services,* ***the development of storage facilities*** *and of an electric power system that enable the safe operation of the electric power system and its adaptation to further developments in the field of electricity generation from renewable energy sources, including the interconnections among European Union Member States and among European Union Member States and third countries.«*

While it should be questioned whether the P2G installations are to be interpreted within the definition of "energy storage" and "energy storage facility" in the Electricity Supply Act 2021, a P2G could be classified as an electricity system user or end consumer e.g. final customer. A P2G plant purchases electricity for its use and thus fits into the definition of the system user, which means an electricity producer, final customer or energy storage operator. It also fits in the separate definition of final customer, who as a natural or legal person buys energy for own final consumption.

5.1.10.2 CLASSIFICATION OF THE P2G PLANT IN THE GAS-SIDE MARKET MODEL

As the *Part III Natural gas* of the Energy Act is similarly to electricity part not valid anymore, primarily a newly adopted legislation related to the gas sector – Gas Supply Act - will be reviewed to establish potential "classification" and wording related to the term P2G plant.

P2G plant could be classified in some of the areas in which legal and natural person of public and private law carry out activities of the energy sector according to the Energy Act. Below are presented some further definitions from the Gas Supply Act[68] that could be linked to P2G plant on gas side market model:

- gas distribution system operator (hereinafter: the gas DSO),
- gas transmission system operator (hereinafter: the gas TSO),
- gas system operator" is a natural gas TSO or DSO,
- energy retail sale undertaking,
- supplier,
- producer,
- horizontally integrated undertaking,
- storage,
- storage system operator,
- natural gas undertaking,

Apart from above-mentioned definitions and wording that can be indirectly linked to P2G plants, the Gas Supply Act contains some provisions and wording more closely linked to P2G plants. Contrary to the Energy Act, the current version of the Gas supply bill states that the provisions of this law apply to all types of gases, **including hydrogen**, if they can be technically safely injected into the system and transferred through it. The bill also contains articles[69], which address the adjustment plan for the uptake of gases from renewable sources into the system. According to Article 3, the term "gas" defines a common term for gases transmitted through a system and may be formed of a mixture of gases of renewable and fossil origin, the majority of which is methane. Considering the expansion of the wording in these new provisions, it could be claimed that Draft Supply Act provisions should apply for P2G plants as well; however, there is no clear definition of P2G nor P2G plants within the act.

[68] Article 3 and 159, Gas Supply Act 2021
[69] Articles 7 and 146, Draft Gas Supply Act

Additional hydrogen and other gases-related wording can be found in the Act on the Promotion of the Use of Renewable Energy Sources 2021 and in the Decree on the energy infrastructure 2016.

In the Act on the Promotion of the Use of Renewable Energy Sources 2021, the »Fuel supplier" however means any legal or natural person who sells to the final customer fuel, biofuel, a mixture of both fuels, hydrogen, or electricity for use in transport. A fuel supplier is also a producer of fuel, biofuels, mixtures of both fuels, **hydrogen or electricity**, their importer from third countries or their acquirer in the Member States of the European Union (hereinafter: the EU), if he uses it as a final customer.

The Decree on the energy infrastructure 2016 defines the types of facilities, installations, networks and systems that are part of the energy infrastructure. Articles 3 to 9 more explicitly state components of energy infrastructure for electricity generation, electricity transmission, electricity distribution, natural gas production, natural gas transmission, natural gas distribution. Beside all components of electricity/gas production/distribution/transmission, the energy infrastructure[70] are also facilities, networks and devices for:

- production and distribution of heat for district heating,
- distribution of liquified natural gas and
- distribution of other energy gases, which have a total rated power of connected customer devices on the network of more than 500 kW.

A review of the gas-related legislative framework in Slovenia and the fact that the P2G plant generates gas(es) from electricity implies that on the gas-side part, a P2G plant could fit best in the definition of system user and gas producer. The Gas Supply Act defines the system user as a natural or legal person feeding in, supplying to, or being supplied by, the system; while the producer is a legal or natural person who produces gas of suitable quality for the uptake into the system and delivers it to the transmission or distribution system to the supplier under a supply contract following the conditions of the system operator.

In the process of reviewing Slovenian energy legislation, there could not be found provisions that explicitly refer to or define P2G. If the P2G installations are to be interpreted within the definition of “energy storage” and “energy storage facility” in the Electricity Supply Act 2021, it is to be questioned whether the definition is specific enough or it should be amended. While P2G facilities play an important role in energy-storing, the definition for energy storage facilities applies to facilities in an electricity system while not addressing relation to gas storage. P2G facilities can be part of the electricity system only (electricity users); however, they can be also connected to the electricity and gas networks at the same time (electricity users/gas producers). If P2G systems are to be considered as integrated energy systems, fragmentation and separation of electricity and gas sector regulation from the legislative perspective could be seen as an obstacle as it does not coordinate sectors and does not fully consider the impact of one system usage has to other systems.

Identified barriers:

- lack of P2G definition in national legislation
- the clarity of definition of energy storage (facility) in electricity supply act 2021
- electricity and gas sector fragmentation from the legislative regulation perspective

[70] Article 9, Decree on the energy infrastructure 2016

5.2 (RENEWABLE) HYDROGEN AND 'RENEWABLE NATURAL GAS'

5.2.1 AUSTRIA

Central definitions in the gas sector are provided in the NGSA 2011. Renewable hydrogen is therefore that which is produced exclusively from energy from renewable energy sources. [71] "Energy from renewable energy sources" is in turn defined as energy from renewable, non-fossil energy sources, i.e. wind, solar (solar thermal and photovoltaic), geothermal, ambient, tidal, wave and other ocean energy, hydropower and energy from biomass, landfill gas, sewage treatment plant gas, biogas and renewable gas.[72] Renewable hydrogen is covered by the definition of renewable gas. In addition, the definition of renewable gas also covers gas from biological or thermochemical conversion produced exclusively from energy from renewable sources, as well as synthetic gas produced on the basis of renewable hydrogen.[73] The definition does not depend on the origin of the carbon dioxide used in the production of the synthetic gas.

5.2.2 BULGARIA

There is a definition for "gas from renewable sources" (GRS) found in the Energy from Renewable Sources (ERS) Act. Definition states that such type of gas is "a gaseous fuel produced from biomass and / or from biodegradable fractions of waste that can be purified until it reaches the quality of natural gas intended for energy purposes, including electricity, heat and cooling, and for use as a biofuel." So, as long the above provisions are fulfilled, one can claim that one is a producer of gas from renewable sources with all the consequences and rights that arise from the production of such substance. For the case of P2G hub, achievement of natural gas quality is reached with the utilization of hydrogen, obtained from water electrolyses. In that respect, the P2G hub is classified as a producer of GRS.

Bulgarian legislation also has a definition for "green hydrogen", found in the Energy Act. It is "hydrogen that has been produced by electrolyses or by other means that use energy from renewable sources. Electric energy that has been used for the production of green hydrogen has to have a Guarantee of Origin from a renewable energy source."

5.2.3 CROATIA

Hydrogen and biomethane are not defined in Croatian legislation; however, there is a reference to these gases in certain legal documents. The best-fitting legislation for the classification of hydrogen and 'renewable natural gas' would be the **Gas Market Act (OG 18/18, 23/20)**. This act regulates the gas market in Croatia, mainly focusing on natural gas because it is the only gas used and traded in Croatia. This Act regulates energy activities such as natural gas production, transmission, storage, liquefied natural gas (LNG) terminal management, gas distribution, gas market organization, trade, supply, and management of the LNG and/or compressed natural gas (CNG) supply points.

Other gases in the distribution system are only mentioned in the Article 85: *"Distribution system located in a geographically limited industrial and/or commercial area which distributes gas to final consumers who are not household consumers, as well as distributes mixed liquefied petroleum gas, evaporated liquefied petroleum gas, city gas, biogas or biomass gas may be defined as a closed distribution system".*

There have been some projects and discussions on the decision-maker level about opportunities to utilize biogas and biomethane into the gas grid (**Big East** and **BiogasAction** projects). Further projects and various

[71] Cf. § 7 (1) (16a) NGSA 2011.
[72] Cf. § 5 (1) (13) REEA.
[73] Cf. § 5 (1) (16b) NGSA 2011.

scientific research have been conducted on the topic of inserting hydrogen and biomethane (from P2G plants) into the gas grid, which will, hopefully, encourage decision-makers to develop new laws and acts, which would include hydrogen and biomethane. Currently, the lack of reference to hydrogen and biogas in the gas grid and their features are defined within the Energy Strategy.

Considering (renewable) hydrogen and renewable natural gas (biomethane) and their production, one can discuss the contents of the **Electricity Market Act (OG 111/21)**, which regulates the electricity market in Croatia. This Act incentivises the production of electricity from renewable energy sources and waste heat, i.e., producer of such energy acquires the status of eligible electricity producer (Article 47 (1)):

"Electricity entity or other legal entity or a person that simultaneously produces electricity and heat in a single generation plant in a highly efficient manner, uses waste or renewable energy sources to produce electricity in an economically appropriate manner in accordance with regulations in the administrative field of environmental protection, regardless of the plant's power may acquire the status of eligible electricity producer."

The produced electricity from aforementioned eligible electricity producers is completely sold on the market. The production and distribution on the market is determined by the balance group. The obligation to ensure and control the takeover of the total produced electricity is on the Transmission System Operator or the Distribution System Operator. The electricity market in Croatia, which must be a liquid one, includes the retail and wholesale electricity markets. Purchase and sale on the wholesale electricity market are contracted through bilateral agreements and the organised electricity market (Article 52):

"Contractual electricity market is a market in which the purchase and sale of electricity are performed directly between participants in the electricity market based on a bilateral agreement on the purchase and sale of electricity."

Even though the possibility of using the produced RES electricity directly for hydrogen production on-site is not specifically mentioned within the Electricity Market Act, there is a possibility of purchasing RES electricity in the electricity market for hydrogen production. The same situation is with the Gas Market Act, where P2G can be classified as a gas buyer – in order to implement activities of hydrogen/biomethane injection. However, the activities of mixing itself are not determined within the aforementioned act.

5.2.4 CZECH REPUBLIC

"Renewable hydrogen" and "Renewable natural gas" are not defined in Czech legislation (Law 382/2021 and Law 362/2021). "Renewable energy sources" are exhaustively defined by the Act on Supported Energy Sources (law 165/2012). "Renewable fuels in transport" are regulated by the Air Protection Act (law 201/2012). Hydrogen is an "alternative fuel" under the Fuel Act (law 311/2006). Under certain conditions it would be possible to apply the definition of "alternative fuel" within the meaning of the current Fuel Act (law 311/2006) so its consumption would be a little less taxed since the hydrogen-running vehicles are exempt from the obligation to purchase highway vignettes (law 13/1997).

Terms "Renewable hydrogen" and "Renewable natural gas" are not known to Czech legislation (Law 382/2021 and Law 362/2021). However, creative interpretation allows infer that once "renewable natural gas" meets all the technical criteria (Act 362/2021) of "natural gas" it can be considered as natural gas.

In the Czech Republic, there are basically two types of energy gases, depending on the method of their distribution. Natural gas, originating from underground production, is distributed through the pipelines of the gasification system. Compressed or liquefied petroleum gas (LPG, propane butane) or compressed or liquefied natural gas (CNG, LNG) is supplied in cylinders. Hydrogen is primarily a technical gas and an already defined alternative fuel in transport. The legal regulations concerning energy gases are part of the Energy Act (law

458/2000) and the requirements for connection of a gas production plant are specified in law 488/2021 which defines the conditions for connection to the gas system. Each connection to the distribution system is assessed in terms of capacity and technical requirements.

Terms “Renewable hydrogen” and “Renewable natural gas” are not known to Czech legislation (Law 382/2021 and Law 362/2021). However, creative forms of interpretation allow infer that these could meet the criteria of “supported energy sources” (laws 362/2021 and 165/2012). Energy from “renewable sources” is categorized by the Act on Supported Energy Sources (law 165/2012), which introduces the term "biomethane" produced from biomass. Thus, no such category currently exists in the Czech legislation.

5.2.5 GERMANY

The Renewable Energy Act (Erneuerbare-Energien-Gesetz) uses the term „green hydrogen“ („Grüner Wasserstoff“) instead of renewable hydrogen. § 93 Renewable Energy Act authorizes the legislator to define requirements for the production of “green hydrogen”, in order to ensure that green hydrogen is „hydrogen that has been credibly generated with electricity from renewable energy sources and which is compatible with the objective of sustainable development of energy supply”[74]. An ordinance issued in July 2021, the legislator provides a definition. Hydrogen is only then considered to be green hydrogen, if it has been produced within the first 5.000 full utilization hours of a calendar year in the facility of production by the exclusive usage of electricity. The consumed electricity has to come from renewable sources and 80% of which have to come from plants with location in the German price area.[75] Further, the electricity must not have been subsidized. The production of green hydrogen can result in the exemption of the so-called EEG levy (see 2.6).

The classification only of hydrogen produced through electrolysis is criticised in a position paper of the Research Network Bioenergy (BMWi-Forschungsnetzwerk Bioenergie). Hydrogen can be gained through thermochemical processes reforming methane. This kind of hydrogen is classified as “turquoise” hydrogen. This classification aims at the usage of fossil methane, but the reforming of renewable natural gas also falls under this term. The experts of the Research Network Bioenergy therefore demand to define hydrogen gained from biomethane as green hydrogen.[76]

The German Association of the Gas and Water Industry (Deutscher Verein des Gas- und Wasserfachs, DVGW) provides the regulations for natural gas and defines renewable natural gas as gas gained from biomass that has been processed and is therefore suitable for injection into the gas grid.[77] In the Renewable Energy Act, RNG and synthetic methane are not mentioned at all. The term “biomethane” is defined as every biogas that has been processed and injected to the gas grid.[78] Biomethane is also mentioned in § 3 Nr. 21 EEG and therefore falls under the classification of “renewable energies”. Biogas is defined as gas gained from anaerobic digestion of biomass.[79]

In the Energy Industry Act, biomethane falls under the definition of biogas: “Biomethane, gas from biomass, landfill gas, sewage treatment plant gas and mine gas, as well as hydrogen produced by water electrolysis and synthetically produced methane, if the electricity used for electrolysis and the carbon dioxide or carbon monoxide used for methanation can each be shown to come predominantly from renewable energy sources”[80]. It is broadly assumed that “predominantly from renewable energy sources” refers to a percentage of at least

[74] § 93 (2) EEG
[75] Cf. BT 19/29793
[76] Cf. Research Network Bioenergy 2021
[77] Cf. DVGW G 260, p. 10
[78] § 3 No. 13 EEG
[79] § 3 No. 11 EEG
[80] § 3 No. 10c EnWG

80%. Since this line is not explicitly expressed in the law text, there might be exemptions in individual cases with a usage of less than 80%.[81]

While the definition of biogas and biomethane in the Renewable Energy Act and the Energy Industry Act don't require reconversion into electrical energy, the term "storage gas" ("Speichergas") of the Renewable Energy Act seems to aim at reconversion. Storage gas is every gas used for intermediate storage of electricity. In this case, the electricity has to come 100% from renewable sources.[82] In case of reconversion, subsidies might apply.

RNG is a so called "replacement gas" (Austauschgas)[83] – after the biogas has been processed in order to increase the methane share, e.g. through methanation processes. The gas qualifies as replacement gas if it fulfils the requirements of DVGW G 260 and only contains accompanying substances listed in table 3, DVGW G 260. The RNG can then replace the natural gas in the grid with a share of up to 100% (see also 2.4).

Renewable natural gases belong to the second gas family (2. Gasfamilie, methane-rich gases) and are divided into the groups L (low) and H (high) according to the Wobbe indices:

- L-gas: Wobbe index of 44.6 MJ/m^3 (deviation of +2.2/-5.0 MJ/m^3 / +0.6/-1.4 kWh/m^3 allowed)
- H-gas: Wobbe index of 54.0 MJ/m^3 (deviation of +2.2/-5.0 MJ/m^3 / +0.7/-1.4 kWh/m^3 allowed)

5.2.6 HUNGARY

Renewable hydrogen and renewable natural gas so far do not appear in the Hungarian legal framework, however for the evaluation of future legislation, we shall examine the closest defined concept which is biogas. Since P2G produced, bio-based methane is essentially biogas, this example is highly fitting.

In the Natural Gas Supply Act, under provision 3. § section 33. the definition of natural gas producer mentions „biogas", as under the Hungarian law, a natural gas producer is a legal or natural person who produces several types of gas, on a commercial basis, from biogas or biomass. The government decree nr. 165/2016. (VI. 23.) on mandatory feed-in and premium - supports electricity produced from renewable energy sources and introduces financial incentives – which will be introduced in the later chapter - for actors generating electricity using biomass or biogas, although neither the Natural Gas Supply nor the government decree clarifies the definition of „biogas".

For finding a term similar to the definition of renewable hydrogen or renewable natural gas, we shall examine the following regulation. The act CXVII of 2010 on the promotion of the use of energy from renewable sources in transport and the reduction of greenhouse gas emissions from transport is introducing the term of „alternative fuel" which is defined as the following: in the energy supply of transport, fuels or energy sources that at least partially replace petroleum sources, including electricity, hydrogen, biofuels, synthetic and paraffinic fuels, natural gas (including biomethane) in gaseous (compressed natural gas - CNG) and liquefied (liquefied natural gas), liquefied propane-butane gas (LPG), which has the potential to contribute to the decarbonization of the transport sector and improve its environmental performance.

Whereas several terms can be found, which could be potentially applicable for renewable hydrogen or renewable natural gas, the Hungarian legislation is expected to implement these definitions following the EU's legislative steps.

[81] Cf. Lietz 2017, p. 232
[82] § 3 No. 42 EEG
[83] DVGW G 260, p. 10, and DVGW G 262, p. 11

The European Union's and Hungary's Hydrogen Strategy's aim is to create a renewable hydrogen definition which shall apply in all of the member states of the European Union.

While the legal framework does not mention the exact term of „renewable hydrogen" nor any other categories under which the type of hydrogen the P2G plants generate could potentially fall, in Hungarian studies we can find several types of hydrogen defined with colors. In the following chapter we will define these different types.

5.2.7 ROMANIA

Romania takes into consideration the promotion of a demand-response mechanism and also the development of energy storage capacities. Also, there are plans for the upgrading and optimizing of the infrastructure to accommodate hydrogen and other renewable gases.

Although in various laws, including some mentioned in the previous point, there is the phrase **"natural gas",** this phrase is not followed by the word "**renewable**". The word "**renewable**" accompanies only the word "**energy**" forming the phrase - "**renewable energy**". **Natural gas** is defined in the law no.123/2012 as *"free gases from methane gas deposits, gases dissolved in crude oil, those from the gas field associated with crude oil deposits, as well as gases resulting from the extraction or separation of liquid hydrocarbons;"*

Other types of gas are also mentioned in the text of the law. In Chapter V, Article 67 the following are mentioned:

g) the energy contained in the waste fermentation gas, also called landfill gas;

h) the energy contained in the sludge fermentation gas from the wastewater treatment plants;

i) energy contained in gaseous by-products, obtained by fermentation from organic waste materials, forming the category of gaseous fuel, called biogas;

Article 100, paragraphs 46 to 49, also states:

46. compressed natural gas for vehicles (CNG) - natural gas stored in pressure vessels, by compression, for use as fuel for vehicles with heat engines;

47. liquefied natural gas (LNG) - natural gas which, following specific processes, is brought into a liquid state and stored in special containers;

48. natural gas - free gases from methane gas fields, gases dissolved in crude oil, those from the gas field associated with crude oil fields, as well as gases resulting from the extraction or separation of liquid hydrocarbons;

49. liquefied petroleum gases (LPG) - light hydrocarbon fractions derived from refining processes, crude oil stabilization plants and natural gas processing, which are normally liquefied by increasing pressure or lowering the temperature for transport or stored, having a vapor pressure not exceeding that permitted for commercial propane, consisting predominantly of the following hydrocarbons, alone or in admixture: propane, propene (propylene), butane (n-butane and / or iso-butane) and butenes (butylenes), including butadiene

Instead, there are definitions for **biomass** and biomethane in law no. 123/2012 where: *biogas - mixture of gases of biogenic origin produced by processes of fermentation, gas or pyrolysis of some organic substances;* respectively *biomethane - biogas brought to quality parameters to be used in transmission and distribution networks mixed with natural gas.* Compressed natural gas (CNG) and liquefied natural gas (LPG) are also mentioned.

Biomass is also defined in law 220/2008 where it is mentioned. "biomass - *the biodegradable fraction of products, waste and residues of biological origin in agriculture (including plant and animal substances), forestry and related industries, including fisheries and aquaculture, and the biodegradable fraction of industrial and municipal waste, codified according to legal provisions*;"

The lack of definitions for certain parameters is sometimes explained by the fact that they are not present in the law (see the case of power to gas) and the lack of definition of other elements sends the reader to the dictionary. These things have a negative impact because they increase the ambiguity and difficulties of perpetuating energy legislation.

Any of these elements, although not defined in the legislation, could fall under the definition of renewable energy. Regarding renewable energy, law 123/2012 in article 67 specifies the following: *"Definition of renewable energy sources. Under the conditions of this title, they are defined as renewable energy sources: a) wind energy; b) solar energy; c) energy of waves and tides; d) geothermal energy; e) hydroelectric energy; f) energy contained in the biodegradable fraction of products, waste and residues from agriculture (including plant substances and animal waste), forestry and related industries, as well as the biodegradable fraction of industrial and municipal, urban and municipal waste, called biomass; g) the energy contained in the waste fermentation gas, also called landfill gas; h) the energy contained in the sludge fermentation gas from the wastewater treatment plants; i) energy contained in gaseous by-products, obtained by fermentation from organic waste materials, forming the category of gaseous fuel, called biogas; j) the energy contained in liquid products obtained by distilling fermented organic matter, forming the category of liquid fuel, called fuel alcohol; k) energy obtained from other renewable sources, not currently exploited. "*

Romania signed the Hydrogen Initiative in 2018. With this, Romania is committed to continuing research and innovation into how it will use hydrogen as an energy source for the future. Hydrogen and its associated technologies are being explored for use in the electricity storage sector, the transport sector and in industry.

Hydrogen is classified as a dangerous substance for transport and is included in the list of dangerous goods as stipulated in the European Agreement concerning the International Carriage of Dangerous Goods by Road ("ADR"), which is implemented at a national level. From both legal and administrative perspectives, the same regulations apply in what concerns the storage of hydrogen as well as the storage of other flammable and dangerous gases.
Romanian authorities are taking into consideration the implementation of a number of pilot and demo projects to with the goal to promote the use of hydrogen in the production of electricity and in the industrial sectors. This aim was mentioned in the Integrated National Plan in the field of Energy and Climate Change 2021-2030, which was sent to EU Commission in 2020.

In the law of natural gas and electricity no.123/2012, the word "**hydrogen**" is present without being accompanied by the word "**renewable**". Just as the phrase "**natural gas**" is present, but not "**renewable natural gas**". But because they are considered as gases, there is the option that when they will be introduced in the legislation, they will be introduced in law no. 123/2012.

Also in the law 123/2012 on hydrogen, more precisely the hydrogen production installations are mentioned in point f in Chapter IV - Authorizations and licenses, Art. 119: Categories of authorizations and licenses.

Letter g, from the same Chapter and article stipulates the commercial operation of hydrogen production facilities.

At the moment no there are no other categories implemented under which renewable hydrogen and 'renewable natural gas' could fall. There is the gas and electricity law no. 123/2012, which also contains information in the form of chapters / articles / paragraphs / paragraphs about renewable energy. That said, any information on the types of renewable energy, hydrogen, renewable hydrogen and renewable natural gas will most likely be

passed on here. There would also be the alternative of drafting a new law for all types of renewable energy classified by source and form and supplementing with existing laws, or introducing an INTEGRATED CHAPTER, COMPLETE IN AN EXISTING LAW.

5.2.8 SERBIA

The existing legislation in Serbia contains definition of renewable hydrogen, while renewable natural gas is not defined.

5.2.8.1 DEFINITION AND CLASSIFICATION OF RENEWABLE HYDROGEN AND RENEWABLE NATURAL GAS

With the adoption of the Law on Utilization of Renewable Energy Sources (OJ RS 40/2021), GoS for the first time classified renewable hydrogen as renewable energy source (art.4 para. 29) and introduced definition of renewable hydrogen „as hydrogen used for energy purposes, produced from water electrolysis using renewable electricity[84] "(art.4 para.20).

It also defines that renewable hydrogen can be used in the heating, transport, and natural gas sectors (art.83 para.2) – while re-conversion into electricity is not foreseen.

The Law provides definition of renewable liquid and gaseous fuels of non-biological origin as fuels made of renewable energy sources other than biomass and biofuels - which are used in transport. This refers to the hydrogen, however, given that this definition limits use of hydrogen only in transport sector – linked provisions are not further analyzed.

Renewable energy sources are legally defined in the Law on Utilization of Renewable Energy Sources as "non-fossil energy sources: hydropower, biomass, wind, solar radiation, renewable hydrogen, biogas, landfill gas, sewage gas, geothermal and other types of renewable energy sources".

In addition, the Law on Amendments to the Energy Law (OJ RS 40/2021) defines hydrogen (of non-specified origin) as a motor fuel (art.2 para.41).

Renewable natural gas is not defined in the Serbian legislation. However, the Law on Amendments to the Energy Law (OJ RS 40/2021) introduced term low-carbon gases as an instrument to mitigate climate change (art.50 para.2). The Law does not provide definition of the low-carbon gases i.e. proper definition of the types and characteristics of low-carbon gases.

The literature cites biogas, bio methane, and renewable hydrogen as low-carbon gases, but this is not legally specified in the Law. It is expected that this gap will be addressed within the bylaws accompanying the Law, which are currently being drafted.

5.2.8.2 APPLICABILITY OF NATURAL GAS LEGISLATION FOR RENEWABLE HYDROGEN AND RENEWABLE NATURAL GAS

Serbian natural gas legislation is applicable for renewable hydrogen and renewable natural gas to a certain extent when it comes to the use of natural gas pipelines.

[84] Renewable electricity is indirectly defined in the Law on Utilization of Renewable Energy Sources as electricity generated using renewable energy sources (art.4 para 20)

Energy Law (art. 315 para.2) prescribes that natural gas, biogas[85] and low-carbon gases can be injected in the gas pipelines if they comply with the technical requirements (see 2.4 for more details).

Hence, the lack of definition of the low-carbon gases in the Energy Law does not provide clear picture of applicability of natural gas legislation for renewable hydrogen and renewable natural gas. In case where both renewable hydrogen and renewable natural gas would be included in the definition of low-carbon gases – provisions of natural gas legislation would be applicable.

Definition of natural gas provided in the Grid codes for natural gas transportation and distribution systems defines natural gas as hydrocarbons or a mixture of hydrocarbons and other gases which is at a temperature of 150°C and an absolute pressure of 1.01325 bar in the gaseous state. Based on this definition, it can be concluded that renewable hydrogen and renewable natural gas should first be processed to the appropriate natural gas quality before being fed into the natural gas grid.

Relevant natural gas legislation in Serbia includes:

- **Law on Amendments to the Energy Law (OJ RS 40/2021)** – provides legal framework for the transportation and distribution of natural gas, unbundling provisions, grid codes content, grid connection procedures and access to the systems, functioning of the natural gas market;
- **Law on Pipeline Transportation of Gaseous and Liquid Hydrocarbons and Distribution of Gaseous Hydrocarbons (OJ RS 104/2009)** – according to definition in the Law, the gaseous and liquid hydrocarbons include natural gas, biogas, gas from gasification plants and their mixtures, crude oil, gas condensate and gaseous and liquid oil derivatives, with prescribed physical and chemical characteristics; this Law regulates the conditions for safe and uninterrupted pipeline transport of gaseous and liquid hydrocarbons and distribution of gaseous hydrocarbons, design and construction, maintenance and use of pipelines and customer gas installations;
- **Decree on conditions for supply of natural gas (OJ RS 47/2006, 3/2010, 48/2010)** – regulates supply of final consumers of natural gas, including requirements for grid connection – as consumer only, measurement and billing of natural gas consumption, and measures for the case of distortion of supply;
- **Rulebook on technical conditions for undisturbed and safe gas transport via gas pipelines of pressure exceeding 16 bars (OJ RS, 37/2013)** – defines in details technical conditions for the construction of gas pipelines (infrastructure) of pressure > 16 bar;
- **Rulebook on technical conditions for undisturbed and safe gas distribution via gas pipelines of pressure up to 16 bars (OJ RS, 37/2013)** – defines in details technical conditions for the construction of gas pipelines (infrastructure) of pressure < 16 bar;
- **Methodology for determining the price of access to the natural gas transportation system (OJ RS 93/2012, 123/2012, 5/2014, 116/2014, 30/2015, 62/2016, 111/2017, 4/2019)** – establishes the conditions and manner of determining the maximum allowable revenues of operator of natural gas transport system, criteria and rules for the distribution of that revenue, billing/tariff elements, method of billing the transportation service, and tariffs for calculating the price of access to the natural gas transportation system;

[85] Biogas is legally defined in the Decree on getting the status of Privileged Power Producer (OJ RS 56/2016, 60/2017, 44/2018, and 54/2019) as gas produce from biomass and by-products of animal origin, in the digestors, using anaerobic processes, in accordance with veterinary regulations.

- **Methodology for determining the price of access to the natural gas distribution system (OJ RS 105/2016, 29/2017)** – establishes the method of regulating the price of access to the natural gas distribution system, tariff elements and the method of calculating regulated prices, ie tariffs, the method of calculating the distribution service and access to the natural gas distribution system, etc.

- **Methodology for determining the price of access to the natural gas storage (OJ RS 143/2014, 4/2016, 4/2019)** - prescribe conditions and manner of determining the maximum allowable revenue of natural gas storage operator, criteria and rules for the distribution of that revenue, tariff elements and the method of calculation of natural gas storage services, tariffs for access to the natural gas storage, etc.

- **Methodology for determining the price of the natural gas for public supply (OJ RS 75/2014, 105/2016, 108/2016, 29/2017)** – defines the conditions and manner of determining the maximum allowable revenue of natural gas public supplier, criteria and rules for the distribution of that revenue, tariff elements and tariffs for calculation of the price of natural gas for public supply, etc.

- **Grid code for natural gas transportation system - Srbijagas (OJ RS 139/2014)[86] –** contains the rules on the operation of the natural gas transmission system including the development of the transport system, technical conditions for connection to the transport system, quality and other characteristics of natural gas, requirements for conditions for reliable and safe operation of the transport system, rules on measurement of natural gas and necessary measuring equipment, maintenance of facilities, access to the transport system, capacity allocation and congestion management, balancing of the transport system and calculation of deviations, etc.

- **Grid code for natural gas distribution system - Srbijagas (OJ RS 139/2014)[87] –** provides the rules on the operation of the natural gas distribution system including development of distribution system, technical conditions for connection to the distribution system, quality and other characteristics of natural gas, rules on measurement of natural gas and required measuring equipment, maintenance of facilities, access to the distribution system, etc.

The existing (listed) secondary and tertiary natural gas legislation is not aligned with the new Law on Amendments to the Energy Law adopted in 2021, and drafting of updates to this legislation is ongoing activity of the Ministry of Mining and Energy of the Republic of Serbia (MoME).

5.2.9 SLOVAKIA

There is no specific legislative regulatory framework in Slovakia for hydrogen technology and projects yet.

The main legal provision governing hydrogen is § 2 (4) Act No. 309/2009 Coll. on the Promotion of Renewable Energy Sources and Highly Efficient Cogeneration and on Amendments to Certain Acts, which recognises hydrogen as a source of renewable energy: "for the purposes of this Act, a fuel produced from renewable energy sources (hereinafter referred to as "biofuel") means (i) biohydrogen, which is hydrogen produced from biomass".

Our conclusion is that renewable natural gas is in Act No. 309/2009 Coll. represented by the term "biomethane" as a renewable energy source. There are no specific paragraphs related to "renewable natural gas" and very little mention of "biomethane". Biomethane is explained (§ 2 paragraph 2 letter f) of Act no. 309/209 Coll.)

[86] There are 3 active operators of the natural gas transport systems in Serbia (Srbijagas, Yugorosgaz, and Gastrans), and each of them has adopted Grid code with the same technical requirements for the characteristics of injected natural gas
[87] There are 33 active operators of the natural gas distribution systems in Serbia, and each of them has adopted Grid code with the same technical requirements for the characteristics of injected natural gas

As treated biogas, which has technical parameters comparable to the technical parameters of natural gas. Under these conditions, the legislation applicable to natural gas is also generally applicable to biomethane. However, this cannot be said for hydrogen, nor for renewable (green) hydrogen, which is not yet really mentioned in the legislation, and if only as a fuel.

In the light of gas distribution, the natural gas legislation as it is enacted in the Act n. 251/2012 Coll. on Energy is applicable for biogas and biomethane as renewable natural gas if the distributed gas as such meets the criteria for distribution of gas enacted by distribution system operator in its Operating rules and technical rules.

The main legal regulation governing hydrogen is § 2 (4) and (5) of Act no. 309/2009 Coll. on the promotion of renewable energy sources and high-efficiency cogeneration and amending certain laws, which means biohydrogen, which is hydrogen produced from biomass and is understood as a fuel produced from renewable energy sources (biofuel). Despite its non-legislative nature "National Hydrogen Strategy Prepared for the future" can provide valuable insight into the developments in the field. According to the National Hydrogen Strategy, the Slovak Government will aim to accelerate the creation of the legislative framework and financial conditions for the implementation of hydrogen technologies. This shall be mainly achieved by the introduction of legislation and safety regulations to support the readiness of the gas infrastructure for the transport, distribution, and storage of hydrogen and removing legislative barriers to the deployment of solutions using hydrogen. [88] The key document called the National Hydrogen Strategy was approved by Slovak Government in June 2021. This document specifies the development of hydrogen industry in Slovakia, but it does not contain any specific legislation. The National Hydrogen Strategy (NVS) defines the strategic role of the state in the use of hydrogen technologies in the Slovak Republic (SR) in the context of current developments in European countries Union (EU). The aim of NVS is to increase the competitiveness of the Slovak economy and at the same time significantly contribute to a carbon-neutral society.[89]

In the light of this document Slovakia will divide hydrogen into three categories.

1. Gray hydrogen is produced in processes that use fossil fuels, especially natural gas or coal, as raw materials. Greenhouse gas emissions during the life cycle of grey hydrogen are high.
2. Blue hydrogen is produced in the same way as grey hydrogen, but the carbon dioxide produced during production is captured, stored, or further used using CCUS5 technology. Blue hydrogen can also be produced by electrolysis of water or salt solution (in the production of chlorine) using electrolysers powered by electricity from low-carbon energy sources6. In the production of blue hydrogen, greenhouse gas emissions during the life cycle must be lower than 100 g CO2eq/MJH27 (3.33 kg CO2eq/kgH_2.
3. Green hydrogen is produced by electrolysis of water using an electrolyser, powered by electricity from renewable energy sources

The document further states:

"In order to achieve the ultimate goal of decarbonization, the Slovak Republic envisages using hydrogen as an energy carrier in its industrial sectors and in public life wherever direct use of electricity is not possible or is cost-inefficient.

Therefore, hydrogen production technology must be based mainly on the use of renewable and, in the transition period, low-carbon energy sources. The goal of the Slovak government will be to support the production and use of green hydrogen as well as the necessary infrastructure for the implementation of these activities. The

[88] https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/slovakia
[89] Slovak National Hydrogen Strategy issued 1.7.2021 https://rokovania.gov.sk/download.dat?id=361F8BABC3FC4DED81622AEAC353040C-7E6A87522DA19835FF227E896470F449

production of blue hydrogen will also be supported. The goal of the SR will be to create conditions for the production of hydrogen so that the Slovak economy is as little dependent as possible on its import."[90]

Based on this document we can predict, that Slovak government will create a coherent framework for the use of hydrogen in its entire chain. It will include the production of hydrogen, its transportation, distribution and storage, as well as the use and production of products, technologies and components for the hydrogen economy, including all necessary safety features and components, explicitly for the case of this questionnaire. The next expected steps of the Government of the Slovak Republic regarding the topic of this questionnaire as stated in the National Hydrogen Strategy will be:

1. introduce general terminology and criteria for hydrogen certification

2. to create, as part of the amendment of the legal framework for the support of renewable energy sources, the conditions for issuing guarantees of origin for hydrogen produced from RES in the form of self-consumption and to create prerequisites for extending the issuance of guarantees of origin also for hydrogen produced in a low-carbon way

3. assess and propose supporting measures stimulating the readiness of the gas infrastructure for the transport, distribution and storage of hydrogen.[91]

5.2.10 SLOVENIA

So far, the main provisions that apply to natural gas undertakings and natural gas customers could be found in part three of the Energy Act, which is being substituted with separate act, Gas Supply Act. Some provisions of the act were kept from the Energy Act, while some are amended or added to improve the provisions based on experience in the implementation of the Energy Act. Gas Supply Act states that the provisions of this law apply to all types of gases, including hydrogen, if they can be technically safely injected into the system and transferred through it. The bill also contains an article which addresses the adjustment plan for the uptake of gases from renewable sources into the system. Article 7 stipulates that the system operator shall determine the technical requirements for the gas and, if necessary, for the individual gas from a mixture, including hydrogen, which may be injected into the system it operates. Draft Act[92] of the draft law also address initial adjustment plans for the injection and transmission of mixtures of gases of renewable or non-fossil origin, including hydrogen. According to Article 3, word "gas" defines a common term for gases transmitted through a system and may be formed of a mixture of gases of renewable and fossil origin, the majority of which is methane.

Apart from the Gas Supply Act, the term hydrogen is also addressed within the Act on the Promotion of the Use of Renewable Energy Sources. The act[93] defines the "Fuel supplier" as a legal person or sole proprietor who sells to the final customer fuel, biofuel, a mixture of both fuels, hydrogen, or electricity for use in transport. According to this act, a hydrogen production plant is a set of equipment and installations that produce hydrogen from low-carbon sources and can operate independently.

[90] Slovak National Hydrogen Strategy issued 1.7.2021 https://rokovania.gov.sk/download.dat?id=361F8BABC3FC4DED81622AEAC353040C-7E6A87522DA19835FF227E896470F449.
[91] Slovak National Hydrogen Strategy issued 1.7.2021 https://rokovania.gov.sk/download.dat?id=361F8BABC3FC4DED81622AEAC353040C-7E6A87522DA19835FF227E896470F449.
[92] Article 146, Draft Gas Supply Act 2021.
[93] Article 3, Act on the Promotion of the Use of Renewable Energy Sources 2021.

In the process of reviewing gas-related legislation, the renewable synthetic methane was found in the Legal Act on the methodology for determining the network charges for the natural gas distribution system[94]. It is defined such as energy gas produced with the use of electricity from renewable energy sources and is equivalent to natural gas in terms of quality specifications. A synthetic methane is additionally mentioned in the definition for the certificate of gas origin, which is with this act defined as a public document proving that a certain amount of biomethane or synthetic methane of renewable origin is produced from renewable energy sources.

6. OWNERSHIP OF P2G

In particular, due to the previously undertaken classification of P2G, there may be implications for the question of the permissibility of the operation of P2G facilities by different market players, whereby the unbundling provisions must be particularly taken into account here.

6.1 AUSTRIA

Assuming that the P2G plant does not carry out any reconversion after feeding into the natural gas grid – this step can be carried out in another power plant, for example, or omitted altogether - it is only to be classified as a gas producer or gas manufacturer and as a natural gas trader. It is not classified as an electricity producer. Accordingly, in line with the unbundling rules, a gas network operator may not operate such a plant.[95] As part of a vertically integrated natural gas undertaking[96], it must be independent in terms of legal form, organisation and decision-making from the activities of supply, sales, provision and production, in other words from those activities that are not related to distribution and transmission.

Austria has made use of the authorisation in Articles 36 and 54 ED 2019 and issued special provisions for the operation of P2G plants by electricity transmission and distribution system operators. Accordingly, they can own, construct, manage or operate P2G plants if certain conditions are met. First of all, the general conditions must be fulfilled, according to which

- the plant may have a maximum capacity of 50 MW and
- when planning the plant, it must be ensured that the aspect of sector coupling and sector integration is taken into account when choosing the location and that the plant is also capable of delivering the hydrogen or synthetic gas produced in pure form.

When meeting the criteria the following options are possible:

1. The system is a fully integrated network component and has been approved by the regulatory authority. This is to be granted if the P2G plant is integrated into the transmission or distribution grid, does not serve control energy or congestion management purposes and contributes to maintaining efficient, reliable and secure grid operation, in view of the fact that there is a technical need for it.
2. The system operator shall conduct an open, transparent and non-discriminatory tendering procedure and the outcome of that procedure shall be that no participant in that procedure has been granted the right to own, construct, manage or operate such facilities. The same result is reached if the tendered service could

[94] Article 2, Legal Act on the methodology for determining the network charges for the natural gas distribution system 2018.
[95] Cf. § 106 NGSA 2011 and § 111 NGSA 2011.
[96] According to § 7 (1) (74) NGSA 2011 that is a natural gas undertaking or a group of undertakings in which the same person or persons are entitled to exercise control, directly or indirectly, where such undertaking or group of undertakings perform at least one of the functions of transmission, distribution, LNG or storage and at least one of the functions of production or supply of natural gas.

not be provided by any participant at reasonable cost or in a timely manner. Moreover, such facilities must be needed for network operators to fulfil their obligations to maintain efficient, reliable and secure network operations and are not used to buy or sell energy on energy markets. The tendering procedure and its conditions must be assessed and reviewed by the regulatory authority and finally approved by it. In addition, the regulatory authority must carry out a public consultation on the existing P2G plants at least every five years to assess the potential for and interest in investing in them. If this consultation shows that third parties are (cost-effective) to own, operate, construct, manage these facilities, the regulator shall ensure that the activities of distribution and transmission system operators directed towards them are phased out within 18 months.[97]

6.2 BULGARIA

PFGRS cannot exert any form of direct or indirect control and cannot possess and/or exercise any form of rights over operators of transmission network who are also owners of the network (Energy Act, art. 81c).

Independence of the owner of the gas transmission network and the operator of the gas storage facility, in cases when being part of a vertically integrated enterprise, is assured by prohibition of their management to participate in companies that are producing gas from renewable sources. In that sense, managers of PFGRS cannot violate the requirements for independence for owners of gas transmission networks and gas storage facility operators by holding positions in both corporate structures of the integrated enterprise (Energy Act, art. 81n).

Integrated enterprises are categorized as vertical and horizontal (Energy Act, Additional provisions, point 27a). Vertically integrated enterprises perform at least one of the activities for transmission, distribution, or storage and at least one of the activities for production, extraction, or supply (Energy Act, Additional provisions, point 3a).

Each enterprise which acquires a transmission network, after licensing, starts to function as an operator of the network. Such enterprises are forbidden, among others, to produce gas from renewable sources (Energy Act, art. 81o).

6.3 CROATIA

Because P2G plants are negligibly addressed in Croatian laws, there are, for now, no restrictions in terms of ownership, development, management, or operation. However, Croatian laws regulate energy activities in terms of licencing. **The Ordinance on licenses for performing energy activities and keeping a register of issued and revoked licenses for performing energy activities (OG 88/15, 114/15, 66/18)** *"prescribes the conditions for issuing, extending, transferring and terminating the license for performing energy activity, the form, content and manner of keeping the register of issued and revoked licenses, and the period for which the license is issued.*" The procedure for issuing, extending, transferring and terminating the license for performing energy activities is conducted by the Croatian Energy Regulatory Agency (cro. Hrvatska energetska regulatorna agencija (HERA), hereafter Agency).

According to the Article 4 of this Ordinance:

- *"Energy activity may be performed by legal entity or person who has obtained a license from the Agency to perform energy activity."*

[97] § 22a EA 2010.

- *"The Agency may issue a license to perform energy activities to a legal entity or a person who is registered to perform energy activities in the Republic of Croatia and who meets the conditions of technical qualification, professional qualification and financial qualification prescribed by this Ordinance(...)".*

- *"(...), The Agency may issue a license to perform energy activities to a legal entity or a person who is the holder of a project of common interest which is, according to Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009 (Text with EEA relevance) (Official Journal of the European Union L 115, 25.4.2013), included in the List of projects of common interest of the European Union."*

- *"(...), The Agency may issue licenses to an active trader from a Member State of the European Union and the Contracting Parties of the Energy Community to perform certain activities in accordance with the provisions of Article 16 of this Ordinance."*

Article 15 (1) defines that *"An energy entity that has been issued a license to perform energy activities is obliged to continuously maintain the required level of technical qualification, professional qualifications and financial qualifications and other conditions on the basis of which the license to perform energy activities is issued. Activities for which it has obtained a permit in the manner prescribed by law and by-laws, and timely fulfil its obligations to other energy entities, which perform their activities as a public service."*

Register of licences is publicly available at Agency's website: **https://www.hera.hr/hr/html/registar_dozvola.html**

Additionally, following the EU legislation framework, which was transposed to the Croatian national legislation framework, unbundling provision was determined within the **Electricity Market Act (OG 111/21)**. The unbundling is the separation of energy supply and generation from the operation of transmission and distribution networks, and it is determined within the act in Articles 78 (1) and 108, where the following is stated:

Article 78 (1): "Distribution system operator, which is a part of the vertically integrated subject, needs to be independent of other activities that are not related to distribution, at least in sense of its legal form, organization and decision-making, whereas there is no obligation of ownership separation of basic distribution operator's assets from the vertically integrated subject".

Article 108 (1): "Transport system operator cannot own or develop energy storage plants, manage nor operate them".

In other words, if a single company operates a transmission network and generates or sells energy at the same time, it may have an incentive to obstruct competitors' access to infrastructure. This prevents fair competition in the market and can lead to higher prices for consumers.

Concerning the gas market, the EU legislation was also adopted into the Croatian national legislation framework and the unbundling provisions are determined within the **Gas Market Act (OG 18/18, 23/20)**. The unbundling aims to disassociate all parties involved in the gas market, to increase competition, reduce prices and allow universal access.

There are two types of activities that can be performed on the Croatian gas market: regulated activities and unregulated (free market) activities. Regulated activities include: gas transmission, gas distribution, organization of gas market, supply of gas, gas storage and LNG terminal operation. The unregulated activities

are: production of gas, operation of LNG/CNG supply site, gas trading and gas supply of end-consumers (households, services and industry). Unregulated stakeholders have the obligation to ensure the safety and reliability of supply, quality of service, environmental protection, necessary health and safety precautions and establish safety protocols for end-consumers. Having said obligations in mind, as well as Croatia's energy strategy and all other applicable laws (e.g., Law on Construction, Urban plans, etc.), the stakeholders (including producers) are equal to all other market participants and have the right to construct energy infrastructure, access to the gas system, application of market prices (or any other established prices), right to perform energy activities and the availability of information. Furthermore, a natural gas producer has the right to access the transmission and distribution networks (according to relevant laws), sell gas to natural gas suppliers, sell gas to gas traders, access underground gas storage, restrict or interrupt the supply of gas, decline access to production pipelines (owned by the gas producer).

Regarding the ownership of the gas producing plant, due to European Law and the TSO model chosen in Croatia for the gas market, none of the regulated stakeholders may participate in market activities, i.e., **the ownership, finance and personnel of all regulated activities must be strictly independent from all market activities**. For instance, Paragraph IV, Article 15 in the Gas Market Act (OG 18/18, 23/20) states:

(1) *"Transmission system operator must be the owner of the transmission system and must be organized as a legal entity independent of all other gas sector activities."*

(2) *"The owner of the transmission system acts as the operator of the transmission system."*

(3) *"Independency of the transmission system operator is guaranteed in a manner that the same person or persons cannot simultaneously:* directly or indirectly control an entity that conducts one of energy activities of production, trade and supply and energy activities of natural gas production as well as directly and indirectly control or exercise other right over the transmission system operator or the transmission system."

In relation to the classification from previous question, the possibilities for ownership of P2G are stated within the aforementioned acts – P2G has the most potential to be classified as a consumer: both electricity and gas. Therefore, it needs to follow the legislative framework that is related to these networks as any other newly planned plant and cover the costs that are related to implementation and connection to the grids. In terms of potential improvement of the legislative framework to support P2G, there are openings in the aforementioned legislative documents. However, the ownership would potentially be better determined within the specific legislative document that would be related to hydrogen and P2G.

6.4 CZECH REPUBLIC

Provided that P2G is not defined in Czech legislation, local law does not create any specific basis for assuming who could or could not be a P2G operator. However, it can only be indirectly assumed that the business entity in question should meet the conditions for (1) operating a business in the Czech Republic (Act 90/2012) and (2) holding a valid license to operate in the energy sector (provided by the Energy Regulatory Office). If the corporation holds a business license for electricity trading or gas trading granted by a competent authority of another EU member state, it may apply to the Energy Regulatory Office for recognition of this license to conduct such a business in the Czech Republic. If P2G will not be operated as a closed island circuit, it can be assumed that (3) the establishment of a large-capacity connection to the electricity grid (Law 362/2021) and (4) the establishment of a large-capacity connection to the gas pipeline (Law 362/2021) will also be required. At the moment, the Czech legislation is not ready for the "natural gas production" option.

6.5 GERMANY

In general, every natural and legal person is allowed to install, own and operate a P2G facility, provided that an application to that effect has been made and approved in accordance with the rules of public law. Especially national and regional building regulations as well as the rules of the Federal Immission Contral Act (Bundes-Immisionsschutzgesetz) might apply.[98] However, unbundling regulations are to be considered.

Unbundling regulations are described in the Energy Industry Act §§ 6 to 10e. The goal of unbundling is to assure "transparency and non-discriminatory design and handling of network operation"[99]. § 6b (3) Energy Industry Act makes sure that discrimination and cross-subsidization are excluded through the obligatory usage of different accounts for electricity transmissions, electricity distribution, long-distance gas pipelines, gas distribution, gas storage and operation of LNG plants.

In general, unbundling rules are phrased for companies operating on the electricity market, for the gas sector, there is usually a subsequent paragraph stating that the already mentioned regulations apply analogously to the gas sector. Energy supply companies that supply to 100.000 or less costumers, are excluded from unbundling rules.

Unbundling regulations mainly address vertically integrated energy supply companies; partly, unbundling also applies to legally independent network operators and operators of storage facilities.[100] "Energy supply companies" ("Energieversorgungsunternehmen") are defined as "natural or legal persons who supply energy to others, operate an energy supply network or have power of disposal over an energy supply network as the owner"[101]. § 3 Nr. 38 EnWG defines vertically integrated companies as companies or groups that performs tasks in both the competitive field (production, trade, supply) and regulated field (transmission and distribution) fields.[102]

The German legislator stated that all unbundling rules apply horizontally between the gas and the electricity sector. An electricity transmission operator is therefore not allowed to supply gas, and vice versa. Transmission operation, on the other hand, is possible for gas and electricity sectors at the same time.[103] The European Commission also supports this reading in the European law. Therefore, this interpretation is generally assumed. Still, legal experts have doubts whether the exact wording of the German law really imply such cross-sectoral unbundling rules.[104] Legal clarification should be provided within the law text.

According to the Energy Industry Act, vertically integrated companies have to ensure that affiliated distribution system operators are legally independent from other areas of energy supply activities, including energy generation in both electricity and gas sectors. Electricity distribution system operators are not entitled to own or construct, manage or operate an energy storage facility. The same applies for gas distribution system operators.[105]

Zapf argues that P2G facilities that reconvert gas into electrical energy are defined as "generators" and therefore also fall under the unbundling rules.[106] For the electricity sector, there are cases in which network

[98] Cf. Thomas 2017, p. 5
[99] § 6 (1) EnWG
[100] Cf. Lietz 2017, p. 452
[101] § 3 No. 18 EnWG
[102] For electricity: at least transmission or distribution and generation or supply of electricity; for gas: at least transmission, distribution, operation of LNG plan or storage and production or supply of natural gas
[103] Cf. BT 15/3917, p. 51
[104] Cf. Lietz 2017, p. 475-478
[105] § 7 (1), (2) EnWG
[106] Cf. Zapf 2017, p. 105

operators are allowed to own and operate a storage facility as well, as long as it is necessary for network operation and they don't participate on the free market with the stored electricity.[107] It is also questionable if unbundling rules apply in case that the vertically integrated company does not trade the stored energy (e.g. own consumption, trade only of the storage capacity).[108] The German Federal Network Agency (Bundesnetzagentur) argues in their 2015 evaluation report that gas distribution system operators are not allowed to operate P2G plants, without exceptions.[109]

Additionally to the legal unbundling, operational unbundling rules make sure that the staff, especially with management function, of a vertically integrated company is not employed and has especially no right of decision or vote in both the transmission and supply area.[110]

Persons who are directly or indirectly in control over a transmission network operator or a transmission network, are not allowed to exercise control over a company operating in the field of production, generation or supply.

The unbundling rules also apply to subsidiary companies of the vertically integrated company.[111]

Conclusion: Unbundling rules are already quite broadly defined in the Energy Industry Act. However, some clarifications are needed in order to reduce insecurities among potential investors and within vertically integrated companies. Especially with the upcoming of P2G facilities, they should be mentioned separately, considering all the different possible ways of operating such plants.

6.6 HUNGARY

As with the legal classification of P2G technologies, the operation of such plants also amounts to a degree of legal uncertainty. It is necessary to examine, whether P2G plants can be operated by any market participant, or the Hungarian legal framework makes some exceptions.

- **Hungarian „unbundling" regulation**

The 2009/72/EK directive introduced the compulsory ownership unbundling regulation in Hungary. For networks built or bought before the 3rd of September in 2009, the operators are allowed to choose between applicating the ownership unbundling regulation or to adapt to ISO or ITO models.

Independent System Operator (ISO)

In the ISO model, the network remains to belong to the vertically integrated company, while the right to operate the transmission system is being transferred to the independent system operator.

Independent Transmission Operator (ITO)

In the ITO model, the network's ownership and the right to operate the transmission system remains to belong to the vertically integrated company.

Both models require stringent measures to be taken, as for the ITO model, the company has to hire a compliance officer as well.

- **Who is allowed to own, develop, manage or operate a P2G plant?**

[107] Cf. Lietz 2017, p. 482
[108] Cf. Lietz 2017, p. 486
[109] Cf. Lietz 2017, p. 428-429; BNetzA 2015, p. 301
[110] § 7a (2)
[111] § 10b EnWG

As P2G plants purchase electrical energy and produce several types of gases, the operation and management of P2G plants shall be examined under the scope of the legal framework which regulates the end product the plant itself produces, which could be gas or electricity.

Operation, development and management of a P2G plant under the scope of the Natural Gas Supply Act

The gas market and the activities that were addressed in the unbundling procedure fall under the scope of the Natural Gas Supply Act. The Natural Gas Supply Act names 10 activities which are separated due to the unbundling requirements, although P2G plants are concerned solely about the following: transmission, distribution, storage and production. Along this structure, actors appearing on the market are separated as well as activities performed by them. Based on this, we can distinguish among vertically integrated companies and horizontally integrated companies. Vertically integrated companies are defined in provision 3. § section 41. a) in the Natural Gas Supply Act as the following: a natural gas undertaking or group of undertakings directly or indirectly controlled by the same person or persons, where at least one of the activities is natural gas transmission, distribution or storage is carried out simultaneously with natural gas transmission, distribution or storage, or is licensed to do so. A person or people directly controlling that undertaking or group of undertakings shall also be considered part of the vertically integrated undertaking.

On the other hand, we can distinguish horizontally integrated companies, which are defined under the provision 3. § section 41. b) in the Natural Gas Supply Act as the following: a natural gas undertaking which carries out natural gas production or at least one of the activities subject to a permit or prior notification stated in Natural Gas Supply Act and is engaging in other not natural gas-related activities.

The Natural Gas Supply Act defines the detailed regulations for the operation for both vertically integrated companies and horizontally integrated companies, named as „common separation rules". In provision 120/A. § (1) the Natural Gas Supply Act clarifies, with regard to the system operator members of the vertically integrated natural gas undertaking, with regard to the separation of activities and with regard to the requirement to ensure independence in its legal form and its organization and decision-making, several special rules shall apply.

In the case of natural gas transmission and system operation, natural gas distribution or natural gas storage within a vertically integrated natural gas undertaking, the organizational and decision-making independence of natural gas transmission, natural gas distribution, natural gas storage from non-natural gas transmission, natural gas distribution or natural gas storage shall be ensured.

Despite of the rich regulation for vertically integrated companies, as horizontally integrated companies engage only in one of the activities defined in the Natural Gas Supply Act, these companies are not addressed by the unbundling requirements.

Following the examination of the existing legal framework for operators falling within the scope of the Natural Gas Supply Act, the classification of P2G plants should be continued in this chapter, as it should be discussed, which existing legal form is suitable for a P2G plant operator.

For a vertically integrated company, provision 120/A. § (3) specifies the conditions which the company shall fulfill, which conditions are - including but not limited to - the following:

- the system operator may not engage in any other activity subject to a prior license stated in Natural Gas Supply Act
- the system operator, with the exception to the organized natural gas market licensee and the transmission system operator, may not acquire a share in another licensee other than its own licensee, which carries out activities subject to a prior license stated in Natural Gas Supply Act

- a senior official of the system operator, the manager of the company, a senior employee, a member of the supervisory board - in case of a natural gas distribution licensee - the executive supervisory committee - and the head of the licensing department of the company's employment contract shall be established in such way to ensure the protection of the independent decision-making affecting operation and procedures without prejudice and to be in accordance with the requirement of equal treatment

- a person with an employment may not have a shareholding in a licensee other than the system operator's licensee, its affiliated undertaking, and such person may not be an integrated natural gas undertaking.

Apart from the regulations regarding the restrictions for the personal composition and the personal composition's activities in the vertically integrated company, the facility itself shall meet the requirements - especially the expected technical conditions – as it is stated in the law.

Operation, development and management of a P2G plant under the scope of the Electricity Act

Electricity markets and competitive activities fall under the scope of the Electricity Act. Based on the activities performed by the actors on the electricity market, the law also differentiates vertically integrated and horizontally integrated companies. Vertically integrated companies are defined in 3. § provision 65. in the Electricity Act as the following: The vertically integrated company is an electricity undertaking or group of undertakings, directly or indirectly controlled by the same person or people, where the electricity undertaking or group of undertakings simultaneously carries out at least one of the production or commercial activities of transmission or distribution activities or has a license for one of these. The person or people directly controlling the electricity undertaking or group of undertakings shall be considered to be part of the vertically integrated electricity undertaking.

The 100. § (2) of Electricity Act declares in the case of transmission system operation or distribution within a vertically integrated electricity undertaking, the organizational, decision-making and distributional independence of the transmission system operator and distribution from non-transmission system operation and distribution activities shall be guaranteed. In order to ensure this independence, 100. § (3) of the Electricity Act states the common requirements to be fulfilled:

a) the network licensee may not engage in any other activity subject to a license pursuant to this Act, except for the public lighting operation activity

b) the network licensee, with the exception of the organized electricity market licensee and other network licensees, may not acquire a share in another licensee

c) the senior official of the system operator, the manager of the company, the senior employee, a member of the supervisory board - in case of an electricity distribution licensee - the executive supervisory committee - and the head of the licensing department of the company's employment contract shall be established in such way to ensure the protection of the independent decision-making affecting operation and the procedure without prejudice and to be in accordance with the requirement of equal treatment

d) The people mentioned in point c) shall not have a company share in a licensee other than the network licensee, in its affiliated company, it may not be its senior official, member of the supervisory board - in case of a distributor, a supervisory board member, company manager, nor may it establish an employment or other employment relationship

e) The manager, senior employee and a head of an organizational unit mentioned in point c) shall not be seconded to another member of the integrated electricity undertaking

f) within one year of the termination of the employment or other employment-like-relationship with the licensee, the senior offical, member of the Supervisory Board, the manager of the company or a senior employee cannot be authorized for other licensee by the MEKH.

Besides the common rules, the Electricity Act defines detailed rules for vertically integrated undertakings with a distributor member and for vertically integrated undertakings with transmission system operator.

For vertically integrated undertakings which operate with a distributor member, besides the common requirements stated above, the following obligations – stated in 101. § (1) in Electricity Act shall be followed:

- the salaries and other benefits of the chief executive officer, the manager, the member of the executive board and of the senior employee of the distributor may not be determined depending on the performance of the non-distribution activities of the vertically integrated electricity undertaking
- the distributor is entitled to take the material, financial and personal decisions necessary for the performance of its licensed activities under the Electricity Act without influence and, in accordance with the requirement of equal treatment, including daily operations, use of support activities, outsourcing of activities and construction of distribution lines, individual maintenance and refurbishment decisions. Nevertheless, the parent company of the distributor is entitled to approve the annual business plan of the distributor and to set general limits on the level of indebtedness of the subsidiary with the exception of giving instructions during the implementation of the annual business plan of the distributor in connection with the day-to-day operation, construction, maintenance or renovation.
- the distributor decides independently about the management of its cash flow within the business year or on its connection to the common payment system operated by the group of companies without influence
- the distributor must have at its disposal the necessary human and financial resources as well as physical and technical means to carry out the distribution activity
- in the communication of the distributor and in the case of the use of branding in its branding, it must distinguish itself from the vertically integrated electricity undertaking
- the distributor shall draw up a compliance program, which sets out the measures and conditions necessary to ensure non-discriminatory, independent operation. The distributor shall draw up an annual compliance report on the implementation of the compliance program, the results identified and the deficiencies.

Vertically integrated companies owning a transmission system operator shall comply with the following requirements defined in 102. § Electricity Act.

- A generation or trading subsidiary of a vertically integrated electricity undertaking shall not have any direct or indirect shareholding in the transmission system operator. The transmission system operator shall not have any direct or indirect shareholding in a generation or trading subsidiary of the vertically integrated electricity undertaking.
- The transmission system operator shall establish a supervisory board and grant the necessary authorizations to perform its duties under this Act.

As for the supervisory board, detailed regulation classifies operational and personal requirements for the members of the board.

In case, all of the obligations set out in the legal regulation is succeeded, MEKH is responsible for issuing a permit for competitive activities throughout the production and distribution chain.

Regulation for ownership unbundling requirements under the scope of the Electricity Act

If the competitive actor decides to apply the ownership unbundling rules, the Electricity Act declares several obligations to be followed:

- the transmission system operator must own the transmission network and all equipment necessary for the performance of the transmission activity, as well as the electronic communications network elements;
- the same person or people are not eligible directly or indirectly to exercise control over an undertaking performing any of the functions of production or electricity, and directly or indirectly to exercise control or exercise any right over a transmission system operator or over a transmission network, and directly or indirectly to exercise control over a transmission system operator or over a transmission system, and directly or indirectly to exercise control or exercise any right over an undertaking performing any of the functions of production or electricity trading
- the same person shall not be entitled to appoint a member of the supervisory board or a person in charge of its operational management in the transmission system operator and to exercise, directly or indirectly, control or any right over an undertaking performing any of the functions of production or trading;
- the same person may not be a person engaged in the operational management of an undertaking performing any of the functions of production or of an electricity trading undertaking, or a member of the supervisory board of an undertaking holding a transmission system operator or a holding in a transmission system operator;
- a generation or electricity trading undertaking shall not exercise any direct or indirect control or any right over the transmission system operator;
- business secrets which were previously held by a transmission system operator which is part of a vertically integrated electricity undertaking shall not be disclosed by the transmission system operator to a generation or electricity trading undertaking and shall be subject to the provisions of Article 102 / A applicable to such a transmission system operator. § (6) and (7) may not be employed by an undertaking engaged in generation or electricity trade during their employment and for 4 years after the termination of their employment, and other persons who have an employment relationship with the transmission system operator for 1 year.

As mentioned earlier, the overall unbundling system which shall be followed by competitors on the production and distribution chain is ownership unbundling. Ownership unbundling itself involves account unbundling and the Electricity Act defines the requirements of the account unbundling to be followed.

In 105. § paragraph (1) of the Electricity Act, it is stated, the integrated electricity undertaking and the multi-licensed undertaking shall, as part of their accounting policies, establish accounting separation rules and maintain separate accounting records for each of their activities, which shall ensure transparency of all activities, non-discrimination, the absence of cross-financing between activities, and prevent distortion of competition.

Regarding 105. § paragraph (2) in the Electricity Act, in the notes to the annual accounts of the integrated electricity undertaking and the multi-licensed undertaking, the licensee shall present the activity as if it had been carried out in a separate undertaking, where the licensee's separate presentation is at least a separate balance sheet and profit and loss account it means an explanation of their lines.

Due to 105. § paragraph (3) of the Electricity Act, the integrated electricity undertaking and the multi-licensed undertaking shall lay down in the accounting separation rules provided for in paragraph 2 the separation of assets, liabilities, revenues, costs and expenses and assets that cannot be clearly allocated to a specific activity. the rules for allocating depreciation between activities.

As for 105. § paragraph (4) of the Electricity Act, the integrated electricity undertaking and the multi-licensed undertaking, in the accounting separation rules it shall lay down how the separation of assets, liabilities, revenues, costs and expenses and such assets, that cannot be clearly allocated to a specific activity, shall be executed, as well as the rules for allocating depreciation between activities.

To sum up, the legal entity and the legal and economic structure of the P2G plants shall be established by complying the rules described above.

6.7 ROMANIA

Romanian legislation does not provide prohibitions or options on who can work in the field of energy as an actor, supplier or operator. As mentioned above Law 123/2012, in the case of natural gas producers, stipulates that they can be both natural and legal persons *who are into the production of natural gas of biogas / bioliquid, hydrogen or other types of gas"*

Instead, the legislation mentions the rights and obligations of producers, suppliers and operators in the energy market. They must be transparent with customers and provide them with the necessary services.

Since in the Romanian legislation in the field of energy there are no provisions regarding the power to gas concept, automatically there are no classifications, regulations regarding the owner of a power to gas power plant.

And in general, regarding the owners of power plants or natural gas, there are no passages here that would restrict the access to own a power plant. As mentioned above, it can be both a natural person and a legal person. The only condition is that it has all the licenses and authorizations it needs from the National Authority for Energy Regulations.

If the concept of Power to gas appears in the legislation, there will probably not be many limitations regarding the ownership of such a plant. If we take into account the operators / producers who deal with both natural gas and electricity, the law only mentions that they regulate the costs between the two. Law 123/2012 states: "*Economic operators who produce combined electricity and heat and who sell at least one of them will divide the costs between the two forms of energy, in accordance with regulations approved by the competent authority. "*

The only property issues that come with bans are the boundaries between producers or suppliers and energy distribution operators. "*Economic operators carrying out any activity of production or supply of natural gas shall be prohibited, directly or indirectly, from exercising control or exercising any right in respect of separate transmission system operators from other Member States of the European Union which shall apply the provisions of Article 9 (1) of Directive 2009/73 / EC of the European Parliament and of the Council of 13 July 2009 on common rules for the internal market in natural gas and repealing Directive 2003/55 / EC. "*

6.8 SERBIA

With regard to ownership of the P2G plant, two options based on different assumptions should be considered:

1. Option where P2G plant feeds into the natural gas grid
2. Option where P2G plant is performing re-conversion into electricity, feeding it into electricity grid.

Key factors that impact ownership of P2G plant, are unbundling provisions of the Energy Law:

- The electricity transmission system operator must not have control in energy entities that perform the activity of production or supply of electricity (art.98)
- The electricity distribution system operator must not have control in energy entities that perform the activity of production, transmission or supply of electricity (art.131)
- The electricity producer may also perform the activity of electricity supply (art.186)
- The natural gas transmission system operator cannot be part of a vertically integrated company and is independent of performing natural gas production and supply activities (art.224)
- An independent natural gas system operator is appointed at the proposal of the transmission system owner (Government of the RS - state ownership), and may have the right of management control over the transmission system operator, production or supply of natural gas (art.227)
- An independent natural gas transport operator may not have a direct or indirect share in a company that performs the activity of production or supply of natural gas (art.232)
- The natural gas distribution system operator must not have control in energy entities that perform the activity of production, transport or supply of natural gas (art.257)
- The natural gas storage operator may neither buy nor sell natural gas except in the case of securing its own natural gas consumption and compensating for losses in the natural gas storage (art.279)
- The natural gas distribution system operator with less than 100,000 users may also perform the activity of natural gas supply (art.297).

Most likely option for operation of P2G plant is feeding into the natural gas grid. In this case, due to unbundling provisions of the Energy Law, P2G plant cannot be owned by the natural gas transmission operator, independent natural gas transport operator, distribution system operator, the natural gas storage operator. Other energy market participants can be the owners of the P2G plant – electricity transmission system operator, electricity distribution system operator, electricity producers and suppliers.

Less likely option for operation of P2G plant is re-conversion into electricity, in which case the P2G plant cannot be owned by the electricity transmission system operator or electricity distribution system operator. Energy actors that can be the owners of the P2G plant in this case are electricity and natural gas suppliers, the natural gas transmission operator, independent natural gas transport operator, distribution system operator, the natural gas storage operator.

6.9 SLOVAKIA

The Slovak gas market is regulated by the Office for the Regulation of Network Industries (URSO), a state administration body for the regulation of network industries with nationwide scope. The Slovak Innovation and Energy Agency, abbreviated as SIEA, is a state-funded organization that provides free energy consultancy,

mediates the drawing of financial aid, prepares energy audits, concepts and studies and verifies the efficiency of operation of heating systems.

It also allocates the European funds and works in direct cooperation with the Slovak Ministry of Economy. Ministry of Economy will be also entrusted by The Government of the Slovak Republic to elaborate and coordinate the National Hydrogen Strategy Action plan**.** The restrictions for the ownership, development, management or operation of the P2G plant are not in place at the moment. The § 6 of the 251/2012 law however specifies, that permission is not required in the case of production and supply of gas from biomass and also production and supply of gas from biogas.

Persons carrying out activities for which no authorization is required according to § 6 par. 4 of Act no. 251/2012 Coll., shall be subject to a notification obligation, which shall notify the Office within 30 days of the commencement, termination and change of such activity. The notification shall include the name, surname, address of residence of the natural person or business name, identification number, registered office and statutory body of the legal person, definition of the activity under paragraph 4.
A person who has a permanent residence or registered office in the territory of a state which is a contracting party to the Agreement on the European Economic Area and is interested in supplying electricity or gas in a defined territory on the basis of an authorization to supply electricity or gas which he has under the law of his country of residence or its registered office or another state which is a contracting party to the Agreement on the European Economic Area, is obliged to apply to the Office for a permit to supply electricity or gas in the defined territory.
Pursuant to Act no. 251/2012 Coll. operator of the transmission or distribution system owns its system or network, and the entities shall be subject to certification where they demonstrate the conditions of the ownership conditions. From this we assume that these entities can own, develop or manage P2G technology, if we take into account mixing of hydrogen into the gas distribution / transmission network.

6.10 SLOVENIA

If the definition of energy storage is interpreted in a way that covers P2G installation, the role of energy storage operator should be further examined. Energy storage activities must be carried out freely on the market, so the owner or operator of the energy storage device cannot be an electricity system operator by the Electricity Supply Act. The electricity system operator also cannot develop or manage these devices. Articles of the Electricity Supply Act that limit electricity system operators to own, develop and operate storage devices are Article 51 and 83 - *Ownership of energy storage facilities*. Article 51 refers to electricity TSO, while Article 83 refers to electricity DSO. Both, the Electricity Supply Act and above-mentioned directive provide deviations from this rule if certain conditions are met. It is allowed for transmission and distribution system operators to own, develop, manage or operate energy storage facilities, where they are fully integrated network components and the regulatory authority has granted its approval, or where all of additional conditions are fulfilled[112] (Article 51 of the Electricity Supply Act and Articles 36 and 54 of the Directive EU 2019/944). While the definition of energy storage may not apply for P2G plant, the latter is definitely an electricity system user (electricity producer, final customer, or energy storage operator) and thus further relations regarding ownership from a side of electricity system operators were analysed. Section two of Chapters IV and V, "Unbundling of a transmission system and system operator" and "Unbundling of a distribution system operators", deal with the unbundling and ownership of electricity system operators. The activity of the distribution system operator must be performed by the distribution system operator in a separate legal entity that does not perform other activities. As part of a vertically integrated company, the electricity distribution network operator must be independent at least in terms of legal form, organisation, and decision-making from

[112] Articles 36 and 54, Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU

other activities not related to distribution. These provisions do not apply for integrated natural gas undertakings with less than 1000 final customers connected.

Generally, a P2G plant cannot be operated by an electricity system operators unless under clear and limited conditions defined with Article 51 of the Electricity Supply Act.

If P2G plant is to be considered as a gas producer, the role of P2G in the gas market from the perspective of the gas-related legislation should be analysed as well. The White Paper on Regulatory Treatment of P2G by the Agency for the Cooperation of Energy Regulators (ACER)[113] and the Council of European Energy Regulators states that investment in P2G must be based on market principles that allow competition to be established and should, in principle, be limited to providing network access and transmission and distribution services.
Similar findings could be found in Slovenian gas directive, The Gas Supply Act, which contains the Article on Restrictions applying to producers, suppliers, gas system operators and persons exercising control over them. The Gas Supply Act[114] prevents the same legal or natural person(s) to (in)directly control an undertaking performing any functions of production or supply and at the same time (in)directly control a gas TSO. An undertaking performing any activity of production or supply referred to in in the preceding sentence shall also be considered an enterprise performing any activity of production and supply in accordance with the law governing the supply of electricity. Moreover, the transmission system operator and the transmission system referred to above shall also be considered the system operator and the transmission system in accordance with the law governing electricity supply. The act also stipulates that the activity of the distribution system operator must be performed by the distribution system operator in a separate legal entity that does not perform other activities. It moreover deals with the unbundling of gas DSOs and stipulates that the gas DSO, who is part of vertically integrated undertaking, should be independent in terms of its legal form, organisation, and decision making from other activities not relating to distribution (Article 65). The Article 67 however stipulates that the provisions of Articles 64 to 66 of this Act shall not apply to integrated natural gas undertakings with less than 100,000 final customers connected. From all above-mentioned provisions it can be concluded that in general gas system operators should not operate a P2G plant.
Considering the option of using existing infrastructure for long-term storage of natural gas also for the storage of the compressed gas from P2G plant, the role of the storage system operator in P2G ownership should further examined. The unbundling of storage system operators is defined with the Article 55 of the Gas Supply Act. It dictates the independency of gas storage operators, who are a part of a vertically integrated undertaking, in particular in terms of their legal form, organisation and decision making from other activities not relating to transmission, distribution, and storage.

7. FEED IN OF HYDROGEN AND 'RENEWABLE NATURAL GAS'

This chapter describes the gas quality standards in the respective countries for feeding hydrogen and renewable natural gas into the gas grid. It is also outlines which percentage of hydrogen may be fed into the gas grid.

7.1 AUSTRIA

As stated above, the NGSA 2011 specifies that when the terms natural gas, gas or biogenic gases are used, they shall be understood to include renewable gases, other gases and gas mixtures that comply with the applicable technical rules for gas quality. Technical rules are those which contain principles derived from

[113] *European Union Agency for the Cooperation of Energy Regulator,* Regulatory Treatment of Power-to-Gas. 2021.
[114] Article 25, Gas Supply Act 2021

science or experience in the technical field and whose correctness and practicality are generally considered to be established in practice.[115] With regard to the gas quality, the rule of ÖVGW G B210[116] provides information. Among others, the following limit values, which are particularly relevant for the project, can be derived from it:

- Carbon dioxide: 2,5 or[117] 4 % mol/mol
- Oxygen: 0,001 or[118] 1 % mol/mol
- Wobbe-Index[119]: 47,70-56,92 MJ/m^3
- Calorific value [120]: 35,54-47,63 MJ/m^3
- Relative density: 0,555-0,700
- Local requirements
  - Hydrogen: up to 10 % mol/mol
  - Relative density: 0,5-0,7

With regard to the hydrogen content, the Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology, together with the Federal Minister for Digital and Economic Affairs, is authorized to set a maximum value for the technically permissible content in natural gas pipeline systems by ordinance.[121]

7.2 BULGARIA

According to the Renewable Energy Sources (RES) Act (art. 18, par. 4,), GRS has a guaranteed access to the transmission and distribution gas network as long as safety criteria developed by gas grid operators and approved by Energy and Water Regulatory Commission (EWRC), is complied with. In the same way, GRS has a guaranteed transmission and distribution.

It is responsibility of the gas transmission network operator to provide connection to feed in gas from renewable sources when this is technically feasible. A contract for accession is signed for that purpose. The price for access that has to be paid by the P2G hub is set in the art. 36, par. 3 of the Energy Act. The same conditions apply for the gas distribution network operator. In cases when there are deviations from the pre-agreed quality of the renewable gas and/or there are payments due, access to the gas networks can be denied.

The connection point is defined by the gas transmission network operator. The operator is obliged to build connection facilities to that point if they are missing.

Required chemical composition and quality of the gas is defined in the Management and technical rules of gas transmission networks. Gas has to comply with the standards in order to be fed into the gas transmission network. For example, CH_4 has to be not less than 70% mole, CO2 not more than 5% mole, gross calorific value should be between 10.0 and 12.7 kWh/m³, and so on. Gas chromatographs are used to control quality of the supplied gas.

[115] Cf. § 7 (1) (53) NGSA 2011.
[116] *ÖVGW*, Gasbeschaffenheit Richtlinie G B210 (2021).
[117] At feed-in points of the grid and at coupling points, the maximum material quantity share of carbon dioxide must not exceed 2.5 %. However, where it can be demonstrated that the gas does not flow into facilities sensitive to higher concentrations of carbon dioxide, a higher limit of up to 4% may be applied.
[118] At feed-in points of the grid and at coupling points, the maximum mass fraction of oxygen, expressed as a 24-h moving average, must not exceed 0.001 %. However, where it can be demonstrated that the gas does not flow into equipment sensitive to higher concentrations of oxygen, a higher limit of up to 1% may be applied.
[119] Standard conditions.
[120] Standard conditions.
[121] Cf. § 133a NGSA 2011.

In addition, predicted supply of annual gas volumes, hourly flow rate, and pressure are defined for the connection point.

7.3 CROATIA

Gas quality standards in Croatia are determined by **General conditions of gas supply (OG 50/18, 88/19, 39/20, 100/21)**, which define specific terms that need to be satisfied in order for the gas network to accept natural gas. These are defined within Annex 2, Table 3 of the conditions. Even though they define the levels of methane that need to be present, including other gases, hydrogen and biomethane as such are not mentioned. Therefore, there is plenty of room to define hydrogen and biomethane as potential and future constituents of the gas grid.

Additionally, the definition of the percentage of hydrogen fed into the gas grid is also non-existing. Even though hydrogen is mentioned in **Low-Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050 (OG 63/21)** and **Energy Development Strategy of the Republic of Croatia until 2030, with a view to 2050 (OG 25/2020)**, these documents do not include the percentage of hydrogen that can be available in the existing gas grid.

However, the Croatian **National Hydrogen Strategy for period 2021-2050**[122] is in the process of development, and there will potentially be the definition of this segment, covering additional information and potential utilization of hydrogen outside of the scope of transport and heating sectors.

7.4 CZECH REPUBLIC

The basic regulation for gas distribution is Decree 545/2006 on the quality of gas supply and related services in the gas industry. It defines the term 'natural gas' exhaustively in Section 5. A standard that could theoretically be applied to "renewable gas" is Decree 459/2012 on requirements for biomethane, the method of measuring biomethane and the quality of biomethane supplied to the transmission system, distribution system or underground gas storage facilities. The quality parameters of gases in the gas distribution system are set by Decree 108/2011 on gas metering and on the method of determining compensation for damages in case of unauthorised withdrawal, unauthorised supply, unauthorised storage, unauthorised transport or unauthorised distribution of gas. This Decree also directly sets out the required chemical composition of the gas. Generally speaking, gas operators must comply with the standards to which they are contractually bound to their customers, in particular the Guarantee of origin (Law 382/2021) and the technical characteristics specified in the contract. Natural gas" suppliers adhere to "ČSN EN ISO 13686" which is just a summary of internationally recognised standards such as EN ISO 13686; EN ISO 15112; EN ISO 13443; EN ISO 12213-1; EN ISO 12213-2; EN ISO 12213-3; EN ISO 15970; EN ISO 15971; EN 16726+A1.

The amount of hydrogen in the gas is set by Decree 108/2011. The maximum hydrogen content is (i) in the transmission system, gas storage and production pipelines ≤ 0,01 % mol (ii) in the distribution system ≤ 0,1 % mol. Details can be traced in the relevant standard (ČSN EN ISO 13686).

7.5 GERMANY

Gas quality standards are defined by the German Association of the Gas and Water Industry. In two papers, namely DVGW G 260 and DVGW G 262, the Association provides rules for gas properties for feed-in gas.

In general, it says in paper G 260: "The gases shall not contain other constituents, associated substances and/or impurities to such a extent that processing of the gas for transportation, storage, distribution, and safe

[122] Not published during the creation of this document.

distribution, and use becomes necessary."[123] All gases that will reach end-consumers eventually, have to be odorized.

The processed RNG usually consists of methane (CH_4), carbon dioxide (CO_2) and water vapor. The following contents must not be exceeded:[124]

- Water vapor
  - 200 mg/m^3 for a low pressure grids (maximum operating pressure of < 16 bar)
  - 50 mg/m^3 for a high pressure grids (maximum operating pressure of ≥ 16 bar)
- Methane
  - ≥ 90 % for L-gas grid
  - ≥ 95 % for H-gas grid
  - Deviating minimum methane contents are possible in agreement with the network operator if more than 1 mol% of combustible components other than methane are present in the upgraded biogas or if the calorific value of the biogas exceeds the calorific value of the natural gas transported in the network.
- Oxygen
  - 0,001 mol% in high pressure grids
  - 3 mol% in grids for gas distribution (maximum operating pressure of < 16 bar)
- Ammonia and amines
  - Technically free[125]
- Organosilicon compounds
  - 5 mg/m^3
- Hydrogen
  - DVGW-study: 5 vol%
  - DIN EN 51624: 2 vol%
  - Some producers of gas turbines require a maximum content of 1 vol%

The RNG also has to fulfil the requirements given in DVGW G 260, Table 3. The table provides maximum values (additionally to the above mentioned values):

- Fog, dust, liquids
  - Technically free
- Hydrocarbon condensation point
  - -2 °C (1 bar ≤ p ≤ 70 bar)
- Sulphur
  - 6 mg/ m^3 excluding sulphur from odorization
  - 8 mg/ m^3 including sulphur from odorization

While RNG as a "replacement gas" is treated as fossil natural gas and can therefore be injected into the grid up to 100%, hydrogen is considered to be an "additional gas" ("Zusatzgas"). In a 2014 document, the German Association of the Gas and Water Industry points out that up to 10% of hydrogen injection is considered to be safe. Even higher percentages can be non-critical for different types of pipes.[126] However, according to the DVGW G 262 paper which defines the rules for injecting into the gas grid, only up to 5% of hydrogen injection

[123] DVGW G 260, p. 15
[124] DVGW G 262, p. 15-17
[125] The trouble-free operation of gas appliances and gas-technical equipment of standard or customary standard or customary design is guaranteed in the long term. (DVGW G 260, p. 21)
[126] Cf. DVGW 2014, p. 5

is allowed. The norm "DIN 51624" limits the injection volume to 2% in case that natural gas filling stations are connected to the affected grid. Since many end applications cannot handle high amounts of hydrogen, mainly 1-3% hydrogen addition are acceptable for immediately useable capacities and 5% for the overall grid.[127]

The injector has to make sure that the injected gas is compatible with the grid. The grid operator has to check how much hydrogen can be injected into his grid, the costs usually bears the connector ("Anschlussnehmer"). If any factors appear after the examination, the grid operator has to analyse again whether the percentage of injected hydrogen can be increased or must be reduced.[128]

In general, the legal regulations for biogas defined in § 3 No. 10c Energy Industry Act apply to renewable hydrogen and synthetic methane. All legal findings and decisions can be used as decision basis for legal conflicts.[129]

7.6 HUNGARY

In order to feed the produced gas into the Hungarian natural gas grid, the stated quality standards should be examined to decide whether the obtained gas is suitable for the purpose or, whether further treatment is necessary.

Gas standards are classified in MSZ 1648 standard, which defines two groups of gases, the 2H and the 2S. Most of the country is supplied by 2H, which is the standard, high-calorific value type, that is available in major pipelines. For gas producing regions, which are sometimes isolated, the lower-calorific value 2S is the standard.

The classification of these categories is based on the Wobbe number of the gases. In addition to the calorific value and the heat of combustion, the Wobbe number is the third combustion characteristic of the natural gas.

The gas appliance is produced in such a way that the heat it produces is proportional to the Wobbe number, so in order to decide which gas group is compatible with the gas appliance we shall examine the Wobbe number of the gas.

The Wobbe number range for 2H gas is 45,66 – 54,76 MJ/m3, as for 2S gas 36,28 – 41,58 MJ/m3.

If the gas appliance is calibrated for the combustion of 2H gases, by putting 2S gas in it, the gas appliance would not work properly.

The quality standards for the two group of gases are clarified in the Annex nr. 11. of Execution of the Natural Gas Supply Act.

The gas composition required are the following:

Sign of the gas group	2H	2S
Characteristic of the gas group	Limit value	

[127] Cf. Lietz 2017, p. 49-49
[128] Cf. BNetzA 2014, p. 6, 9
[129] Cf. BNetzA 2014, p. 1

Wobbe-number	45,66-54,76 MJ/m3 (12,68-15,21 kWh/m3)	36,29-41,58 MJ/m3 (10,08-11,55 kWh/m3)
Namely Wobbe-number	50,72 MJ/m3 (14,09 kWh/m3)	39,11 MJ/m3 (10,86 kWh/m3)
Upper calorific value	31,00-45,28 MJ/m3 (8,61-12,58 kWh/m3)	
Lower calorific value	27,94-40,81 MJ/m3 (7,76-11,34 kWh/m3)	

Wobbe number is the gas appliance specific gas quality parameter. The heat produced by the gas appliance is not directly proportional to the calorific value or heat of combustion, but to the Wobbe number. As the domestic produced gas has a lower calorific value than most imported types (mainly Russian origin), limit values are calculated with an aim of allowing the inclusion of domestic gases.

Regarding the results of the interviews and workshops organized in connection with the project, experts stated, the feed-in of P2G produced methane is feasible, although feeding in hydrogen would require mixing it with high calorific value natural gas. Since the provisions focus on the calorific value of the fed-in gas, there is no specific threshold for hydrogen content. The actual limit depends on the quality of the mixed natural gas.

7.7 ROMANIA

It is specified in the law, for example, that biomethane must be brought to a quality standard before being put into use. It also specifies the quality of services that must be qualitative in relation to the price "regulated price - the price at which the supply of natural gas is made on the basis of a framework contract, service quality standards and / or specific conditions set by The gas supplier is also accountable to consumers for a "specified gas quality." This specified gas quality is also a consumer's right. As for the restrictions, they have not been identified. the amount of hydrogen that can be introduced into the grid has not been identified.

This may mean that hydrogen is not used in the gas grid and this is harmful because it would have been an additional source, which would have increased the flow of gas / energy. The absence of restrictions is also not auspicious due to the fact that although the manufacturer / supplier / operator knows what standards to meet and what obligations and permissions he has, he does not know what are the possible restrictions that may occur.

Storage capacities, considering also integrating hydrogen into the system are also within the priorities of Romanian energy strategy for the years to come.

At the time of the elaboration of this document, hydrogen is used mainly in the chemical industry, specifically in refineries and for ammonia production. In Romania, there are currently 13 industrial producers of hydrogen all of them coming from fossil fuels, and the hydrogen market comprises of two main types of actors: captive producers, the ones who produce hydrogen for their direct customers or for their own use; and by-product hydrogen that is resulting from certain chemical processes, the Chlor-alkali industry.

A mention regarding hydrogen was made to the Energy Law on 24 July 2020 in order to include hydrogen production provisions (“Law 155”).

The general regulatory framework on hydrogen will be established by the energy regulator, ANRE in accordance with Law 155. The energy regulator will elaborate the technical and commercial procedures regarding the operation of a hydrogen terminal and the methodology of related tariffs. "Tariffs for services provided by the hydrogen terminal operator, regarding the operation of the terminal, are established by the economic operator concerned. These will be approved by ANRE and published on the operator's own web page."

7.8 SERBIA

Grid codes for natural gas transportation and distribution systems defines required composition and pressure of the gas to allow its feed-in into the natural gas grid. Required gas quality is presented in the following Table.

Table 1 - Technical requirement of feed-in into the natural gas grid

Chemical composition	Methane C1	Min 90% mole fraction
	Ethane C2	Max 4% mole fraction
	Propane C3, Butane C4...	Max 2% mole fraction
	Nitrogen + Carbon Dioxide	Max 5% mole fraction
Sulphur content	Hydrogen-Sulphide	Max 5 mg/m³
	Mercaptan Sulphur	Max 5.6 mg/m³
	Sulphur - total	Max 20 mg/m³
Dew point		-5°C (at 40 bar g)
Lower calorific value		33,500 +/- 1,000 kJ/m³

To feed the gas into the natural gas grid, the pressure of the gas should comply with the following requirements:

1. For the gas pipeline of 50 bar pressure – pressure of the feed-in gas must be 40-45 bar
2. For the gas pipeline of 75 bar pressure – pressure of the feed-in gas must be 60-68 bar
3. For the distribution gas pipeline – pressure of the feed-in gas must be <16 bar.

The lower Wobbe Index, which is an indicator of the interchangeability of gases, should be in the range of 42-46 MJ/m³. In addition, gas cannot contain impurities, resin or substances that produce resin, and liquids such as hydrocarbons, condensate, glycol, water, etc.

The further restrictions are applicable to feed-in the natural gas grid:

1. Transportation system operator has the right to terminate further takeover of natural gas into the system, if elapsed volume expressed in Sm³/hour[130] is greater than 1/24 of the available capacity on that gas day[131].

[130] Standard cubic meter (Sm³) of natural gas is a quantity of gas, which at pressure of 1,013.25 mbar and temperature of 15°C has a volume of 1 m³.
[131] The gas day is a time period of 24 hours that starts at 8.00 am Central European Time any day and ends at 8.00 am

2. If natural gas of inadequate quality is fed into the grid, transportation system operator has the right to charge penalty for inadequate quality of natural gas (when Wobbe Index deviates <=10%, or claims compensation for damage caused by the delivery of unsuitable natural gas in accordance with the law.

3. Required minimum capacity for access and delivery to the natural gas grid is:

   - 10,000 Sm³/day – for transportation system
   - <=10 Sm³/day – for distribution system of pressure <6 bar
   - 100 Sm³/day – for distribution system of pressure 6-16 bar.

Blending of renewable hydrogen into the existing natural gas pipeline is not specifically foreseen in the Serbian legislation. However, blending of renewable hydrogen into the existing natural gas pipeline is possible as long as mixture comply with the technical requirements specified in Table 1.

7.9 SLOVAKIA

Gas quality standards are set in URSO Decree no. 278/2012 Coll.[132], which establishes quality standards for gas storage, gas transportation, gas distribution and gas supply, and in the Technical Regulations of the Distribution Network Operator. For example, compliance with gas quality during its storage by the reservoir operator, compliance with gas quality during its transportation in accordance with the quality of gas received for transportation from the user of the transmission network, compliance with gas quality during its distribution established in the technical conditions of the distribution network operator and other gas quality standards. The same applies to the operator of the transmission network (Eustream a. s.) and in its Technical Rules, where the quality of natural gas is required at the entry and exit points of the transmission network.

Distributed gas must meet the current conditions set primarily for natural gas. The exact percentage of hydrogen admixture has not yet been determined, but the current rules setting maximum and minimum chemical and physical values allow an insignificant amount of hydrogen to be supplied to the gas network (0,2 % mol as stated in the table below).

As for biomethane, the quality standards are set very precisely in the technical rules of the distribution network operator.

Parameter	**Unit**	**Value (min)**	**Value (max)**
Wobbe index	kWh/m^3	12,7	14,9
Upper calorific value	kWh/m^3	9,7	/
Relative density	m^3/m^3	0,555	0,7
Total sulphur	mg/m^3	/	20
Hydrogen sulphide and carbonyl sulphide	mg/m^3	/	5
Mercaptan sulphur	mg/m^3	/	7
Oxygen content	mol %	/	0,5
Carbon dioxide	mol %	/	5
Nitrogen content	mol %	/	2
Hydrogen content	mol %	/	0,2

Central European Time the next day. When switching from "winter "daylight saving time" and vice versa, the day will be 23 or 25 hours, depending on case.

[132] Decree of the Office for the Regulation of Network Industries Establishing Quality Standards for Gas Storage, Gas Transportation, Gas Distribution and Gas Supply 278/2012 Coll.

Methane content	mol %	95	/

In November 2012, the Slovak Republic issued the Technical Regulation of the gas distribution network operator (TPP 983 01), which precisely sets the requirements for the quality of biomethane transferred to the distribution network. The content of gas components in biomethane transferred to gas networks is expressed as % mol by default. Some required requirements for the composition of biomethane in gas networks are shown in the tables above, while the reference conditions of the volume unit are pressure: 101.325 kPa and temperature 15 °C. Biomethane delivered to the distribution network must not contain: - water and hydrocarbons in a liquid state, - solid particles in such an amount that would damage the materials used in gas distribution, - other gases that may affect the safety or integrity of the distribution network.

More specific information regarding the current technical standards can be found on the webpage of the distribution system provider: https://www.spp-distribucia.sk/wp-content/uploads/2018/10/Technickepodmienky1112012.pdf.

The current allowed amount of hydrogen in the content is max 0,2%mol as seen in the table. This amount is so small, it represents no risk for the existing gas infrastructure. In order to implement new technical standards, more research and quality standards from across Europe need to be studied and tested.

The transfer station can be connected to the distribution network only in the part where it consists of a high-pressure gas pipeline. The place of connection shall be determined by SPP-D in the connection conditions ("Agreement on the connection of the biomethane production facility to the Distribution Network").

In order for biomethane to be "connectable" to the gas network, in addition to the increased CH_4 concentration, the corrosive gases H_2, S and ammonia must be removed and must reach the same calorific value (Russian gas 10.95 kWh / m3, North Sea gas 11.45 kWh / m3). For this purpose, propane must be added to biomethane.

Injection into the gas grid – blending hydrogen into the existing gas networks:

The injection of hydrogen into the gas grid is not explicitly regulated at present. Existing laws on injection, transport and use of gas would apply to hydrogen as they do for methane gas. Slovakia has not introduced its own legislation regarding hydrogen blending. Instead, Slovakia is monitoring the efforts of other EU countries which have introduced limits on the injection of hydrogen into the gas grid and are undertaking research to raise the limit to between 20 and 30%.

SPP-distribúcia a.s. as the main Slovak gas grid operator and distributor therefore joined the H2PILOT project to be able to further study and upgrade the knowledge in this field. According to an article issued in February 2021, the objectives and plans of SPP are as follows[133].

- SPP plan to follow the general European flow of feeding max 20% into the grid
- the need to upgrade the measuring technology (converters) even at H_2 concentrations higher than 6%;
- to deal with the fact that the mixture will not be stable, but the amount of hydrogen in it will fluctuate (problematic in terms of measuring the energy actually transported) - the resulting necessity have chromatographs to measure the concentration of hydrogen in the mixture and the subsequent recalculation of the actual "combustion heat" taken by the gas customer
- at hydrogen concentrations higher than 3% the need to allocate the area in question and to carry out continuous measurements and evaluations of combustion heat in it separately (or to choose a suitable analytical model)
- measuring the tightness of gas equipment will require new highly sensitive diagnostic devices, able to detect hydrogen leakage even at minimal quantities

[133] https://www.slovgas.sk/aktuality/p-demec-projekt-h2pilot-skuma-mozne-prinosy-vodika-aj-obmedzenia-pre-cinnost-spp-distribucia/

- deteriorated combustion properties - reduction of the energy value of the same amount of gas, impact on the amount of air needed for perfect combustion - there are arguments that hydrogen combustion produces increased NOx concentrations compared to natural gas combustion
- other explosive limits (4-76%) vs. methane (5-15%) - impact on jet fire
- risk of atomic hydrogen entering the steel - possible cause of hydrogen embrittlement
- higher permeability of individual materials (both steel and plastic), fittings, seals, etc., due to the much smaller size of the H_2 molecule compared to the CH_4 molecules

7.10 SLOVENIA

Due to the lack of own sources, the supply of natural gas to the Slovenian market depends entirely on imports. The gas transmission system in Slovenia is owned and operated by the TSO Plinovodi, d.o.o. In 2020, the system consisted of 967 (2020) kilometres of high-pressure pipelines with a nominal pressure above 16 bar and 210 kilometres of pipelines with a nominal pressure lower than 16 bar. The distribution of natural gas is carried out as an optional local service of general economic interest of the DSO. The distribution of natural gas as a service of general economic interest was carried out by 13 DSOs and none of the distribution systems had a connected source of natural gas, biomethane or synthetic methane in 2020[134].

In accordance with the provisions of the Gas Supply Act 2021, the company Plinovodi is as the TSO in the Republic of Slovenia obliged to adopt and submit for confirmation to the Energy Agency a 10- year network development plans every year. The purpose of the plan is to determine the main infrastructure for transmission that is to be built and upgraded over the next years for players on the market, list all investments that are in progress and will be completed in this period and provide a time frame for all investment projects. The Ten-Year Gas Transmission Network Development Plan for the 2021 − 2030 period and the draft document for 2022 − 2030 period have been studied to provide some insight regarding the current state of the transmission system and regarding the feed in of hydrogen and ‘renewable natural gas.

In the year 2020, the Republic of Slovenia adopted the Integrated National Energy and Climate Plan (NEPN). In accordance with the provisions of the NEPN, Slovenia should reduce greenhouse gas (GHG) emissions by at least 20% and achieve at least 27% share of renewable energy sources (RES) in final energy consumption by the year 2030. These provisions will also be reflected in the natural gas market therefore the plan indicates the replacement of least 10%[135] natural gas by the year 2030 with hydrogen or synthetic gas in the transmission and distribution network. The NEPS also envisages using the gas system as an energy storage and storing surplus electricity in the form of synthetic gas and hydrogen. Pilot projects for the production and injection of renewable gases into the transmission gas system are expected to be implemented.

Given the projected energy balance for the year 2030, it will be necessary to provide 1.047 GWh of synthetic gas and 116 GWh[136] of hydrogen in the energy supply. The Plinovodi company is prepared to take a more active role in the planning and installation of a pilot test plant with the possibility of testing and analysing the impact of injecting various renewable gases into the transmission system. Moreover, the company will prepare everything necessary for the connection of pilot and larger commercial plants to the transmission system; however, the appropriate legislative and regulatory support for these policies is also extremely important for further development. As part of the development of the system, the natural gas TSO will make efforts to prepare the transmission gas system for injection and operation with hydrogen and renewable gases, considering the anticipated needs of the system and implementing effective measures to ensure the adequacy of the system. In

[134] *Energy Agency*, Poročilo o stanju na področju energetike v Sloveniji 2020, 2021., p. 157.
[135] With the support to implementation of pilot projects.
[136] *Plinovodi d.o.o.*, Desetletni razvojni načrt prenosnega plinovodnega omrežja za obdobje 2022 – 2031, 2021. p. 11.

this way, the TSO will aim to provide a gas transmission infrastructure that will allow the injection of gases from RES, such hydrogen and synthetic methane and biomethane, into the transmission gas system.

The planned projects linked to the hydrogen and renewable gases feed in, that were listed in the Ten-Year Gas Transmission Network Development Plan for The 2021 − 2030 period[137], can be find below:

- **A22**; Project name: Analyses, studies and testing with the gases from the renewable energy sources

  Purpose: Analyses and studies of the transmission network and its parts for the acceptance of renewable gases and testing to determine the acceptable shares, volume and composition of renewable gases in the gas transmission system for safe, reliable and effective operation of the gas transmission system.

  Planned start of operations: 2021 / 2022 and after 2022

- **A23**; Project name: Hydrogen and renewable gas transmission system preparation projects

  Purpose: Location analysis and planning of transmission pipeline system upgrades for the preparation for injection and operation with hydrogen and renewable gases.

  Planned start of operations: after 2023

It is also worth mentioning that the TSO monitors and engages in the development in the field of application of natural gas transmission systems for transmission of alternative gaseous fuels (e.g., methane, synthetic methane, hydrogen) or the storage and transmission of surpluses of renewable energy sources in the form of alternative gaseous fuels. In the period 2020/2021, the company Plinovodi joined the initiative The European Hydrogen Backbone. The initiative consists of leading gas TSOs from Western and Central Europe (The main goal of the initiative is to explore the possibilities of safe, continuous and cost-effective transport of hydrogen through the gas network, which would be intended exclusively for hydrogen. Such solution then also enables integration of the existing natural gas networks with a hydrogen network and increases the overall flexibility of the system and the maximum use of renewable gases. The part of the Ten-Year Gas Transmission Network Development Plan for the 2021 − 2030 period is also a chapter on Natural gas quality measurement and analysis systems. The intentions of the TSO are to upgrade the measuring system for measuring the quality of natural gas that will allow to study the impact of renewable and low carbon gases on the Wobbe index and the upper calorific value of Group H natural gas transmitted in the transmission system. It will pay special attention to the methane number, relative density, and dew point of hydrocarbons.

It could be concluded that the hydrogen and 'renewable natural gas' market in Slovenia is still not evolved and the market uptake and bigger changes are expected yet to happen. The legislation regarding the feeding in of these gases can at this moment similarly to all legislative framework for P2G, be marked as deficient. There are however acts addressing a quality of natural gas and some provisions referring to hydrogen and synthetic methane.

The Legal Act on the methodology for determining the network charges for the natural gas distribution system defines renewable synthetic methane as the energy gas produced with the use of electricity from renewable energy sources and is **equivalent to natural gas according to quality specifications**. The provision implies that certain quality specification must be reached, but does not provide further definitions on quality specifications.

Natural gas quality is however defined in the Network code for the natural gas distribution. The two most important Articles regarding natural gas quality seem to be Article 131 – *Quality of transmitted natural gas*

[137] Table 19 on p. 48 and 49.

and Article 132 *Natural gas quality requirements*. According to these articles, the quality of the natural gas is determined and documented daily by the TSO, either based on measurements of the gas properties of the operator of the neighbouring transmission system, or on the basis of own measurements, or both. The TSO is obliged to accept for transmission only natural gas with the characteristics set out in the Network code[138]:

Parameter	***Symbol***	**Unit**	**Value (min)**	**Value (max)**
Wobbe index	*WI*	kWh/m^3	13,79	15,7
Upper calorific value	H_s	kWh/m^3	10,7	12,8
Relative density	*d*	m^3/m^3	0,555	0,7
Total sulfur	Total S	mg/m^3	/	30
Hydrogen sulfid and carbonyl sulfide	H_2S + COS	mg/m^3	/	5
Mercaptan sulfur	RSH	mg/m^3	/	6
Oxygen	O_2	mol %	/	0,02
Carbon dioxide	CO_2	mol %	/	2,5
Water dew point	H_2O DP	°C *at* p_a *= 40 bar*	/	- 8
Hydrocarbons dew point	HC DP	°C at (1 bar < p_a < 70 bar)	/	0
Maximum gas temperature	*t*	°C	/	42
Methane number	MN	/	78	/

Also, relevant and important legislation related to the quality of the gas and feeding are the provision is the Gas Supply Act. The Article 4 states that the provisions of this act shall apply to all types of gases, including hydrogen, under the condition **that it can be technically safely injected into the system and transmitted through it**. The Article 7 elaborates on the adjustment plan for the uptake of renewable gases into the system. In the scope of the Article 7 it is stated that the system operator shall lay down technical requirements for the gas and, where applicable, for the individual gas in the mixture, including hydrogen, which may be fed into the system. In doing so, the operator determines at least the permissible range of the pressure level, the upper calorific value and the Wobbe index. Furthermore, the system operator is the one who monitors the quality of the gas at least at the entrance to the system and accordingly calculates the characteristic parameters and publishes the calorific value of the gas. The system operator also should prepare a system adjustment plan for the uptake and transmission of renewable or non-fossil gases (including hydrogen). The Article 79 that tackles uptake of the gas into the system from manufacturer defines that system operator determines the physical and chemical parameters of the gas, which can be feed in the system, in accordance with the system operating instructions. The system operator is also the one responsible for achieving and maintaining appropriate gas quality parameters[139].

While the definition and application of synthetic methane and hydrogen are to be found among national legislation, it could be beneficial to establish more connections among several laws or to define some of the provisions more in detail. So far, the national legislation defined natural gas quality in the Network code for the natural gas while specifications for technically safely injection and transmission of the hydrogen could not be found. The newly adopted Gas Supply Act however foresees a preparation of the transmission gas system for injection and operation with hydrogen and renewable gases, considering the anticipated needs of the system and implementing effective measures to ensure the adequacy of the system. In this way, the TSO will aim to provide a gas transmission infrastructure that will allow the injection of gases from RES, such as hydrogen and synthetic methane and biomethane, into the transmission gas system. The first adjustment plan for the uptake and transmission of the renewable gases including hydrogen should be prepared within six months after the Gas Supply Act enters the force while the first adjustment plan for the uptake and distribution will be

[138] Network code for the natural gas distribution system, 2015., Annex 2 – Natural Gas technical quality specifications
[139] Article 19 Draft Gas Supply Act 2021.

prepared within a year. The Gas Supply Act entered into force in January 2022. Once these plans are accepted it is questionable how fast all necessary analysis, testing, and preparation projects will take place as well as when the effective measures to ensure the adequacy of the system will be implemented.

Identified barriers:

- lack of transmission/distribution network analysis and quality standards related to feeding in the hydrogen and 'renewable natural gas',
- gas system adjustment pace.

8. SYSTEM CHARGES, LEVIES AND TAXES

In this chapter it is outlined which system charges (network charges) are applicable to P2G, whether any and if so which taxes and levies have to be payed by a P2G plant and whether there are any exemptions for P2G from the obligations to pay system charges, taxes and levies.

8.1 AUSTRIA

8.1.1 SYSTEM CHARGES

First, the system charges for the purchase of electricity are explained, and subsequently for feeding into the natural gas grid.

8.1.1.1 SYSTEM CHARGES INCURRED FOR THE PURCHASE OF ELECTRICITY FROM THE PUBLIC GRID

§ 51 (1) EA 2010 defines that system users are obliged to pay system charges for services supplied by the system operators and control area operators in exercising the duties imposed upon them. "System Charges" is used as a general term which means that it consists of a list of different charges. According to § 51 (2) EA 2010 these are the system utilisation charge, the charge for system losses, the system admission charge, the system provision charge, the system services charge, the metering charge, the charge for supplementary services and if applicable a, charge for international transactions and for contracts for the transport of energy pursuant to § 113 (1) EA 2010. These individual system usage charge components (with the exception of the system admission charge and the charge for international transactions) are set by the regulatory authority by ordinance[140] as fixed prices or as a maximum price, whereby the charges are to be stated in € or cents per billing unit. The amount of the respective system charges depends on the network level and the network level to which the respective system is connected. As a result, the tariffs set by the regulatory authority are binding and are not at the discretion of the system operator or the system users (also with regard to the amount).

8.1.1.1.1 SYSTEM UTILISATION CHARGE

The system utilisation charge serves to compensate the grid operators for the costs incurred by the expansion, maintenance and operation of the grid. It is paid per metering point, which should be done exclusively by the withdrawing parties and not the injecting parties. For a P2G system, this means that it would in principle have to pay the system utilisation charge, as it is to be defined as a withdrawing party on the basis of § 7 (1) (14) EA 2010 and the fact that it draws electricity from the public grid. However, if certain criteria are met, the P2G system can be exempted from this obligation (system utilisation charge and the charge for system losses for

[140] Currently the System Charges Ordinance 2018 (Verordnung der Regulierungskommission der E-Control, mit der die Entgelte für die Systemnutzung bestimmt werden (Systemnutzungsentgelte-Verordnung 2018 – SNE-V 2018) F.L.G. II No. 398/2017 last amended by F.L.G. II No. 558/2021) is in force.

their electricity consumption). These criteria require the purchase of electrical energy from renewable energy sources and also stipulate a minimum capacity for the plant of 1 MW. If the P2G plant meets the requirements, it is exempt from the aforementioned levies for a period of 15 years from the moment of commissioning.

8.1.1.1.2 CHARGE FOR SYSTEM LOSSES

The charge for system losses compensates the network operator for the transparent and non-discriminatory procurement of appropriate quantities of energy to compensate for physical network losses.[141] It has to be paid by withdrawing and injecting parties with a connected capacity above 5 MW. As the P2G plant is a withdrawing party within the meaning of § 7(1) (14) EA 2010 due to the withdrawal of electricity, it would basically have to pay the charge for system losses. However, the abovementioned exemption applies for the charge for system losses too. Therefore, P2G plants do not have to pay the charges for system losses imposed on the purchase of renewable electrical energy for 15 years from the time of commissioning, provided that the respective facility has a minimum capacity of 1 MW.

8.1.1.1.3 SYSTEM ADMISSION CHARGE

The system admission charge shall be used to reimburse the system operator once for all reasonable expenses in line with market prices that are directly associated with the initial establishment of a grid connection or the modification of a connection as a result of an increase in the connection capacity of a system user.[142] For P2G plants, there is a special provision. Provided that the facility has a minimum capacity of 1 MW, purchases exclusively renewable electrical energy and does not feed into the gas grid, no grid access fee is to be paid up to a grid connection quotient of 200 rm/MW_{el} of agreed capacity. If the grid connection quotient exceeds 200 rm/MW_{el} of agreed capacity, 50% of the costs for the line lengths exceeding this shall be borne by the operator of the installation.[143]

8.1.1.1.4 SYSTEM PROVISION CHARGE

The system provision charge is charged to withdrawing parties when the grid connection is established or when the agreed extent of system utilisation is exceeded as a one-off payment reflective of capacity for the already completed and necessary expansion of the system in order to enable the connection. It is calculated according to the agreed extent of network utilisation. If no extent of system utilisation has been agreed or if the agreed extent of system utilisation has been exceeded, the system provision charge shall be calculated on the basis of the extent of system utilisation actually used.[144] With regard to P2G plants, their operators do not have to pay a system provision charge for such a facility, provided that it exclusively purchases renewable electrical energy, does not feed into the gas grid and has a minimum capacity of 1 MW. [145]

8.1.1.1.5 CHARGE FOR SYSTEM SERVICES

The purpose of the system utilisation charge is that injecting parties with a connected capacity of more than 5 MW pay a compensation to the control area manager for the costs incurred by the balancing of load fluctuations in the course of secondary control.[146] In contrast to (large) grid injecting parties (P2G plants do not count as

[141] Cf. § 53 EA 2010.
[142] Cf. § 54 EA 2010.
[143] Cf. § 54 (6) EA 2010.
[144] Cf. § 55 EA 2010.
[145] Cf. § 55 (10) EA 2010.
[146] Cf. § 56 EA 2010.

such), which have to pay the system utilisation charge, this is not the case for a P2G plant as a withdrawing party when withdrawing electricity from the grid.

8.1.1.1.6 METERING CHARGE

The metering charge is paid by the system users to the system operators for the costs associated with the installation and operation of metering equipment. The corresponding charges, which have to be charged regularly (monthly) based on the costs, is set by ordinance as a maximum price.[147] The metering charge is determined according to the type of metering in § 10 (1) of the System Charges Ordinance 2018 (Systemnutzungsentgelte-Verordnung 2018 F.L.G. II No. 398/2017 as amended by F.L.G. II No. 558/2021). If the metering is done by means of a smart meter, the corresponding charges for the substituted metering services or additional functions apply. In conclusion this means for a P2G facility that as a withdrawing party it shall pay the metering charge.

8.1.1.1.7 SUPPLEMENTARY SERVICE CHARGES

§ 58 EA 2010 allows grid operators to charge grid users (withdrawing as well as injecting parties) for other services if this is necessary. The conditions for this are that the costs are not covered by the previously discussed charges and that they were directly caused by the grid users. Since the P2G system is a grid user, the charge for other services must also be paid by it if required.

8.1.1.2 SYSTEM CHARGES INCURRED WHEN INJECTING SYNTHETIC NATURAL GAS INTO THE NATURAL GAS GRID

According to § 70 (1) NGSA 2011, the system charges for the gas sector are also set by the regulatory authority by ordinance. System users are obliged to pay system charges for services supplied by the system operators in exercising the duties imposed upon them.[148] According to § 72 (2) NGSA 2011 the system charges consist of the system utilisation charge, the system admission charge, the system provision charge, the metering charge and the supplementary service charge.

For the gas sector (unlike the electricity sector) these components are all payable by both the withdrawing party and the injecting party. These individual system usage charge components (with the exception of the system admission charge) are set by the regulatory authority by ordinance as fixed rates or as a maximum price, whereby the charges are to be stated in € or cents per billing unit. The amount of the respective system usage fees is largely determined by the entry and exit point as well as the network level and the network area to which the respective facility is connected, at least in the distribution system. The tariffs set by the regulatory authority are binding and are not at the discretion (also with regard to the amount) of the system operator or the system users.

8.1.1.2.1 SYSTEM UTILISATION CHARGE

The system utilisation charge in the distribution network and in the transmission network, which is payable by withdrawing parties, end consumers and injecting parties, is particularly designed to compensate the system operator for the costs of constructing, expanding, maintaining and operating the system, including the costs associated with the construction and operation of metering equipment, as well as calibration and meter reading at injection and withdrawal points. It is to be determined by ordinance by the regulatory authority and invoiced on a regular basis. As an injecting party the system utilisation charge must be paid. § 73 (6) stipulates for the distribution level and section 74 (3) for the transmission level that the system utilisation charge for feed-in to

[147] Cf. § 57 EA 2010.
[148] § 72 (1) first sentence NGSA 2011.

the grid from production or generation of biogenic gases is to be paid by the natural or biogenic gas producer in relation to the contracted capacity per entry point. The Gas System Charges Ordinance 2013 (Gas-Systemnutzungsentgelte-Verordnung 2013 F.L.G. II No. 309/2012 as amended by F.L.G. II No. 176/2022) contains the concrete determination of the system utilisation charge. For the system utilisation charge for the feed-in into the distribution grid from production or from the generation of renewable gases, fees are determined therein, which, unless specifically stated, are given in EUR/kWh/h per year and per feed-in point. For the feed-in from production of renewable gases in all network areas 0.12 is set.

8.1.1.2.2 SYSTEM ADMISSION CHARGE

The system admission charge pursuant to § 75 NGSA 2011 shall be a one-off payment to the system operator of all reasonable costs, considering normal market prices, directly arising from connecting a facility to a system for the first time or altering a connection to account for a system user's increased connection capacity. As an injecting party the system admission charge must also be paid once by the P2G plant. However, for the grid connection of new plants to be built for the production and processing of renewable gas up to a grid connection quotient of 60 lfm/m³CH_4-eq/h of agreed annual energy quantity to be fed into the gas grid, the costs of system admission for the feed-in of renewable gases, quantity measurement, quality testing, any odorization, as well as compressor stations or lines required for continuous feed-in shall be borne by the system operator.[149]

8.1.1.2.3 SYSTEM PROVISION CHARGE

The network provision charge according to § 76 NGSA 2011 is a capacity-oriented one-off charge and is paid by network users (both withdrawing and injecting parties). The relevant point in time is the first connection or the increase of the contracted maximum capacity. The past or future grid expansion measures that are necessary to enable the connection should be covered by this. The amount of the system provision charges depends on the agreed extent of grid use and is determined by the regulatory authority by ordinance.

The system provision charge according to § 76 (1) NGSA 2011 and § 6 and § 9 (1) Gas System Charges Ordinance 2013 has to be paid as well.

8.1.1.2.4 METERING CHARGE

The metering charge according to § 77 NGSA 2011 is paid by the system users to the system operators for the costs associated with the installation and operation of metering equipment including calibration and meter reading. The corresponding charges, which have to be charged regularly (monthly) based on the costs, is set by ordinance as a maximum price. The metering charge is determined according to the type of metering in § 15 Gas System Charges Ordinance 2013. In conclusion this means for a P2G facility that as an injecting party it shall pay the metering charge.

8.1.1.2.5 SUPPLEMENTARY SERVICE CHARGES

§ 78 NGSA 2011 allows grid operators to charge grid users (withdrawing as well as injecting parties) for other services if this is necessary. The conditions for this are that the costs are not covered by the previously discussed charges and that they were directly caused by the grid users. Since the P2G system is an injecting party, the charge for other services must also be paid by it if required.

[149] Cf. 75 (4) NGSA.

8.1.2 LEVIES

8.1.2.1 RENEWABLE ELECTRICITY FLAT RATE AND RENEWABLE ELECTRICITY CONTRIBUTION

The renewable electricity flat rate and the renewable electricity contribution are part of the funding mechanism pursuant to § 71 REEA. The renewable electricity flat rate is the contribution in euros per metering point which is payable by all final consumers connected to the public electricity grid. However, the obligation to pay the flat-rate shall not apply to final consumers who provide balancing services (pursuant to sections 23b to 23d EA 2010), pumped-storage power plants and final consumers in low-income households.[150] The renewable electricity flat rate was set at zero for 2022 and will only have to be paid from 2023.[151] The renewable electricity contribution is the fee payable by all end-users connected to the public electricity grid, with the exception of pumped storage power plants and end-users in low-income households.[152] It shall be paid in proportion to the respective system utilisation charge and the charge for system losses and is determined annually in advance by the Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology in agreement with the Federal Minister for Digital and Economic Affairs by ordinance.[153] The renewable electricity contribution for the year 2022 was set in the renewable electricity contribution Ordinance 2022 (F.L.G. II No. 600/2021) at 0 % of the Austrian-wide average system utilisation charge and the charge for system losses per grid level pursuant to the System Charges Ordinance 2018. Thus, no renewable electricity contribution is payable in the calendar year 2022. Furthermore, provided that a P2G plant has a minimum capacity of 1 MW, purchases electricity exclusively from renewable sources and does not feed into the gas grid, exemptions from the obligation to pay the renewable electricity flat rate and the renewable electricity contribution may, where applicable, be established in the ordinances pursuant to § 73 (7) and § 75 (2) REEA in accordance with the EU state aid rules. However, as long as this is not the case, these exemptions may be granted as de minimis aid under the conditions of Regulation (EU) 1407/2013 (as amended in 2020 L215/3).[154]

8.1.2.2 COMMUNITY LEVIES FOR THE USE OF PUBLIC LAND

If public municipal land or the airspace above it is used by energy supply companies (e.g. for electricity grids) beyond the scope of public use, municipalities may charge fees.[155] This fee is a municipal charge and can be set by municipalities through ordinances, whereby the maximum amount is set by the provinces (Vorarlberg and Burgenland do not have any provincial regulations in this regard).[156] Since the possible charging of this levy can be determined by each municipality itself, no general statement can be made as to whether and in what amount it is to be borne by energy suppliers. However, it can be assumed that if this levy is demanded, it will be passed on to the grid users by the energy suppliers. Thus, a P2G plant must at least expect that these additional costs could be incurred when drawing electricity or gas from public grids.

[150] Cf. § 6 (1) (16) REEA.
[151] Cf. § 73 (1) REEA.
[152] Cf. § 6 (1) (15) REEA.
[153] Cf. § 75 (1) and (2) REEA.
[154] Cf. §§ 73 (1a) and 75 (1a) REEA.
[155] *Raschauer*, Energierecht, p. 162.
[156] § 8 (5) Fiscal constitutional law 1948 F-VG 1948 Bundesverfassungsgesetz über die Regelung der finanziellen Beziehungen zwischen dem Bund und den übrigen Gebietskörperschaften (Finanz-Verfassungsgesetz 1948 - F-VG 1948) F.L.G. No. 45/1948 last amended by F.L.G. I No. 51/2012.

8.1.3 TAXES

8.1.3.1 ELECTRICITY TAX

According to § 1 (1) Electricity Tax Act (Elektrizitätsabgabegesetz F.L.G. No. 201/1996 as amended by F.L.G. I Nr. 63/2022, the supply of electrical energy is subject to the electricity tax.[157] The amount of this tax is basically 0.015 € per kWh.[158] However, for operations after April 30, 2022 and before July 1, 2023, the levy is 0.001 euros per kWh.[159] The purchase of electricity by the P2G plant from the public electricity grid for the purpose of conversion into hydrogen or optionally into synthetic natural gas is initially to be qualified as a supply of electrical energy and thus as a taxable event. However, it is to be assessed whether a tax exemption is enshrined for the supply of electricity to the P2G facility. [160] First, § 2 (1) (1) of the Electricity Tax Act must be examined, according to which electrical energy is exempt from tax if it is used for the production and transmission of natural gas. The fact that the term "natural gas" is not defined by law or what is meant by it in terms of the Natural Gas Tax Act causes difficulties.[161] However, it can probably be assumed that the electricity input required for the production and feed-in of hydrogen or synthetic natural gas (these must meet the requirements of ÖVGW Guideline G B210) is also exempt from electricity tax. [162] In addition, P2G plants could also be eligible for tax relief in the form of compensation under Section 2(1)(2) of the Electricity Tax Act, which exempts electrical energy from tax if it is used for non-energy purposes. According to the guidelines to the Electricity Tax Act of the Federal Ministry of Finance, a non-energy use exists both in the case of chemical or physical use and in the case of use for the decomposition or conversion of substances for electrolysis.[163] A clarification to what extent the purchase of electricity for electrolysis in the context of P2G is covered by the tax relief would be advisable.

8.1.3.2 NATURAL GAS TAX

The Natural Gas Tax Act (Erdgasabgabegesetz F.L.G. No. 201/1996 as amended by F.L.G. I No. 63/2022)[164] explicitly refers to hydrogen. With its revision, hydrogen and biogas are no longer assigned to the Mineral Oil Tax Act 2022 (Mineralölsteuergesetz 2022 F.L.G. No. 630/1994 as amended by F.L.G. I No. 63/2022), but to the Natural Gas Tax Act.[165] Accordingly, natural gas within the meaning of the Natural Gas Tax Act is now to be understood as products of subheading 2711 21 00 of the Combined Nomenclature[166], biogas[167] and hydrogen[168], and are thus the subject of the tax. The levy for hydrogen is 0.021 € per m^3.[169] For operations after

[157] The tax territory under this Act comprises the federal territory with the exception of the local municipalities of Jungholz in Tyrol and Mittelberg in Vorarlberg, § 1 (3) Electricity Tax Act.
[158] § 4 (2) Electricity Tax Act.
[159] Cf. § 7 (11) Electricity Tax Act.
[160] Cf. *Markl*, Power-to-Gas in Österreich? – Eine Analyse des rechtlichen Rahmens im Vergleich zu Deutschland in *Steinmüller* et al, Energiewirtschaft Jahrbuch 2012, pp. 164-165; *P. Oberndorfer/Schmied*, Wohin mit dem Strom? ZTR 2015, 99, 105-106.
[161] Since 2019, hydrogen has also been subsumed under natural gas within the meaning of section 2 (1) (3) of the Natrual Gax Tax Act. It could be considered whether the subsumption of hydrogen under natural gas also extends to the Electricity Tax Act and thus to the exemption under section 2 (2) Electricity Tax Act. However, without further indication, it cannot be assumed without further ado that the use of the term also applies to other laws, in concreto the Electricity Tax Act.
[162] An explicit legal extension would nevertheless be useful.
[163] *Federal Ministry of Finance*, Energieabgaben-Richtlinie 2011 of 15.04.2011.
[164] Bundesgesetz, mit dem eine Abgabe auf die Lieferung und den Verbrauch von Erdgas eingeführt wird (Erdgasabgabegesetz) F.L.G. No. 201/1996 last amended by F.L.G. I No. 103/2019.
[165] The Natural Gas Tax Act has a lower tax rate compared to the Mineral Oil Tax Act.
[166] § 2 (1) (1) Natural Gas Tax Act.
[167] § 2 (1) (2) Natural Gas Tax Act.
[168] § 2 (1) (3) Natural Gas Tax Act.
[169] § 5 (4) Natural Gas Tax Act.

April 30, 2022 and before July 1, 2023, however, the levy will be €0.0038 instead of €0.021 per m3.[170] In addition, tax exemptions were introduced by way of compensation. For biogas, hydrogen produced exclusively from renewable energy sources as well as synthetic gas produced from renewable hydrogen (unmixed or insofar as they are mixed with natural gas) a tax exemption by way of remuneration was implemented, provided that they verifiably fulfil the sustainability criteria of the Fuel Regulation 2012 (Kraftstoffverordnung 2012)[171] or other standards implementing RED II.[172] However, it should be noted that the applicability of § 3 (2) (3) of the Natural Gas Tax Act, implementing this tax exemption, has been postponed until the obligations under EU law, in particular under state aid law, have been fulfilled.[173]

8.1.3.3 VALUE-ADDED TAX

For the purchase of electricity from the public grid: Pursuant to § 1 (1) (1) Value Added Tax Act 1994 (Umsatzsteuergesetz 1994)[174], a supply made by a entrepreneur for consideration within the scope of his business in Austria is subject to VAT at the rate of 20 %.

8.2 BULGARIA

8.2.1 SYSTEM CHARGES

P2G hubs have to pay to their electricity supplier charges for transmission, access, and other electrical grid services, along with the price of the electrical energy. There is a possibility for exemption of P2G hub from paying these charges. According to the RTEE (art. 29, par.6), no electricity transmission and access charges are due as long as the P2G hub uses the production of GRS as means of storage of electrical energy, and the stored GRS is used to generate electrical energy which will be fed back to the electrical grid.

According to the RES Act, GRS cannot be discriminated in reference to charges for transmission and/or distribution.

A payment has to be made for connecting the P2G hub to the electrical grid. Methodology for calculation of the price is developed by the EWRC (art. 29, par. 9 of the RES Act).

In order the PFGRS to be connected to the gas distribution network or gas transmission network, a price according to art.36, par.3 of the Energy Act, has to be paid.

[170] Cf. § 8 (6) Natural Tax Act.
[171] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Qualität von Kraftstoffen und die nachhaltige Verwendung von Biokraftstoffen (Kraftstoffverordnung 2012) F.L.G. II No. 398/2012 last amended by F.L.G. II No. 630/2020.
[172] § 3 (2) (3) Natural Gax Tax Act. The Federal Minister of Finance is authorised, by ordinance in agreement with the Federal Minister of Sustainability and Tourism, to regulate in more detail the procedure for proving compliance with the sustainability criteria pursuant to § 3 (2) (3) and, if necessary, to establish consistency with environmental regulations, in particular standards for the implementation of RED II.
[173] Cf. § 8 (5) Natural Tax Act and BGBl. II No. 440/2019 (Announcement of the Federal Minister of Finance on the date of applicability of § 2 (1) and § 3 (2) (3) Natural Tax Act, § 1 (3) (2) and § 2 (2) (2) (b) Energy Tax Rebate Act (F.L.G No. 201/1996 as amended by F.L.G. I No. 46/2022) as well as § 2 (1) (1) and § 4 (1) (10) Mineral Oil Tax Law (F.L.G. No. 630/1994 as amended by F.L.G. 63/2022), F.L.G. II. No. 440/2019).
[174] Bundesgesetz über die Besteuerung der Umsätze (Umsatzsteuergesetz 1994 – UStG 1994) F.L.G. No. 663/1994 last amended by F.L.G. I No. 52/2021.

8.2.2 LEVIES

8.2.2.1 "OBLIGATION TO SOCIETY" LEVY

It is collected from consumers by each trading participant who sells electrical energy to end users, connected to the electrical grid (Energy Act, art. 31, point 3). Again, as in the case for system charges, there is a possibility for exemption of P2G hub from paying this type of levy. According to the RTEE (art. 31a, par.1), no levy is due as long as the P2G hub uses the production of GRS as means of storage of electrical energy, and the stored GRS is used to generate electrical energy which will be given back to the electrical grid.

"Obligation to society" levy, along with the compensation mechanism for the producers of electrical energy from RS, is defined according to a methodology developed by the EWRC, as stipulated in art. 35, par. 5 of the Energy Act.

8.2.2.2 LEVIES FOR THE FUND "PROTECTION OF THE ELECTRICAL ENERGY SYSTEM"

The Fund for protection of the electrical energy system (FPEES) is defined in the Energy Act (art. 36b). It has the obligation to manage the required financial resources for provision of preferential pricing, premiums, commitments under long-term contracts for purchase of electrical energy at subsidised prices and so on. Each producer of electrical energy makes instalments in the Fund amounting to 5% of the revenues it generates. Producers of electrical energy from RS and from green hydrogen are exempted form that obligation. The exemption does not apply for installation under 30 kW which are meant to be built on roofs and facades. In that reference, the P2G hub does not have to pay the 5% levy for the case when it produces electrical energy from RS.

8.2.3 TAXES

8.2.3.1 EXCISE TAXES

Selling electrical energy and biogas to end-consumers is exempted from paying excise (Excises and Tax Warehouses Act – ERWA Act).

The following entities are subject to registration under the ERWA Act and excise payment do apply:

- Consumers of electrical energy, produced from installation with power capacity over 5 MW;
- Consumers of electrical energy which are licensed for production of electrical energy per the provisions of the Energy Act;
- Producers of electrical energy form RS with power capacity under 5 MW who sell their own energy;
- Consumers of electrical energy, produced from RS and installation with power capacity under 5 MW. The norm does not apply when consumption is for household needs;
- Producers and suppliers of biogas for enterprise needs and for their own needs. The norm does not apply when the biogas is used for household needs or for production of electrical energy.

8.2.3.2 VALUE ADDED TAXES

Value added tax is paid and recuperated according to the Value Added Tax Act (VAT Act). No exemptions are made under the VAT Act.

8.3 CROATIA

System charges for the purchase and usage of electricity and gas from the grid are determined with several acts and decisions.

Table 1. Tariff items for first two months of using guaranteed supply (UT=unique tariff, HT=high tariff, LT=low tariff)

Tariff model		Tariff item for energy [HRK/kWh]		
		EN_{UT}	EN_{HT}	EN_{LT}
High voltage		/	0.7096	0.4174
Medium voltage		/	0.6934	0.4079
Low voltage	Blue	0.6750	/	/
	White	/	0.7780	0.4576
	Red	/	0.6776	0.3986
	Yellow	0.5283	/	/

Table 2. Tariff items after first two months of using guaranteed supply (UT=unique tariff, HT=high tariff, LT=low tariff)

Tariff model		Tariff item for energy [HRK/kWh]		
		EN_{UT}	EN_{HT}	EN_{LT}
High voltage		/	0.8064	0.4743
Medium voltage		/	0.7879	0.4635
Low voltage	Blue	0.7671	/	/
	White	/	0.8841	0.5200
	Red	/	0.7701	0.4530
	Yellow	0.6003	/	/

Additionally, there are also charges for the distribution and transmission of electricity, which are defined by the **Decision on the amount of tariff items for electricity distribution (OG 112/2018)** and the **Decision on the amount of tariff items for electricity distribution (OG 112/2018)**. These tariffs determine the charges for utilization of the electricity grid and are presented in the following tables:

Table 3. Tariff items for distribution of electricity (UT=unique tariff, HT=high tariff, LT=low tariff)

Category of buyer	Tariff model		Tariff element					
			Workforce			Calculated peak workforce	Excessive reactive energy	Charge for the
			UT	HT	LT			

									metering point
				(HRK/kWh)	(HRK/kWh)	(HRK/kWh)	(HRK/kW)	(HRK/kvarh)	(HRK/month)
			Tariff items						
				1	2	3	4	5	6
Entrepreneurship	High and very high voltage	White	1						
	Medium voltage	White	2		0.10	0.05	12.00	0.15	66.00
	Low voltage	Blue	3	0.22				0.15	41.30
		White	4		0.24	0.12		0.15	41.30
		Red	5		0.16	0.08	24.00	0.15	41.30
		Yellow (public lighting)	6	0.17					14.70
Households	Low voltage	Blue	7	0.22					10.00
		White	8		0.24	0.12			10.00
		Red	9		0.16	0.08	24.00		41.30
		Black	10	0.13					5.80

Table 4. Tariff items for transmission of electricity (UT=unique tariff, HT=high tariff, LT=low tariff)

Category of buyer	Tariff model		Tariff element					
			Workforce			Calculated peak workforce	Excessive reactive energy	Charge for the metering point
			UT	HT	LT			

				(HRK/kWh)	(HRK/kWh)	(HRK/kWh)	(HRK/kW)	(HRK/kvarh)	(HRK/month)
			Tariff items						
				1	2	3	4	5	6
Entrepreneurship	High and very high voltage	White	1		0.04	0.02	14.00	0.16	68.00
	Medium voltage	White	2		0.04	0.02	14.00		
	Low voltage	Blue	3	0.09					
		White	4		0.11	0.05			
		Red	5		0.05	0.02	14.50		
		Yellow (public lighting)	6	0.06					
Households	Low voltage	Blue	7	0.09					
		White	8		0.11	0.05			
		Red	9		0.05	0.02	14.50		
		Black	10	0.05					

Moreover, to participate in the system of guarantees of electricity origin, a separate charge needs to be paid, according to the **Decision on amount of charge for participating in guarantee of electricity origin system (OG 34/2015)**. This Decision is based on the **Regulation on establishment of the guarantees origin for electricity system (OG 84/13, 20/14, 108/15, 55/19)**.

Therefore, producers that want to be included in the system and have the oppotunity to provide the guarantee of origin of their electricity need to settle the following charges:

Table 5. The annual charge for account administration within the Register of guarantees of origin for electricity

No.		Type of account in the Register	Charge amount without compensation [HRK] (VAT excl.)
1	The user account of eligible producer of electricity		
	1.a	With a total installed power of all the plants within the Register equal or higher than 0.5 MW	5,000.00
	1.b	With a total installed power of all the plants within the Register lower than 0.5 MW	100.00
2	The user account of other Register users		10,000.00

Table 6. Annual charge for each production plant registered within the Register

No.	Installed power of the plant	Amount of annual charge [HRK] (VAT excl.)
1	Higher than 10 MW	18,000.00
2	Higher than 5 MW, up to and incl. 10 MW	8,000.00
3	Higher than 1 MW, up to and incl. 5 MW	500.00
4	Higher than 300 kW, up to and incl. 1 MW	200.00
5	Higher than 30 kW, up to and incl. 300 kW	100.00
6	Up to and incl. 30 kW	50.00

Concerning the gas grid, there are also several charges that need to be covered, in order for a producer of gas to participate in the system. Although renewable natural gas is not mentioned in these charges, they could apply for it when injected into the system.

Natural gas production is defined as a manner in which the production facility ensures that the natural gas meets the criteria for gas quality, after the production, which is carried out in accordance with regulation from the mining and hydrocarbon sectors, so that it can be safely transported or distributed through the gas system, including the sales and supply. The natural gas producer is defined as an entity that participates in the market and produces natural gas.

According to the **Gas Market Act (OG 18/18, 23/20)**, a natural gas producer has every right to connect to the transport or distribution network (while meeting the technical requirements), sell the gas to natural gas suppliers and traders, and have access to the underground gas storage and manipulate natural gas quantities.

The minimum obligations of the producer, defined within the **Network rules of the distribution system (OG 50/18)**, are as follows:

- to ensure safe, reliable and efficient operation of production pipelines,
- to ensure objective, equal and transparent conditions of production pipeline access to facilities which provide additional technical services,
- provide necessary information determined by the law,

- establish and ensure the functioning of a control centre for the management of the production facility as well as for gas quality monitoring,
- creation and update of five-year development plans,
- plan and account for measures for safe and continuous gas production,
- ensure required gas quality, and
- be connected to the distribution or transport system.

The gas producer and the supplier (trader) determine their mutual obligations via contracts. These contracts must contain the following: name and PIN of both parties, the subject of the contract, the location of gas delivery, identification number and the capacity of the meter, the date of gas delivery, the price of gas and other levies, terms of supplied gas metering and payment, information exchange details, etc.

Depending on the injection site (transportation or distribution system), the supplier needs to agree upon the terms of gas transportation or distribution with the relevant operator, defined within the **General terms for gas supply (OG 158/13, 74/17, 50/17)**. If not obliged by the public service of gas supply, the supplier determines the price unhindered.

Once the quality of gas is determined, the supplier must establish and maintain a system for gas quality metering. Furthermore, the supplier is obliged to send reports on the gas quality markers every quarter to the regulatory agency. Every March 1st, the supplier must deliver a report to the Agency containing the following items: description of the system for quality tracking, data on the gas quality markers, description of measures undertaken for improvement of the gas quality, and proposition on measures to increase the quality of supply.

The fee is calculated on a case-by-case basis depending on the amount of gas and production facility technical characteristics, whose methodology is defined by the following:

- **Methodology for determining the price of non-standard services regarding gas transport, gas distribution, gas storage, receival and shipping of LNG and the public service of gas supply (OG 48/18)**
- **Methodology for determining the fee for connecting to the gas distribution or transport system and for the increase of connection capacity (OG 48/18)**

In Croatia, there are no specific levies for the aforementioned connections to the electrical and gas grids. The charges that are mentioned in the previous question are the ones that are currently the only fees for connection to the grids.

However, in order to collect enough means to finance the feed-in-tariffs and production of renewable energy sources, the Croatian Energy Market Operator (cro. Hrvatski operator tržišta energije d.o.o. - HROTE) charges a fee for all end-users of electricity. This fee is determined through the **Decision on the charge for renewable energy sources and highly efficient cogeneration (OG 87/17, 57/20)**, which amounts to 0.105 HRK/kWh, with several exceptions that are described within the Decision (e.g., obligators of the emission trading system scheme). However, currently there are no levies that are applicable for hydrogen or P2G.

In Croatia, taxes are determined within the **Value Added Tax Act (OG 73/13, 99/13, 148/13, 153/13, 143/14, 115/16, 106/18, 121/19, 138/20)**. The tax is mandatory for all taxpayers currently present in Croatia and in regard to this topic, it includes distributors of gas and electricity, but also heating and cooling.

VAT in Croatia amounts to 25%. However, some services and goods have a lower percentage of VAT, and this includes services of electricity supply, which have VAT of 13%. On the other hand, gas is taxed by 25%.

Regarding (renewable) hydrogen and "renewable" natural gas (biomethane), there is no mention of both in the aforementioned legislative document. Therefore, they would need to be mentioned and inserted and their transmission, utilization and distribution managed and legalized.

8.4 CZECH REPUBLIC

8.4.1 SYSTEM CHARGES

All charges related to the distribution of electricity and gas are set out in the pricing decisions of the Energy Regulatory Office (published several times a year). The price of electricity consists of charges (i) for reserved power (ii) for system services (iii) to the market operator from renewable surcharges and (iv). The gas price includes a consumption charge and a market operator service charge. The term "system charges" is not known to Czech legislation (Law 362/2021 and 382/2021). There are dozens of electricity/gas network operators in the Czech Republic and each of them has different charges, conditions, pricing etc. Not all operators are active in all regions. For a significant customer, the charges are negotiated individually.

8.4.2 LEVIES

No "other levies" or "exemptions" were traced.

8.4.3 TAXES

Gas and electricity are taxed according to the Act on the Stabilization of Public Budgets (law 261/2007). Gas is partially exempt from the tax if it is used as an "alternative fuel" in transport. Electricity from "supported sources" is fully exempt from the tax. The current legislation (laws 362/2021 and 382/2021) does not foresee that any hypothetical P2G operator should pay any extra taxes than usual for business entities (law 586/1992).

8.5 GERMANY

8.5.1 SYSTEM CHARGES

For the usage of the electricity and gas networks, system charges ("Netznutzungsentgelt") have to be paid. The system charges are independent from the distance and consist of a commodity price for the amount of energy withdrawn in ct/kWh or €/MWh and a demand charge for the maximum power used in ct/kW or €/MW. The network operator determines the network charges for parties connected to the low voltage grid. The charges have to be non-discriminating, transparent and appropriate and are to be calculated on the basis of the operation management, therefore they are regulated. The network charges have to be published on the operators' websites.[175,176]

For plants consuming at least 10 GWh per year, an individual network charge of only 10-20% of the published network charge applies, depending on the number of hours used. The regulation authority has to approve.[177] Individual network charges also apply for consumers directly connected to the middle voltage grid, as well as for electricity storage facilities.[178]

The grid connection has to be borne by the connecting party, thus the P2G hub owner. The costs are calculated by the grid operator.[179] For actual building costs, a building subsidy might apply for the connecting party in

[175] Cf. § 21 EnWG
[176] https://www.bundesnetzagentur.de/DE/Beschlusskammern/BK08/BK8_06_Netzentgelte/BK8_NetzE.html
[177] § 19 (2) StromNEV
[178] § 19 (3), (4) StromNEV
[179] §§ 6 and 9 NAV

case of connections above 30 kW power.[180] For the gas grid, the operator also calculates the costs (usually as a lump sum) which have to be borne by the connecting party.[181] For connections to the middle voltage grid, there is no specific legal regulation. Grid operators make offers for connections, the costs and the building subsidy have to be borne by the connecting party.

According to §118 (6) Energy Industry Act, electrical energy storage facilities (built after 2008 and start of usage before August 2026) are exempted from the network tariffs. They are exempted if they reconvert the energy into electricity (sentence 3) and also if they produce hydrogen through electrolysis or gas through methanation. Sentence 7 of § 118 (6) also exempts those plants, that produce hydrogen and gas through electrolysis and methanation, from feed-in tariffs of gas the produced gases into the gas grid.

The amount or duration of the exemption is not specified. Therefore, it is assumed that exempted plants can reduce network tariffs up to 100%.

8.5.2 LEVIES

With the introduction of the Renewable Energy Act, a special levy, called the "EEG surcharge" ("EEG-Umlage") has been established and is charged via the electricity price. The idea is to use the surcharge in order to finance renewable energy projects.

The EEG surcharge has to be paid whenever an electricity supply company delivers electricity to end users. Since P2G plants can be classified as storage facilities, the EEG surcharge has to be paid for the delivery of electricity. This leads to the problem that the EEG surcharge might be collected twice – once during the storage and again during the withdrawal. Therefore, numerous exceptions from the EEG surcharge have been introduced.[182]

In case of reconversion of the stored gas, the EEG surcharge for the electricity used for storage is being reduced by the amount of EEG surcharge that had to be paid for the reconverted electricity in the same period (usually one calendar year, sometimes one calendar month). The maximum reduction is 100% and the maximum amount of which the surcharge can be withdrawn is 500 kWh per year. The rules apply to facilities that produce "storage gas" and are therefore valid for P2G plants that reconvert the gas. For "lost" energy due to technical reasons of the storage facility, the EEG surcharge is also removed.[183]

EEG surcharge = EEG surcharge for used electricity – EEG surcharge for produced electricity

If the P2G facility does not reconvert the stored electricity, the complete EEG surcharge has to be paid for the electricity used to produce gas, since it is considered to be an "end user" in such cases. P2G facilities can only then benefit from "special compensation regulations" ("besondere Ausgleichsregelungen", § 64 f. Renewable Energy Act), if it is classified as an "energy intensive company". This is the case only for plants that fill hydrogen or biomethane into gas cylinders. The EEG surcharge might be reduced to a certain amount.[184] Further, § 69b Renewable Energy Act contains a special rule for the production of green hydrogen. For electricity used to produce green hydrogen, no EEG surcharge has to be paid.

Other taxes for the purchase of electricity are the offshore-liability charge (Offshore-Haftungsumlage), the CHP surcharge (Kraft-Wärme-Kopplungs-Umlage), surcharge of the Electricity Grid Fee Ordinance

[180] § 11 NAV
[181] § 9 NDAV
[182] Thomas 2017, p. 17
[183] § 61l (1), (2) EEG, cf. Thomas 2017, p. 19-20
[184] Cf. Zapf 2017, p. 216

(StromNEV-Umlage) and the concession fee (Konzessionsabgabe). There are no exemptions from these charges, but the impact is on the electricity price is comparatively small (appr. 3%).[185]

8.5.3 TAXES

In Germany, the so-called "electricity tax" ("Stromsteuer") has to be paid for consumed electrical power. Currently, the electricity tax is 20,50 € per megawatt hour.[186]

§ 9 of the Electricity Tax Law (Stromsteuergesetz) states that electricity used for electricity production is exempted from paying the tax. This aims at stationary batteries. However, experts are considering other storage facilities to fall under this regulation, since in the Electricity Tax Ordinance (Stromsteuerverordnung), the legislator limited the scope of the exemption for pumped hydro storage facilities and for electricity used for ancillary and auxiliary equipment. Experts argue that analogously those storage forms that have not been mentioned in the ordinance can therefore make use of the exemption rule.[187] If this is assumed to be the fact, the exemption again only applies to those P2G plants that reconvert the gas into electricity.

According to § 9a (1) Renewable Energy Act, "companies in the manufacturing sector" ("Unternehmen des produzierenden Gewerbes") that make use of electrolysis, can apply for remission, reimbursement or compensation. Companies in the manufacturing sector are classified by the Classification of Economic Activities, 2003 edition (Klassifikation der Wirtschaftszweige, Ausgabe 2003 (WZ 2003)). It lists companies that are active in the field of exploitation of oil and gas, which also includes methane.[188] The term "Gewinnung" is used for methane. As mentioned above, the term "Gewinnung" can also be translated as "production". This seems to be the case, since the term "Förderung" ("extraction") is used for gas. It can therefore be argued that P2G plants fall under the term "companies in the manufacturing sector". Lietz points out that for production of gas, P2G plants might fall under the definition of the subgroup "chemical product manufacturing" ("Herstellung von chemischen Erzeugnissen") and for the case of reconversion, they can fall under the group of "electricity and water supply" ("Energie- und Wasserversorgung").[189] However, the assumption of such classification is evaluated differently by experts.[190] A legal clarification is needed.

8.6 HUNGARY

In order to operate a P2G plant, one shall purchase electricity to use it in the production of hydrogen or hydrogen-based methane. After the gases or electricity is produced, to use the result as energy source, the final product needs to be fed into the existing compatible grid. The consumption and production of electricity and gas are targeted by several system charges which will be discussed in the following chapters.

8.6.1 SYSTEM CHARGES

8.6.1.1 SYSTEM CHARGES FOR THE PURCHASE OF ELECTRICITY

For using the public electricity grid, market participants are obliged to pay several system charges.

[185] Cf. Kreeft 2018, p. 69
[186] § 3 StromStG
[187] Cf. Kreeft 2018, p. 67
[188] Cf. WZ 2003, p. 162
[189] Cf. Lietz 2017, p. 217
[190] Cf. Dena 2018, p. 2

The Hungarian system is regulated as feeding in parties as well as withdrawing parties are obligated to pay for system charges. The actual amount and the detailed circumstances of the payment of the system charges varies depending on the contract which was concluded between the parties involved.

System charges are listed in provision 142. § section (1) in Electricity Act. System charges are the following:

- transmission fee
- distribution fee
- public lightning distribution fee

System charges are regulated by the Hungarian Energy and Public Utility Regulatory Authority (hereinafter: MEKH), which determines the pricing based on the system usage fees for the period immediately preceding the price regulation cycle and the justified costs on which the system usage fees are based, taking into account changes in the parameters influencing the development of costs. The price regulation cycle is cc. 4 years, as prices applicable from April 2021 will be binding until the 31st of December in 2024.

As it is stated in provision 142. § (5) energy efficiency considerations shall also be considered when setting system charges, including cost savings through consumption and demand side responses, as well as distributed generation and other energy efficiency measures, including reductions in transmission, distribution and network investment costs, and also the savings achieved through more optimal network operation.

As P2G plants are considered to withdraw electrical energy from the public grid, system charges shall be paid by them.

Based on the conditions mentioned above, the fees are to be calculated the following way.

Transmission fee

Based on the provisions 4. § of Regulation on charges regarding the electricity market, transmission fee is imposed as it shall cover the following expenses:

- the justified operating costs of the activity of a transmission system operator licensee,
- the justified depreciation and cost of capital of the assets used for the activity of the transmission system operator licensee,
- the reasonable cost of obtaining electricity to compensate for the recognized network loss in the transmission network,
- the justified costs of the sub-activities necessary for the provision of system-level services in accordance with the principle of least cost at the level of the national economy,
- reasonable costs incurred by the transmission system operator in meeting its international market integration obligations; and
- reasonable costs incurred by the transmission system operator in complying with other obligations laid down in law, an act of the European Union or the rules on electricity supply.

Transmission fee is to be paid by several actors appearing on the electricity market. First of all, the transmission system operator can receive the transmission fee from an energy plant, from a user, from the interconnector-based electricity transmission carrier, from the distributor or from a licensee and from the operator of a direct or private pipeline. Distributor can receive transmission fee from the user, from energy plants, from a licensee,

and from the operator of a direct or private pipeline. Due to provision 4. §. (3) of Regulation on charges regarding the electricity market, transmission fee has to be defined as kWh.

As P2G plant is purchasing electricity, it shall be considered as an user, therefore it is obligated to pay for a transmission fee.

Distribution fee and Public lightning distribution fee

Based on provision 5. § of the Regulation on charges regarding the electricity market, the distribution fee shall cover the following expenses:

- the reasonable operating costs of the distribution licensee's activities, including the use of flexibility services in accordance with the least cost principle,
- the justified depreciation and cost of capital of the assets used for the licensing activity of distributors,
- the justified cost of purchasing electricity to compensate for the recognized network loss in the distribution network, and
- the justified cost of compensating for the deviation from the profile.

Distribution fee is calculated based on the following components:

Basic distribution fee, HUF / connection point / year,

+ distribution capacity fee, HUF / kW / year,

+ distribution traffic fee, HUF / kWh,

+ distribution reactive energy fee, HUF / kVArh.

Taking everything into account provision 5. § (3) sets: Distribution fee elements shall be set per voltage level, based on justified costs, taking into account cost ratios per voltage level, measurement conditions and incentive aspects.

Public lightning distribution fee is a fee set in HUF / kWh.

Regarding the circumstances as the withdrawing parties are obligated to pay for all kind of system charges, P2G plants, as gas market participants who purchases electricity as an user, shall pay for distribution and public lightning fee as well.

8.6.1.2 SYSTEM CHARGES FOR THE FEED-IN OF GAS

For the use of the natural gas system, system charges shall be paid by parties feeding in gas into the gas grid, as well as by parties withdrawing gas from the gas grid. While P2G plants may sell the produced gas in the market, in it shall also withdraw gas for mixing from the gas grid system. In these cases mentioned above, P2G plants are obligated to pay for natural gas system charges defined by the MEKH. Decree of MEKH 8/2020. on a framework for the setting of natural gas system charges, separate tariffs and connection charges for the price control cycle starting in 2021 (hereinafter: Regulation on charges regarding the gas market) lists transmission system operation fee, natural gas distribution fee, distribution transfer fee and natural gas storage fee as system charges.

Transmission system operation fee

The transmission system operation fee is calculated out of three components: the transmission capacity charge, the shipping fee and the odorization fee. Due to the provision 6. § of Regulation on charges regarding the gas

market, the transmission system operation fee is imposed to cover the operating costs of the transmission system operator justified in accordance with price regulation, the depreciation and cost of capital of the transmission system operator 's assets in relation to price control assets and the settlement difference of the transmission line justified in accordance with the price regulation.

Natural gas distribution fee

The natural gas distribution fee consists of 3 components as well, as it is declared in the Regulation on charges regarding the gas market. The three components are the removal fee, the storage fee and the storage capacity fee. Provision 7. § (2) of the Regulation on charges regarding the gas market clarifies, the components of the natural gas distribution shall be determined based on the justified costs, taking into consideration the cost ratios per sales category as well as the measurement conditions for each sales category.

Natural gas distribution fee is imposed as it shall cover the operating costs of the natural gas distributor justified according to the price regulation, the depreciation and cost of capital of the price control assets of the natural gas distributor's eligible assets and the settlement difference of the distribution network justified in accordance with price regulation.

The natural gas distribution fee is calculated by MEKH as well.

Distribution transfer fee

Due to provision 6. § (1) of the Regulation on charges regarding the gas market, distribution transfer fee is imposed to cover the following expenses:

- the operating costs of the transmission system operator justified in accordance with price regulations,
- the depreciation and cost of capital of the transmission system operator 's assets in relation to price control assets.
- the settlement difference of the transmission line justified in accordance with the price regulation.

Natural gas storage fee

Regarding the provision 9. § natural gas storage fee is imposed as it shall cover the justified operating costs of the natural gas storage licensee, the depreciation and cost of capital of the price control assets of the natural gas storage licensee's justified assets, the settlement difference of the natural gas storage facility justified in accordance with the price regulation, and the cost of capital for the cushion gas recorded as an asset.

- **Charges for residential and non-residential users**

In the Regulation on charges regarding the gas market other fees besides the system charges shall apply on certain gas market participants. We can distinguish system charges from connecting fees and service fees.

Connecting fees shall be paid by gas market actors who are feeding gas into the gas grid, in certain cases f. e. P2G plants. Service fees are defined by system operators (DSOs and TSOs as well), and shall be paid by residential and non-residential users in certain cases.

Payable fees are different for residential and non-residential users. F. e. in the electricity market, MEKH defines all charges for residential and non-residential users which means users and non-residential users receive an invoice which shows solely one payable amount that includes all of the charges applying.

Through this system, residential users are obliged to pay a fee which includes energy fee, system charges, VAT, gross electricity fee, the rounded gross electricity fee and a basic fee for distribution. Besides the components of the fee stated above, non-residential users are required to pay for further expenses: excise duty,

distributive reactive energy charge, distribution performance fee and for certain funds defined in provision 147. § of Electricity Act.

For users purchasing gas in the Hungarian market, also the MEKH defines the charges applied. For the simplified fee paying system, residential and non-residential users also receive only one payable amount for each month. The charge for residential users mainly includes system charges, capacity fee, odorization fee and shipping fee. For non-residential users, further components are required to be covered by. The amount of further components may apply in the fee shall be calculated depending on the circumstances of the non-residential user and the circumstances of the purchase.

In such cases P2G plants are obtaining gas or electricity from the public grid, they are subject to the charges mentioned above. Due to the provision 3. § section 47. of the Natural Gas Supply Act, residential users are the user who owns a household - a place of use forming one or more residential buildings, apartments, holiday homes or weekend houses, as well as residential used for the purpose of consuming natural gas for the purpose of consuming natural gas under a contract concluded and does not carry on with the natural gas thus purchased economic activity for the purpose of obtaining income. If in a residential building the number of technically divided, self-contained dwellings exceeds the number of self-contained dwellings in the building the number of non - residential premises, the residential building as a user for common consumption shall be deemed to be for own household use buy and do not carry out economic activities with the purchased natural gas for the purpose of earning income activity. As non-residential users are not defined in the Natural Gas Supply Act, every gas market participant who is considered as a user, but does not fall under the scope of being a residential user, shall be defined as a non-residential user. While P2G plants may carry out economic activities with the purchased gas, they shall be considered as non-residential users. Therefore, fees defined below which are subject to non-residential users shall be paid by the P2G plants in certain cases.

- **The "reduction of regulated prices"**

The reduction of regulated prices is a continuous governmental project from 2013 with an aim to provide affordable energy for residential users of electricity or gas. In the act LIV of 2013 on the execution of the reduction of regulated prices (hereinafter: Reduction of Regulated Prices Act), which came into effect on the 1st of May in 2013, the measures which result the reduction of the regulated prices are introduced. In Hungary, the average energy expenditure for housing per household is quite high. Based on statistics from EUROSTAT, in 2012, across the EU, the average expenditure spent on housing was ranging from 24,3%. On average, Hungarian households are spending 22,6% of their income on energy costs. Due to the high level of these expenses, the reduction of regulated prices was introduced in the Hungarian energy market in 2013.

To understand the significance of the whole program, first, we shall divide users who are end consumers and users who are eligible to transmit, sell and distribute the obtained gas or electricity. Due to the P2G plant's possible functions, they shall be classified as users who can transmit, sell and distribute gas or electricity as well as consuming it.

Due to the regulated price reduction campaign, in the Hungarian legal system, residential users are prioritized over market users in terms of fees and obligations, regarding this discriminative regulation, P2G would be targeted by more obligations and higher fees.

Since P2G plants do not classify as residential users, they would be subject to proportionately higher fees as it was mentioned in chapter 2.5.4.

Hydrogen as the end product of the P2G processes, cannot be fed into the grid in its original form, as it does not comply with the quality standards. In order to reach the expected gas quality which would be suitable to be fed into the grid, we need to mix the hydrogen with natural gas. In terms of natural gas, P2G plants are also not residential users, therefore the required gas shall be bought from the natural gas market and not from a

universal service provider. As the gas is originated from the competitive gas market, the payablesystem charges will be proportionately higher than in the case of universal service providers.

The upkeep costs of the strategic natural gas reserves are also spread across the natural gas consumers. In order to reduce the regulated gas price, the residential customers were excluded from contributing to the strategic reserve, therefore the proportional weight on the market consumers are higher.

8.6.2 LEVIES

The P2G technologies cover five different functions, with different profiles and processes. In these sections, electrical energy and gas can be purchased as well as sold, and certain kind of energy producing activities are being carried out. The following list summarizes the different levies and special expenses occurring for P2G projects.

Energy stocking expenditure

In the process of converting electricity into gas, the process is followed by another step in which electricity is produced again from the gas. In this procedure power generating power plants are needed, although a P2G plants with a power generating capacity exceeding 50MW is unlikely in the near future, but in such case, the extra costs would occur.

In the GKM Decree nr. 44/2002. (XII. 28.) on the minimum amount of energy stocks of power plants with a capacity of 50 MW and more and the storage order (hereinafter: Decree on the minimum amount of energy stocks) energy stocking obligation is introduced for power plants.

Based on provision 1. § of the Decree on the minimum amount of energy stocks, for a production licensee for a power plant with a nominal capacity of 50 MW and more per power plant or - if it generates electricity with different technologies - per power plant, it shall form a normative energy stock and a safety energy stock on the basis of the average daily heat consumption calculated from the annual plan.

For gas-fired power plants, this decree imposes an alternative-fuel obligation, namely oil. Gas-fired power plants exceeding the 50MW limit shall keep 8 days' worth of fuel stock – in this case gas – and 8 days' worth of security stock – oil. To fulfill these obligations, power plants are burdened with excess expenditures.

A P2G plant with a power generating capacity exceeding 50MW is unlikely in the near future, but in such a case, the extra costs would occur.

- **Energy efficiency obligation system**

The energy efficiency obligation system is established with an aim to help reducing energy consumption costs and protect environmental resources for future generations. In order to succeed in this goal, subjects to this levy are required to pay a certain amount after the energy sold to end users in Hungary.

The personal scope of the energy efficiency obligation system extents on legal entities that sell transport fuel to end users.

The amount to be paid is calculated by the MEKH based on the provisions stated in Decree of MEKH 17/2020. (XII. 21.) on reporting end - use energy savings.

The P2G plant's activities would not include selling transport fuel directly to end users, thus it is not required to pay fee to the energy efficiency obligation system.

- **Natural gas security stockpile membership contribution**

The natural gas security stockpile membership contribution covers the financing of Hungary's strategic gas reserves, an it is paid by natural gas consumers.

Earlier, the contribution was built in the price of the universal service, however, Decree of KHEM nr. 72/2009 introduced measures, which resulted the price of the Universal Service no longer including the amount of the contribution, therefore it is indicated on a separate line on the invoice of electrical energy.

Pursuant to Decree 5/2010 (IV.15) MSzKSz, the amount of the security stock member's contribution is HUF 0.0605 / MJ as of 1 July 2010.

8.6.3 TAXES

- **Energy tax and Excise duty**

Energy tax was in effect in Hungary until the 1st of January in 2017 and was regulated in the act LXXXVIII of 2003 on energy tax (hereinafter: Energy Tax Act). From the 1st of January in 2017, it was merged with the excise duty which is regulated is regulated in Chapter X. of the Act LXVIII. of 2006 on Excise Duty Act.

Excise duty is an indirect type of tax that is payable on the sale or use of certain products, such as alcohol, tobacco and energy products.

Under provision 109. § (1) of the Excise Duty Act, the excise duty is based on the quantity of energy product, measured in units of quantity specified at the tax rate. The measurement of the tax is defined as the following.

Measurement of excise duty

- In case of supply, sale or use of road vehicles as fuel, for natural gas 28 HUF / nm3, otherwise 0.3038 HUF / kWh
- In case of electricity 310.50 HUF / megawatt hour

In the Energy Tax Act electricity users (consumers) and electricity traders was obliged to pay energy tax solely in several cases.

Due to provision 2. § section 14. in the Energy Tax Act, the residential user was defined as a user who purchases energy for the consumption of its own household - in accordance with separate legislation in the case of electricity and natural gas - and does not engage in economic activity with the purchased energy for profit, and - in the case of coal - declares this in writing to the energy trader.

While residential user was classified in the Energy Tax Act, the legal term of energy trader was not cleared, although was used in the legal text.

In the Excise Duty Act the residential user's definition cannot be found, while the energy trader's legal term is defined. In provision 3. § section (2) point 8. the definition of the energy user is classified as the following: a person who purchases natural gas, electricity or coal for his or her own use or transmission of electricity permitted under the Electricity Act, a person who purchases natural gas for the purpose of a site service pursuant to the Natural Gas Supply Act; a person who purchases natural gas, electricity or coal for his or her own use or transmission of electricity permitted under the Electricity Act, a person who purchases natural gas for the purpose of a site service pursuant to the Natural Gas Supply Act;

In provision 3. § section (2) point 9. of the Excise Duty Act, the energy trader is classified as the following: a person who regularly and commercially purchases and sells natural gas, electricity or coal for non-own use, who holds a natural gas trade permit in accordance with the Natural Gas Supply Act for natural gas and an electricity trade permit in accordance with the Electricity Act for electricity.

Exemptions for taxpayers are introduced in provision 112. § (1) from point a) to cc). Tax deduction is also possible due to provision 113.-117. § in certain cases, f. e. relating to transport or for engine-development related activities.

In case energy would be solely used while creating electrical energy or through electrolysis, obtaining hydrogen and with methanation methane, due to provision 112. § (1) point cc) P2G plants would be entitled not to pay excise duty, however as the method of the technology is more nuanced, it is not likely for P2G plants to be eligible for exemption or tax deduction.

- **"Robin hood" tax**

The income tax of the energy suppliers, or so called the "Robin hood" tax is regulated by the Act LXVII of 2008 on making district heating more competitive (hereinafter: Robin Hood Tax Act)

As contributing to the reduction and elimination of the competitive disadvantage of residential district heating users is a state task, the subject of the "Robin hood" tax is

- the energy supplier,
- the public service provider, unless it submits a tax return due to the completion of the company registration procedure, and if it is subject to liquidation or compulsory cancellation proceedings.

The "Robin hood" tax is 31 percent of the positive tax base, calculated as stated in provision 6. § of the Robin Hood Tax Act.

In provision 4. § (1) it is declared, energy suppliers are targeted by the Robin hood tax and the definition of energy suppliers in provision 10. § point 1. P2G plants may fall under the definition of producer licensee under the Electricity Act.

For energy market actors if they are a production licensee of a power plant with an installed capacity exceeding 50 MW who benefit from KÁT and METÁR introduced later in chapter 7.1 and 7.2, it is not required to pay for Robin hood tax.

P2G plants, due to the fact, for technologies at an experimental phase power plants are only being built with a lower capacity, it is not likely to be subject to the Robin hood tax, however, if the P2G plant itself does not apply for KÁT or METÁR it is possible it would be targeted with this tax as well.

- **Value Added Tax**

Value-added tax (hereinafter: VAT) is introduced in act CXXVII of 2007 on value-added tax (hereinafter: VAT Act).

Based on provision 1. § of VAT Act, market actors are obliged to pay VAT after

- the supply of goods or services effected for consideration within the territory of the country by a taxable person acting as such,
- the supply of a product within the European Community (hereinafter referred to as the Community), both domestically and for consideration; and
- imports of a product.

The personal scope of the VAT Act is defined in provision 5. § as the following: a legal person or entity that carries out an economic activity under its own name, regardless of its location, purpose or results. The legal and legal capacity of the person or organization concerned is governed by its personal law, but if it would not have legal capacity under its personal law, but under Hungarian law, its legal capacity should be assessed under Hungarian law.

As P2G are affected by the VAT Act, it is obligatory to pay for VAT in the stages – the purchase or selling products – during the technology.

8.7 ROMANIA

8.7.1 SYSTEM CHARGES

Romanian legislation stipulates that each supplier buys energy from the wholesale energy market, which it subsequently distributes to the supplier at a price to which it adds the costs of distribution, transport, system and other operations. It should be mentioned that each operator / supplier has its addition, so the price is one that differs from one operator to another. Prices differ even depending on the region.

For example, ENEL, one of the largest players in the Romanian energy market, has tariffs for equal system services in all regions, namely 11.96 lei / MWh (2.43 EUR), but in terms of tariffs for distribution service on high voltage the lowest price is in the Bucharest Ilfov Region where the company E-distributie Muntenia charges 10.41 lei MWh (2.12 EUR) and in Oltenia there is the highest price of 27.27 lei MWh (5.54 EUR) applied by the company Distributie Energie Oltenia.

* Note that the rates specified above do not include VAT

Context of 2020 : Electricity is excisable. In 2020, the excise on commercially used electricity was set to RON2.54 / MWh. In the case of electricity used for non-commercial purposes, the excise was RON5.08 / MWh.

According to ANRE (National Authority for Energy Regulation) The purchase price for July 2021 is 808.02 lei / MWh. (EUR 164.24). It is also specified that the invoicing of the final household customers taken over because they have not ensured the supply of electricity from any other source is made at the last resort price PUI determined by FUI, according to art.8 paragraph (1) of ANRE Order no.171 / 2020 with subsequent amendments and completions, with the following formula: PUI = Pach + Pf [lei / MWh]

Pach - the purchase price of electricity taken into account by the supplier of last resort, including Tg [lei / MWh];

Pf - the supply component established by the supplier of last resort, for a period of application (includes the cost of the supply activity, the cost of participation in the centralized markets managed by the Romanian electricity and natural gas market operator OPCOM SA and the profit) [lei / MWh]. The Pf supply component established by FUI applicable in the period 01.07.2021-30.09.2021 is 259.06 lei / MWh. (52.65 EUR)

Thus, the PUI price for July 2021 is 1067.08 lei / MWh. (EUR 216.91)

* Mention that FUI stands for Supplier of Last Instance.

Economic Operator	Activity	Rate from 01 July 2020 (lei / MWh) ANRE Order no. 142/2020
National Transport Company of Transelectrica Electric Power - TO.	Average tariff for electricity transmission service	17,97 lei / aprox. 3,6 EUR
	Transmission tariff - component for introducing electricity into the network - TG	1,30 lei / aprox. 0,3 EUR
	Transport tariff - electricity extraction component from the network - TL	16.67 lei / aprox 3,4 EUR
	The tariff for system service, of which: (for functional system services)	14,45 (2,49) lei / aprox 2,9 EUR (0,5 EUR)
Note*** Tariffs do not include value added tax (VAT)		

In terms of prices, the last two years have been full of events. These events occurred as a result of the measure to release energy markets. Thus, the National Energy Regulatory Authority, ANRE (abbreviation in English NERA) decided to give up the standard prices for suppliers of last resort.

ORDER no. 27 of 23 March 2020 laying down measures for the supply of natural gas to domestic customers with a view to eliminating regulated prices, specifies in the first two articles the following: "Article 1

(1) This Order establishes certain measures regarding the supply of natural gas to household customers, with a view to eliminating regulated prices for this category of final customers.

(2) This order applies in the relationship between natural gas suppliers and domestic customers in their own portfolio who have not exercised their right of eligibility and have not opted for the supply of natural gas in a competitive manner.

Article 2

(1) In the perspective of eliminating the regulated prices, in order to ensure the supply of natural gas starting with July 1, 2020, the household customers provided in art. 1 para. (2) must choose its natural gas supplier and conclude with it a contract for the supply of natural gas on a competitive basis, by 30 June 2020.

(2) The natural gas suppliers have the obligation to inform the domestic customers provided in art. 1 para. (2) on the liberalization of the internal market in natural gas and the elimination of regulated prices for this category of final customers.

Although Order 27/2020 also provided for information activities for suppliers, they were missing or inaccessible to many of the customers (especially those in rural areas) so the whole process was delayed.

Because many of the clients did not manage to conclude contracts on the competitive market in due time, in September ANRE (NERA) published a new order (Ord. 171/2021) which came to solve the problem and which specified the following: "Article 2

(1) The supply of electricity to household customers is made by suppliers of last resort based on contracts concluded in accordance with the provisions of the framework contract for electricity supply to household customers of last resort suppliers, approved by order of the President of the National Authority Energy Regulation.

(2) The supply of electricity to non-household customers receiving universal service and to those taken over because they have not ensured the supply of electricity from any other source is made by suppliers of last resort based on contracts concluded in accordance with the provisions of the framework supply contract of electricity to non-household customers of suppliers of last resort, approved by order of the President of the National Energy Regulatory Authority.

3. In contracts for the supply of electricity concluded between suppliers of last resort and non-household customers in their own portfolio who have not used their eligibility and do not meet the conditions or have not applied for universal service, the clauses shall be established by the parties. The price for these customers is set by each provider of last resort, for each network area, on a competitive basis.

(4) The contracts concluded, based on the framework contract for the supply of electricity to non-household customers of last resort suppliers, approved by order of the President of the National Energy Regulatory Authority, between last resort suppliers and non-household customers in its portfolio, who have not used the eligibility and do not meet the conditions or have not applied for universal service, shall remain in force until 31 December 2021, if their period of validity exceeds this date.

Article 3

From 1 January 2021, household customers in the portfolio of suppliers of last resort may continue to benefit from universal service, by maintaining the contractual relationship with the supplier of last resort in whose portfolio it is or by concluding a contract with another supplier. of last resort, at the price of the offer for its universal service, or they can choose an electricity supplier with which to conclude a contract for the supply of electricity in a competitive regime."

The energy market liberalization measure entered into force in January 2021 through Ordinance 20/2021, which is a modified and final version of the previous orders. The most important thing is to amend Article 4 of the previous order. Thus: "(1) From 1 January 2021, following the elimination of regulated tariffs, household customers who have not chosen a competitive offer and have not concluded a contract on the competitive market have the right to be provided by the suppliers of last resort In the case of these customers, the supplier of last resort shall apply the offer price for the universal service, established in accordance with the provisions of the Annex to this Order.

(2) The suppliers of last resort have the obligation to send to the customers of the universal service the competitive offer with the lowest value, which includes the price of active electricity (including the transmission tariff - component of electricity introduction in the T_G network), supplier costs and profit , as well as regulated tariffs for services, being prohibited the inclusion of fixed components expressed in lei / day or lei / month or of other products or services besides the supply of electricity.

(3) The regulated tariffs for services include the transmission tariff - the electricity extraction component from the network (T_L), the tariff for the system service and the tariff for the electricity distribution service related to the voltage level at which the place of consumption is supplied.

(4) Providers of last resort may apply to domestic customers in universal service, without discrimination and conditionality, a commercial discount from 1 January 2021 until at least 30 June 2021, equal to the difference between the price in the universal service offer. applicable from 1 January to 30 June 2021 and the price in the competitive offer.

(5) The commercial reduction provided in par. (4) shall apply if the customer chooses the universal service offer, if he chooses a competitive offer from any provider, until the date of application of the chosen competitive offer, as well as in the absence of communication by the customer of an option.

(6) From 1 July 2021, in the case of household customers who have not concluded a competitive contract with a supplier with effect from 1 July 2021, the electricity consumption achieved from that date shall be billed by providers of last resort with a price equal to the price in the universal service offer in force as of July 1, 2021.

(7) Suppliers of last resort have the obligation to inform, throughout 2021, their home customers receiving universal service about their applicable competitive offers and the right to conclude a contract on the competitive market with any licensed supplier.

This measure was thought to be beneficial for the economy and for the energy price increases that were to come at the national level. In the summer of 2021 and the beginning of autumn, significant increases in energy production and transmission costs were expected to be borne by the final consumer in the price of the bill. Thus, the Romanian state decided to take an emergency order to compensate for the high costs of energy bills.

The emergency order 118/2020 regarding the establishment of a compensation scheme for the consumption of electricity and natural gas for the cold season 2021-2022, issued by the Romanian Government specifies the following:

"Considering the situation determined by the price increase on the international electricity and gas markets, as well as the effects caused by these increases for the Romanian population, it is necessary to regulate a compensation mechanism for the period November 2021- March 2022 so that prices at electricity and natural gas paid by the household consumer should not aggravate the level of energy poverty.

Article 1

(1) In order to support the clients defined in art. 3 point 15 and art. 100 point 23 of the Law on electricity and natural gas no. 123/2012, with subsequent amendments and completions, hereinafter referred to as household customers, in the cold season 2021-2022 is established a scheme for granting a monthly compensation for the payment of bills related to electricity and natural gas consumption for November 2021-March 2022 , the final price difference granted as compensation will be borne from the state budget, through the budget of the Ministry of Labor and Social Protection, from a separate position of budget expenditures, by settling the amounts related to the compensation scheme for electricity and gas suppliers .

(3) The monthly values of the compensations provided in par. (1) shall be granted according to the annex and may be updated by a decision of the Government at the proposal of the Ministry of Energy and the Ministry of Labor and Social Protection, at least 5 working days before the application period.

(4) The amount of compensation shall be deducted from the total payment of the invoice issued by the supplier.

(5) The compensation is applied to the electricity bills issued for consumption related to the period 1 November 2021-31 March 2022, regardless of the type of bill - estimated or regularization, corresponding to the maximum consumption limits provided in art. 3 para. (2), taking into account a reference price of 0.68 lei / kwh determined according to the annex.

(6) The compensation is applied to the natural gas invoices issued for consumption related to the period 1 November 2021-31 March 2022, regardless of the type of invoice - estimated or regularized, corresponding to the maximum consumption limits provided in art. 3 para. (5), taking into account a reference price of 125 lei / Mwh, determined according to the annex. "

Transport, system and distribution tariffs
Valid from January 1, 2021

Network/grid area	Banat	Dobrogea	Muntenia	Moldova	Oltenia	Muntenia (north)	Transilvanya (north)	Transilvanya (south)
Counties	Timiș, Arad, Hunedoara, Caraș-Severin	Tulcea, Constanța, Ialomița, Călărași	Ilfov, Giurgiu și municipiul București	Suceava, Botoșani, Neamț, Iași, Bacău, Vaslui	Argeș, Vâlcea, Gorj, Olt, Teleorman, Dolj, Mehedinți	Galați, Prahova, Buzău, Brăila, Dâmbovița, Vrancea	Bihor, Satu Mare, Sălaj, Cluj, Bistrița Năsăud, Maramureș	Brașov, Alba, Harghita, Covasna, Sibiu, Mureș
Unit	lei/MWh (EUR)	lei/MWh (EUR)	lei/MWh (EUR)	lei/MWh (EUR)	lei/MWh (EUR)	lei/MWh (EUR)	lei/MWh (EUR)	lei/MWh (EUR)
Regulated tariff for TG networking service	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)	1,30 lei (0,26 EUR)
Regulated tariff for the transport service	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)	19,22 lei (3.91 EUR)
System services regulation tariff	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)	11,96 lei (2.43 EUR)
Regulated tariff for high voltage distribution service	15,51 lei (3.15 EUR)	20,17 lei (4.10 EUR)	10,41 lei (2.12 EUR)	19,90 lei (4.05 EUR)	27,27 lei (5,54 EUR)	18,72 lei (3.81 EUR)	19,23 lei (3.91 EUR)	22,23 lei (4.52 EUR)
Regulated tariff for medium voltage distribution service	53,78 lei (10.93 EUR)	62,97 lei (12.80 EUR)	44.96 lei (9.14 EUR)	62,41 lei (12.69 EUR)	78,69 lei (16.00 EUR)	56,87 lei (11.56 EUR)	66,35 lei (13.49 EUR)	67,47 lei (13.71 EUR)
Regulated tariff for low voltage distribution service	161,59 lei (32.58 EUR)	198,14 lei (40,28 EUR)	157,18 lei (31.95 EUR)	192,05 lei (39.04 EUR)	206,35 lei (41.95)	184,75 lei (37.56 EUR)	173,93 lei (35.36 EUR)	178,78 lei (35.34)

Note: The prices are fixed in Romanian lei and the conversion into EURO was made after the exchange rate corresponding to the day of making this table, July 27, 2021

It can be seen that the values of system, network, transport taxes differ depending on the region. At the same time, some of them are equal, as decided by the Energy Regulatory Authority, as is the case with Rugged tariff for TG network service, Regulated tariff for transport service and System services regulation tariff.

Regarding the tariffs for energy distribution on high, medium and low voltage, the highest prices are found in Oltenia and Transylvania (which is divided into two sub-regions, northern and southern). The lowest prices are in the Bucharest Ilfov Region, to which Giurgiu County was added. Banat has the second, lowest costs while Dobrogea and Muntenia fall within the median area of these values.

"The beginning of 2021 brought the complete liberalisation of the electricity market. This means that households will no longer pay prices set by ANRE. Households are now able to compare supply offers and choose accordingly. There are approximatively six million consumers who have remained in the regulated market and now have two options: they stay with the old supply contracts and automatically pay the 'universal service' prices, which will be 13–26 per cent higher that the free market price, or conclude other contracts in the free market.

The price on the balancing market is now freely determined by the supply-demand mechanism and can reach negative values. The participation of the balancing market is now voluntary, and the rules now provide for

settling responsible-party imbalances by applying a single settlement price with an application date correlated with the implementation date of the 15-minute settlement interval."

8.7.2 LEVIES

In addition to the acquisition fees by the supplier from the manufacturer, the supplier adds other taxes before the energy reaches the consumer, be it household or company, industry, etc.

It should be mentioned that after the liberalization of the energy market, each furzinor comes with offers that try to be more attractive for customers.

For example, ENEL, one of the major players on the Romanian energy market, has the specificity of providing energy in the following conditions:

- at the price of universal service (SU);

- in the regime of last instance (UI), at prices determined based on the provisions of the Conditions for the supply of electricity by the suppliers of last resort approved by ANRE Order no. 171/2020, with subsequent amendments and completions in the case of customers taken over by FUI because they did not ensure the supply of electricity from any other source;

- in a competitive manner (free market), for an offer negotiated with the supplier.

For more information see the calculation formula from the previous question PUI = Pach + Pf [lei / MWh]

Among the taxes and tariffs it must be mentioned as stipulated in the previous question that besides the acquisition costs, the supplier also adds other taxes, among which:

- transport service charges (introduction into the TG network + withdrawal from the TL network)

- fees for system services

- distribution service charges

It is important to note that these fees may differ depending on the provider and even depending on the region. Until the liberalization of the energy market, the National Authority for Energy Regulations - ANRE, publishes orders regarding the distribution tariffs approved for each supplier. Since ENEL Romania has the package that stipulates the complete fees, we will take their case as an example.

8.7.3 TAXES

Article 358 - Electricity

1. For the purposes of this Chapter, electricity is the product falling within CN code 2716.

(2) For the purpose of applying the provisions of art. 338 and 339, the electricity is subject to excise duties and the excise duties become due at the time of electricity supply, as the case may be, by producers, distributors or redistributors to the final consumers in Romania.

(3) An entity that produces electricity for its own use is considered, for the purposes of applying par. (2), both producer and final consumer.

(4) By exception from the provisions of art. 338, the consumption of electricity used for maintaining the capacity to produce, transport and distribute electricity, within the limits established by the regulatory authority in the field, shall not be considered as a fact generating excise duty.

(5) The authorized economic operators in the field of electricity have the obligation to register with the competent authority before carrying out the activity with electricity, under the conditions provided in the methodological norms.

amendment introduced by LAW no. 296 of December 18, 2020, published in the OFFICIAL GAZETTE no. 1269 of December 21, 2020

(6) When electricity is supplied in Romania by a distributor or redistributor from another Member State, which is not registered in Romania, the excise duty becomes chargeable on supply to the final consumer and is paid by a company designated by that distributor or redistributor. , which must be registered with the competent authority in Romania.

In other words: Excise duty is a tax levied by the state on certain consumer goods, including electricity. The payment of the tax by the consumers is made through the electricity bill, together with the payment of the equivalent value of the consumed electricity, and the transfer of the excises to the state budget is made by the electricity supplier.

According to the methodological norms of application of art.162 of the Fiscal Code with the subsequent amendments and completions, the excise duty for electricity is calculated as follows:

A = Q * K * R

where:

A = value of excise duty

Q = amount of active electricity expressed in MWh

K = unitary excise tax provided for in point 18 of Annex no. 1 to Title VII - Excise duties from the Law

no. 571/2003 on the Fiscal Code, with subsequent amendments and completions

R = leu / euro exchange rate

8.8 SERBIA

8.8.1 SYSTEM CHARGES

Considering that operation of P2G plant requires both electricity (for electrolysis) and natural gas (for blending renewable hydrogen), following system charges that have to be paid by the P2G plant are applicable, depending on the level to which P2G plant is connected – transmission or distribution.

Costs of connection to the electricity transmission or distribution system

The costs of connection to the system are set by the Transmission System Operator (TSO) or Distribution System Operator (DSO) on the basis of elements given in the connection application and the Methodology for Setting Costs of Connection to the Electricity Transmission and Distribution Systems (OJ RS 109/15). The Methodology defines following types of costs: collection of documentation, procurement and instalment of equipment and material, works, the manner of calculation of all costs.

For calculating the costs of connection to the system, the TSO/DSO is obliged to adopt certain standards and to use market prices.

TSO: Since connections to the transmission system cannot be standardized and since each of them is a project of its own, TSO is obliged to comply with principles of transparency and non-discrimination and to inform the applicant, upon his/her request, on the documents which serve as the basis for setting the level of connection costs and the method for setting these costs.

DSO: The DSO is obliged to comply with the principles of transparency and non-discrimination and provide an insight to the applicant into acts which serve as the basis for the establishment of connection costs and the manner of setting these costs. In the Methodology, distribution system connections are grouped into kinds and types and therefore, depending on the distance between a facility and the system, on technical conditions and methods of connection, there are standardized and individual connections. When it comes to standardized connections, depending on the number of metering devices, they could be individual or group standardized connections.

Except for one-time payment for the construction of the connection, the applicant is obliged to pay defined set of costs arising from the connection application.

TSO/DSO is the investor, i.e. the owner of the constructed facility (of the connection line, metering equipment and other equipment, up to the metering point within the customer's facility).

Use-of-system charge for the electricity transmission system

Use-of-system charge for the electricity transmission system is regulated based on the Methodology for Setting Electricity Transmission Use-of-System Charge (OJ RS 105/12, 84/13, 87/13, 143/14, 65/15, 109/15, 98/16, 99/18, 158/20, 71/21). Average transmission use-of-system charge (VAT and levies free) was 0.5 RSD[191] (0.00423 EUR) per kWh in 2020.

Serbia applies a single use-of-system transmission charge which covers all relevan costs of the TSO. Cost items included in calculation of the use-of-system charge includes – losses, system services (primary, secondary and tertiary reserve, congestion management, black-start, voltage control/reactive power, system balancing), and infrastructure costs (OPEX except system services adn losses, depreciation, return on capital invested), and cost of financing Regulatory Energy Agency of Serbia (AERS) – 0.68% of transmission tariff.

Use-of-system charge for the electricity distribution system

Use-of-system charge for the electricity distribution system is regulated based on the Methodology for Setting Electricity Distribution Use-of-System Charge (OJ RS 93/12, 123/12, 116/14, 109/15, 98/16, 99/18, 4/19, 158/20, 71/21). Average distribution use-of-system charge (VAT and levies free) was 3 RSD[192] (0.02542 EUR) per kWh in 2020.

Serbia applies a single use-of-system distribution charge which covers all relevan costs of the DSO. Cost items included in calculation of the use-of-system charge includes – losses, metering point charge, and infrastructure costs (OPEX, depreciation, return on capital invested).

Costs of connection to the natural gas transmission or distribution system

[191] Energy Agency of the Republic of Serbia (AERS), 2020 Energy Agency Annual Report, May 2021, p.20
[192] Energy Agency of the Republic of Serbia (AERS), 2020 Energy Agency Annual Report, May 2021, p.29

Natural gas transmission/distribution connection costs are set by TSO/DSO on the basis of elements from the connection application and the Methodology for Setting Costs of Connection to Natural Gas Transmission and Distribution System (OJ RS 42/16).

The Methodology defines the types of connection costs including design and collection of necessary documentation, procurement of devices, equipment and material, execution of works, as well as the method of calculation of all costs. After connection costs are set in the connection decision, the TSO/DSO is obliged to use market prices of goods, works and services.

The applicant for connection bears the costs of connection to the transmission/distribution system.

TSO: Since connections on the transmission system cannot be standardized and since each of them is a project of its own, the TSO is obliged to comply with the principles with publicity and non-discrimination and to give the applicant, upon his/her request, insight into the documents which serve as the basis for setting the level of connection costs and for the method of calculation of these costs. The applicant has to cover true connection costs and a part of costs for system development which arose from this connection which depend on characteristics of that connection.

DSO: Connection service costs are set by the DSO and they correspond to average costs of construction of standard connection (i.e. to true costs of construction of other types of connections) and prescribed segment of cost which was caused by the connection of an applicant's facility to the system.

Use-of-system charge for the natural gas transmission system

Use-of-system charge for the natural gas transmission system is regulated based on the Methodology for Setting Natural Gas Electricity Transmission Use-of-System Charge (OJ RS 93/12, 123/12, 5/14, 116/14, 30/15, 62/16, 111/17, 4/19). Average distribution use-of-system charges (VAT and levies free) were 2.7 RSD (0.02288 EUR) for Srbijagas, and 0.76 RSD (0.00644 EUR) per m³ in 2020[193]. Serbia applies a single use-of-system transmission charge which covers all relevan costs of the TSO.

Use-of-system charge for the natural gas distribution system

Use-of-system charge for the electricity distribution system is regulated based on the Methodology for Setting Electricity Distribution Use-of-System Charge (105/16, 29/17). Average transmission use-of-system charge (VAT and levies free) was 4.3 RSD (0.0364 EUR) per m³ in 2020[194]. Serbia applies a single use-of-system distribution charge which covers all relevan costs of the DSO.

8.8.1 LEVIES

Considering that P2G plant use electricity for its operation, it would be obliged to pay the fee for renewable energy, used to finance incentive mechanism for renewable electricity, in addition to charge for energy efficiency - used to establish Energy Efficiency Fund. On top of that, consumption of natural gas is charged with energy efficiency fee per cubic meter of natural gas.

There are no exemptions in paying these levies.

Renewable energy fee for electricity

According to Decree on the Fee for the Privileged Power Producer Incentive in 2020 (OJ RS 8/2020), which regulates the procedure of how the funds for renewable energy promotion are collected and distributed, each final electricity consumer is paying the amount of 0.437 RSD (0.00371 EUR) per kWh of electricity consumed

[193] Energy Agency of the Republic of Serbia (AERS), 2020 Energy Agency Annual Report, May 2021, p.79
[194] Energy Agency of the Republic of Serbia (AERS), 2020 Energy Agency Annual Report, May 2021, p.83

- for renewable energy fee. The fee is reviewed and adjusted every year, in connection with the costs of the incentive scheme for renewable electricity.

Energy efficiency fee for electricity

Based on the Law on Fees for use of Public Goods (OJ RS 95/2018, 49/2019, 86/2019, 156/2020, 15/2021), fee for financing state budget fund for improving energy efficiency is RSD 0.015 (EUR 0.000127) per kWh of electricity consumed. Fee is paid through electricity bill and reviewed by the Government of Serbia.

Energy efficiency fee for natural gas

Fee for financing energy efficiency, based on the mentioned Law on Fees for use of Public Goods is also charged to final consumers via natural gas bills in the amount of RSD 0.15 (EUR 0.00127) per cubic meter of natural gas.

8.8.1 VAT

VAT

For the purchase of electricity in the Republic of Serbia, according to Law on Value Added Tax (OJ RS 84/2004, 86/2004, 61/2005, 61/2007, 93/2012, 108/2013, 6/2014, 68/2014, 142/2014, 5/2015, 83/2015, 5/2016, 108/2016, 7/2017, 113/2017, 13/2018, 30/2018, 4/2019, 72/2019, 8/2020,153/2020) VAT rate is 20%, while for the purchase of natural gas – reduced VAT rate of 10% is applied.

Excise for electricity

Based on the Law on Excises (OJ RS 22/2001, 73/2001, 80/2002, 43/2003, 72/2003, 43/2004, 55/2004, 135/2004, 46/2005, 101/2005, 61/2007, 5/2009, 31/2009, 101/2010, 43/2011, 101/2011, 6/2012, 43/2012, 76/2012, 93/2012, 119/2012, 8/2013, 47/2013, 4/2014, 68/2014, 142/2014, 4/2015, 5/2015, 55/2015, 103/2015, 5/2016, 108/2016, 7/2017, 18/2018, 30/2018, 4/2019, 5/2020, 7/2020, 78/2020, 153/2020, 11/2021, 53/2021, excise of 7.5% is paid for the purchase of electricity for final consumption in Serbia.

8.9 SLOVAKIA

8.9.1 SYSTEM CHARGES

Prices are regulated by Decree no. 24/2013 Coll.[195] Decree of the Office for the Regulation of Network Industries laying down the rules for the functioning of the internal market in electricity and the rules for the functioning of the internal market in gas

Price for connection to a very high voltage level	
1) for an applicant who is a customer of electricity	82,74 €/kW
2) for an applicant who is an electricity producer (excluding a producer from renewable energy sources or cogeneration)	165,48 €/kW
3) for an applicant who is a producer of electricity from renewable energy sources or cogeneration	162,17 €/kW

[195] 24/2013 Coll Decree of the Office for the Regulation of Network Industries laying down rules for the functioning of the internal market in electricity and rules for the functioning of the internal market in gas https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2013/24/#poznamky.poznamka-13

The price for the connection with VAT is calculated by multiplying the required value kW (MRK) by the price without VAT and rounded to 2 decimal places mathematically.

To this value is added 20% VAT rounded to 2 decimal places mathematically.

More prices at https://www.zsdis.sk/Uvod/Spolocnost/Dokumenty/Cenniky.

6. Distribution network connection services		without VAT	with VAT
New connection - category Out of households (Small Entrepreneurs) (if the length of the connecting gas pipeline to the connection of the offtake gas equipment to the distribution network is greater than 30 meters, the application will be assessed individually)	EUR / power	180,30	216,36
New connection – Apart from households category (Medium and large customers (in case the length of the connecting gas pipeline to the connection of the offtake gas equipment to the distribution network is greater than 30 meters, the application will be assessed individually)	EUR / power	495,30	594,36
Extension of the distribution network (determination of technical and business conditions for the extension of the distribution network for the application with the number of consumption points 2 and more)	EUR / power	450,00	540,00

More prices at https://www.spp-distribucia.sk/wp-content/uploads/2020/12/Cennik-externy-sluzieb-platny-od-1.2.2021_final.pdf

The costs of building a connection that connects the biomethane production facility to the distribution network are calculated by the distribution network operator to the extent of 75% of the actual costs. The biomethane producer bears the costs of building a connection to the distribution network in the amount of 25% of the actual costs; however, not more than € 250,000. If the length of the connection to be built exceeds four kilometres, the biomethane producer will pay the costs associated with building the connection over four kilometres in full. The connection becomes the property of the distribution network operator.

Distribution tariffs do not depend on distance, but on the annual quantity and daily capacity of biomethane (postage stamp principle) A biomethane producer may trade in biomethane without having to hold a ÚRSO permit for gas production and supply.

8.9.2 LEVIES

Since May 2011 there is a levy adopted. The Levy is for the purpose of financing the National Nuclear Fund for De-Commissioning of Nuclear Facilities and Disposal of Spent Nuclear Fuel and Radioactive Waste.

As stated in the official declaration of The National Nuclear Fund (Slovak NJF), the price of the levy for 2022 does not change and stays at the level of 3.27 Euros per megawatt hour.

The electricity consumers must pay the effective levy rate according to the manner of their connection to the system either to the System Operator, or the electricity supplier or electricity producer who subsequently pays the levy rate to relevant System Operator. Therefore, the System Operator pays the collected Levy to the account of the Nuclear Fund.

However, there are few exemptions stated by the Government Decree: (a) own consumption of electricity in the electricity generation process; (b) own consumption of electricity by producer of electricity; (c) consumption of electricity consumed for re-pumping in pumped-storage hydroelectricity power plants; and (d) electricity designated for export.

8.9.3 TAXES

The taxes for energy sector are defined in the Act No. 609/2007 on the Excise Duty on Electricity, Coal, and Natural Gas supplementing Act. No. 98/2004 on the Excise Duty on Mineral Oil. It covers the tax from electricity, tax from coal, tax from natural gas.

The tax rate for electricity has been established since January 1, 2010 in the amount of 1.32 euros/MWh. The rate of excise duty on coal is set at 10.62 euros/t. The rate of excise duty on natural gas is established if: a/ used as fuel for heat production, or delivered for the production of compressed natural gas intended for use as fuel for heat production in the amount of 1.32 euros/MWh, b/ delivered for the production of compressed natural gas intended for use as a propellant in the amount of 9.36 euros/MWh. Rate of excise duty on compressed natural gas (CNG) supplied or used as a/fuel is 0.141eur/kg, b/ fuel for heat production is 0.01989 euros/kg.

The electricity from renewable sources may be exempt from excise duty under sec. 7 (1) (e) of the Act n. 609/2007 Coll. on excise duty on electricity, coal and natural gas. This exemption could be applicable for the P2G production.

Exemption from tax

Electricity is exempt from tax:

when it is used primarily for the purposes of chemical reduction, in electrolytic processes or in metallurgical processes, which can apply to hydrogen production. It is also exempt from tax when used for the production of electricity and for maintaining the capacity of the equipment for the production of electricity, including losses in a technologically justified amount, including during the transmission of electricity or distribution of electricity, while the relevant customs office is entitled to assess based on the decision of the price proposal approved by the Office for the Regulation of Network Industries, whether the generated electricity losses correspond to the nature of the electricity company's activity and the usual amount of losses of another electricity company with the same or similar activity.

The last case applicable for the Power to gas concept using renewables is tax exemption of electricity produced from a renewable source, if its production is proven by a guarantee of the origin of electricity from renewable energy sources and if it concerns the production of electricity 1. in a solar installation, 2. in a wind power plant, 3. in a facility for the use of geothermal energy, 4. in a hydroelectric power plant, 5. in a facility for the use of biomass or a product made from biomass Electricity produced in a facility for the combined production of electricity and heat, if it is delivered directly to the final consumer of electricity or consumed by the person who produced it, and if its production is proven by a certificate of origin of the electricity produced by highly efficient combined production, and if the facility for the combined production of electricity and heat is not depreciated according to a special regulation, but for a maximum of 12 years from the commissioning of the

equipment for the combined production of electricity and heat, and electricity used for the combined production of electricity and heat is also an exemption.

Coal is exempt from tax if it is used:

a) for dual use, b) in mineralogical processes, c) for a purpose other than propellant or fuel for heat production, d) for the combined production of electricity and heat, e) for the production of electricity, f) for the production of coke and semi-coke, g) for the transport of persons or goods carried out as part of business in rail transport or in river transport, h) final customers of coal in the household, with the exception of coal intended for the production of heat and heating of domestic hot water supplied to the common heat source of the apartment building, f) for operational purposes and technological purposes in a coal mining and coal processing enterprise.

Natural gas is exempt from tax if it is used:

a) for dual use, b) in mineralogical processes, c) for a purpose other than propellant or fuel for heat production, d) for the combined production of electricity and heat, e) for the production of electricity, f) to end customers of natural gas in the household, with the exception of natural gas intended for the production of heat and heating of domestic hot water delivered to the common heat source of the apartment building, g) for operational purposes and technological purposes in the gas company, including losses in a technologically justified amount, including during the transportation of natural gas or the distribution of natural gas, while the relevant customs office is entitled, based on the price proposal approved by the Office for the Regulation of Network Industries, to assess whether the natural gas losses correspond to the nature of the gas company's activity and the usual amount of losses of another gas company with the same or similar activity.

8.10 SLOVENIA

8.10.1 SYSTEM CHARGES

This chapter will provide a list of charges applicable when purchasing electricity or feeding-in natural gas.

Both, the Electricity Supply Act as well as the Gas Supply Act define the network charge as the amount that the user has to pay for the use of the electricity or gas system. Beside charges and the market price of the energy, the consumes also must pay for different contributions and levies that are part of the electricity and natural gas bill. These are defined by the Decree on energy savings requirements, the Decree on the method of determining and calculating the contribution for ensuring support to produce electricity from high-efficiency cogeneration and renewable energy sources and the Decree on the award of a concession and on the method of provision of a service of general economic interest – electricity market operator.

8.10.1.1 SYSTEM CHARGES FOR THE PURCHASE OF ELECTRICITY FROM THE PUBLIC GRID

The final amount to be paid on the electricity is a sum of several items, which are divided into three segments: energy, network charges and contributions, and levies and taxes.

The final amount for supplied electricity to consumer consists of several items divided into these three main segments[196]:

1. *Energy: market price of electricity.*
2. *Network charges:*
   i. transmission network charge,
   ii. distribution network charge
3. *Levies, contributions and taxes:*
   a. contribution to support the productions of electricity from renewable energy sources (hereinafter: RES) and high-efficiency cogenerations (hereinafter: CHP),
   b. contribution for energy efficiency,
   c. contribution for market operator, other than costs for carrying out the activities of the Centre for RES/CHP support.
   d. the excise duties on electricity,
   e. the value-added tax (VAT).

The *market price of electricity* is determined by the electricity supplier and is charged for each kilowatt hour consumed in a higher (HT), lower (LT) or single (ST) tariff.

The obligation to pay *network charges* is set by Electricity Supply Act. A system user is liable to pay for the use of an electricity system, meaning that the electricity customer pays for the transmission and distribution of electricity through the electricity network. The network charges paid by the system user for the use of the electricity system shall be one of the sources to cover the eligible costs incurred by the electricity system operators – costs for the activities the distribution operator (SODO, d.o.o.), the activities of the system operator (ELES, d.o.o.), covering the costs of system services (ELES, d.o.o.) and covering the operating costs of the Energy Agency.

The network charge consists of:

- network charge prices, which are charged for each kilowatt hour of electricity consumed (HT, LT, ST)
- price for the chargeable demand based on the nominal capacity of a device.

Electricity system operators' activities are regulated by the Energy Agency based on the regulated network charge method. This method together with considering the surplus of the network charge from previous years, enables the Energy Agency to determine the network charge and other revenues to ensure system operators' coverage of all eligible costs in the regulatory period. Before the regulatory period commences, the Energy Agency determines the network charge and consequently the network charge tariffs. The Energy Agency has set the regulatory framework for electricity operators and the network charge for the regulatory period 2022. The new tariff items of the network charge are valid from 1 January 2022. While the network charge for the distribution system is more than 14% higher than before, the network charge for the transmission system remains unchanged. In 2018, the Energy Agency issued the Legal Act on the methodology for determining the regulatory framework and network charges for the electricity distribution system. Based on this, the Energy Agency defined a regulatory framework for the 2019–2021 regulatory period for two system operators. To this end, in 2018, the Energy Agency issued two decisions in which it determined network charge tariffs[197].

For the calculation of the network charge, the Energy Agency uses a non-transaction postage-stamp method, meaning that the tariffs for calculating the network charge are unified for the whole territory of Slovenia within each consumer group. The end consumer is by system operator classified into a consumer group according to

[196] Explanantion provided under the subpage »Understand your bill« on the Energy Agency's official website
[197] *Energy Agency,* Poročilo o stanju na področju energetike v Sloveniji 2020, 2021., p. 76-78.

voltage level (HV, MV, LV), type of connection (busbar, feeder), operating mode (operating hours) and type of consumption.

The network charge tariffs for individual consumer groups, that are determined by the Energy Agency, are divided into:

- the network charge for the transmission system,
- the network charge for the distribution system,
- the network charge for the excessive reactive power, and
- the network charge for connected load.

Network charge tariffs for the transmission and distribution systems are divided into following groups:

- High daily tariffs during high tariff time (HT) - *charged from Monday through Friday from 6:00 to 22:00*, and
- Low daily tariffs during off-peak time (LT) - *charged in the remaining week hours and Saturdays, Sundays and public holidays (all day)*, or
- Single daily tariffs (ST) - *charged every day all day*.

The chargeable demand is determined based on the nominal capacity of a device preventing the agreed load from being exceeded (charge fuse) and the connection type (single-phase or three phase connection)

A system user is by the Article 109 of Electricity Supply Act obliged to pay a network charge for the use of the electricity system, which is one of the sources intended to cover the eligible costs of electricity operators. P2G plant as a consumer of electricity and therefore system user has to pay network charges for the system as well as the network charge for connected load, which is also paid by each final customer as a one-off amount in relation to the connected load at the time of the first connection to the network and whenever the power connection already exists, except for temporary connections.

While this chapter provides explanation regarding the network charges that apply to electricity consumers, the contributions will be more in detail presented under the chapter 2.6 *Levies*. The taxes are further described under the chapter 2.7 *Taxes*.

8.10.1.2 SYSTEM CHARGES FOR THE INJECTION OF THE NATURAL GAS/HYDROGEN MIXTURE OR SYNTHETIC NATURAL GAS INTO THE NATURAL GAS GRID

Due to the lack of own sources, the supply of natural gas to the Slovenian market depends entirely on imports. The transmission system is owned and operated by the TSO, the company Plinovodi, which supplies natural gas to major industrial users and natural gas distribution networks, operated by DSOs. All companies that carry out the activity of natural gas distribution in Slovenia also act as suppliers of natural gas. The market for the supply of natural gas is complemented by companies that specialize only in the supply of gas.

Report on the energy sector in Slovenia 2020[198] shows that at the end of 2020 the natural gas distribution activity in Slovenia was carried out by 13 DSOs and that none of the distribution systems had a connected source of natural gas, biomethane or synthetic methane.

In the case when hydrogen or synthetic natural gas would be injected into natural gas grid and therefore would need access to the natural gas transmission or distribution network to deliver an agreed quantity of gas; the network charge for the natural gas transmission/distribution system use, that is charged to transmission/distribution system users, should apply. The transmission network charge, that must be paid by

[198] *Energy Agency*, Poročilo o stanju na področju energetike v Sloveniji 2020, 2021.

the transmission system user for the use of the natural gas transmission system, is calculated on the basis of the tariff rates of the network charge and on the extent of use of this system in accordance with the Legal Act on the methodology for determining network charges for the natural gas transmission system 2019.

By the Article 110 of the Gas Supply Act, system users pay a network charge, which ensures that the system operator is able to cover all the eligible costs of the regulatory period. The Agency shall prescribe in detail the methodology for charging network charges, separately for:

- use of the transmission system (separately for entry and exit points),
- use of the distribution system for customers,
- own use to ensure the operation of the system,
- metering,
- other services.

Tariffs and network charges determined by the operator shall be objective, transparent and non-discriminatory and shall encourage the use of gas from renewable sources. No network charge for the use of the distribution system is charged for collection points in the distribution system. The network charge tariffs for an individual year of the regulatory period are determined by the TSO and approved by the Agency.

A producer, in this case, P2G plant, is by Gas Supply Act a legal or natural person who produces gas of suitable quality for acceptance into the system and delivers it to the transmission or distribution system to the supplier under the supply contract in accordance with the conditions of the system operator. As the act defines a network charge as the amount to be paid by the system user for the system usage, it can be concluded that all above-mentioned charges apply for P2G plant when feeding gas into the system e.g. using the system.

It is to be assumed that a P2G facility would be subjected to the payment of system charges on both sides, electricity, and a gas side, it, however, can't be certainly claimed how the P2G plant would actually be defined and addressed in practice and what charges would apply.

Identified barriers:

- clear definition of charges that would apply specifically for a P2G plant

The contributions and taxes applicable when purchasing natural gas from public grid will be presented in the chapters 2.6 *Levies* and 2.7 *Taxes*.

8.10.2 LEVIES

8.10.2.1 CONTRIBUTION TO SUPPORT THE PRODUCTIONS OF ELECTRICITY FROM RENEWABLE ENERGY SOURCES (RES) AND HIGH-EFFICIENCY COGENERATIONS (CHP)

Pursuant to the Decree on the method of determining and calculating the contribution for ensuring support for the production of electricity from high-efficiency cogeneration and renewable energy sources[199], final customers of electricity and final customers of solid, liquid, gaseous fossil fuels or district heating for final use are liable to pay a contribution to provide support for the production of electricity from renewable energy sources and in high-efficiency cogeneration (contribution of RES + CHP).

[199] Article 3 Decree on the method of determining and calculating the contribution for ensuring support for the production of electricity from high-efficiency cogeneration and renewable energy sources 2021.

By this definition all end electricity customers, P2G plant as well, should pay the contribution to support the productions of electricity from renewable energy sources (res) and high-efficiency cogenerations.

The amount of contribution paid by final customers of electricity depends on the power and voltage level of the end-consumer delivery point, the consumer group, and the purpose of energy consumption. It is calculated per kW of chargeable demand monthly. For the supply of solid, liquid, and gaseous fossil fuels and district heating, final customers are charged per MWh of supplied energy, depending on the energy value of the fuel. The contribution is charged as a special item on the fuel supply invoice.

At this point it is worth mentioning that the new version of the Decree on the method of determining and calculating the contribution for ensuring support for the production of electricity from high-efficiency cogeneration and renewable energy source was open for public consultation in September 2021 and has been passed on the 26th of November 2021. This year newly adopted Act on the Promotion of the Use of Renewable Energy Sources sets out new additional conditions that energy-intensive companies must meet in order to be eligible for a reduced contribution for the promotion of RES and CHP. The amendments to the previous decree were minor and nothing significant has changed except, a shorter deadline for the public hearing has been set. The aim was to adopt the amended regulation as soon as possible to give more time to eligible beneficiaries to carry out the necessary energy audits and ensure the implementation of energy or environmental management systems or to ensure own energy production from RES.

According to Article 17 of the Act on the Promotion of the Use of Renewable Energy Sources that regulates the contribution, the latter shall not be paid for renewable sources and heat from efficient district heating and cooling systems that fully use renewable energy sources for their operation. It can be assumed that the exemption in the case of P2G plant as an electricity customer using electricity from RES, can be made here, but some additional clarification regarding conditions would be needed here.

Identified barrier:

- Lack of more-defined specifications on exemptions regarding the payment of contributions that would apply for P2G.

8.10.2.2 CONTRIBUTION FOR ENERGY EFFICIENCY

Contribution for energy efficiency, which is one of the measures in the range of mechanisms to promote energy efficiency in the country, is set by The Decree on energy savings. The part III of the decree that deals with the contribution for energy efficiency determines the amount of the energy efficiency that has to be paid by the final customer of electricity, natural gas, district heating and final customer of solid, liquid and gaseous fuels. The contribution is set at 0,08 cents per kilowatt hour. The amount of the contribution, calculated per sales unit for each type of energy source, is specified in the table[200] below:

Energy source	Contribution	Unit
Electricity	0,080	€c/kWh
Natural gas	0,757	€c/Sm^3
District heating	0,080	€c/kWh
LPG	1,023	€c/kg
Petrol	0,736	€c/l

[200] Article 10 Decree on energy savings requirements 2015.

Diesel fuel	0,800	€c/l
Extra-light heating oil	0,800	€c/l
Heating oil	0,882	€c/kg
Woody biomass	0,080	€c/kWh
Coal and coke	0,080	€c/kWh

Energy efficiency contribution is charged by operators on the electricity and natural gas bills, while suppliers charge a contribution to final customers on the bills for district heating and other gaseous, liquid, and solid fuels. Operators and suppliers must transfer collected funds to the Eco Fund, Slovenian Environmental Public Fund.

Similarly, to previous chapter, P2G plant as electricity customer should pay the contribution for energy efficiency based on the amount of energy purchased.

8.10.2.3 CONTRIBUTION FOR MARKET OPERATOR

Contribution for the operation of the electricity market operator is a contribution determined by the Government of the Republic of Slovenia with an intention to cover the costs of the market operator, Borzen, d.o.o. The Electricity Supply Act defines that the contribution for the electricity market operator has to be paid by final customers according to the received electricity (kWh). The final customer pays the contribution as a special item on the monthly bill. The recipient of the contribution must transfer it immediately and free of charge to the market operator. The amount of the contribution is defined with the Decree on the award of a concession and on the method of provision of a service of general economic interest – electricity market operator. The contribution for electricity market is set at 0.00013 EUR / kWh[201]. A P2G facility is as the final customer of electricity subjected to the charge of contribution for market operator.

8.10.3 TAXES

8.10.3.1 THE EXCISE DUTIES ON ELECTRICITY AND NATURAL GAS

Excise Duty Act regulates the way of payment and introduces the obligation to pay excise duty on alcohol and alcoholic beverages, tobacco products and **energy products** and **electricity**. It defines that excise duty shall be paid on energy products and electricity used as motor fuel or heating fuel[202]. The type of energy products and electricity is determined according to the classification in the tariff code or according to the characteristics of each product. The Article 90 and 91 more in detail defines electricity and natural gas and stipulate that notwithstanding other provisions of the Excise Duty Act, a taxpayer for electricity/natural gas is:

1. Electricity/natural gas supplier with its registered headquarters in Slovenia and supplies a final customer in Slovenia;
2. a final customer who, in the course of performing his activities, obtains electricity/natural gas for final use in another Member State or imports it from third countries or is supplied to it by a supplier who is not registered in Slovenia;
3. a producer who produces electricity/natural gas to cover his own needs or supplies it to another person for its final use.

[201] Article 24 Decree on the award of a concession and on the method of provision of a service of general economic interest – electricity market operator 2015.
[202] Article 88 Excise Duty Act 2016.

The articles 90 and 91 define the final customer as person who purchases electricity/natural gas for his own final use and has installed measuring devices for determining electricity/natural gas consumption.

The obligation to calculate excise duty also arises when electricity/natural gas from the electricity/natural gas transmission or distribution network is supplied by the supplier to the final customer at the point of consumption; the final customer enters or imports electricity/natural gas into Slovenia or is supplied to it at the point of consumption by a supplier who is not established in Slovenia, or the producer uses the produced electricity/natural gas to cover his own needs or supplies it to another person for its final use.

A producer of electricity referred to in point 3 of the first paragraph is exempt from paying the excise duty for electricity produced in a small hydro powerplant or from another renewable energy source (non-fossil or non-nuclear origin) with a capacity up to 2 MW and consumed by the producer. The exemptions also apply for electricity produced in the household or with appliances used for own consumption and for temporary electricity supply in the events of disruption. The Excise Duty Act furthermore allows the refund or exempt of the duty on electricity/fuel in some cases. Articles 93 to 95 more in detail determine the conditions for the refund (for industrial and commercial purpose, on an agricultural and forestry machinery, on commercial transport), while the Article 96 sets out rules for exemption from excise duty for energy-intensive companies.

The excise duty calculation is based on the quantity of electricity and natural gas in megawatt hours or the quantity of energy products in kilograms, cubic meters, liters or gigajoules[203].

8.10.3.2 ENVIRONMENTAL TAX - CO2

The Decree on the environmental tax on pollution caused by carbon dioxide emissions (Official Gazette of the Republic of Slovenia, No. 48/2018 of 13 July 2018 / Uredba o okoljski dajatvi za onesnaževanje zraka z emisijo ogljikovega dioksida (Uradni list RS, št. 48/18 in 168/20) sets out the obligation to pay an environmental tax on air pollution caused by the emission of carbon dioxide into the air during fuel combustion. This means that the environmental tax is payable by all customers who use natural gas from the network in accordance with the provisions of this decree. The amount charged depends on the amount of natural gas consumed.

The exemption of environmental tax payment applies for fuel exported from the Republic of Slovenia, regardless of whether it is produced in the Republic of Slovenia, obtained from other EU Member States or imported. An operator of a small installation, who is by the European Commission granted for exclusion from the EU Emission Trading System according to the law governing environmental protection, is entitled to an exemption from environmental tax payment as well - up to the amount allocated.

8.10.3.3 VALUE-ADDED TAX

The Value Added Tax Act regulates the system and introduces the obligation to pay value added tax (hereinafter: VAT) on the territory of the Republic of Slovenia for the supply of goods, purchase of goods from the Union (which are made on the territory of Slovenia for payment), provision of services, etc. Article 41 determines the VAT rate, which is charged and paid at the general 22% rate of the tax base and is the same for the supply of goods and service. The electricity, gas, heating or cooling energy and similar goods are also subject to taxation at the rate of 22%.

As a system user of both, electricity, and gas network, it appears that a P2G plant would be subjected to double taxation and levies. To prevent limiting the uptake of P2G technology and electricity-gas sector integration it may be beneficial to re-examine the current conditions regarding double charging users of more than one network.

[203] Article 92 Excise Duty Act 2016.

Identified barrier:

- double taxation/levies for P2G facilities.

9. GUARANTEES OF ORIGIN

This chapter sets out the provisions governing the issuance of Guarantees of Origin with regard to renewable gases.

9.1 AUSTRIA

A guarantee of origin is an electronic document that serves exclusively as proof to an end customer that a certain share or quantity of energy is produced from renewable sources.[204] Only one guarantee of origin may be issued for each unit of energy produced. This applies by default to 1 MWh.[205] Guarantees of origin shall be valid for twelve months from the date of production of the unit of energy concerned and shall be cancelled after use. If it has not been cancelled, it shall be given the status "expired" in the guarantee of origin database no later than 18 months after the generation of the energy unit.[206] For installations producing renewable gas on the basis of renewable electricity, the operator of the installation shall transfer guarantees of origin and the environmental impact of electricity production to gas production. For this purpose, the guarantees of origin and environmental impacts on which electricity generation is based must be reduced by the conversion losses incurred during gas generation and classified in the electricity verification system as energy input for gas labelling. The conversion losses are to be classified as consumption of the energy sector.[207]

In addition, the newly introduced renewable gas certificates serve as proof of the generation of renewable gas that is not fed into the public grid and is used in final consumption or materially.[208] Once generated, they are listed in the database of the regulatory authority pursuant to § 86 (2) REEA. It should be noted that the issuance of such a certificate excludes the issuance of certificates of origin according to §§ 81-84 REEA.[209] The validity of the Renewable Gas Certificate refers to 1 MWh[210] and a duration of twelve months from generation. After consumption, the certificate must be cancelled.[211]

A Renewable gas badge is „a record of renewable energy that counts towards Austria's national contribution under Article 3 (2)" RED II[212] and "towards suppliers' renewable gas quota;".[213,214] Therefore, if a renewable gas certificate has a renewable gas badge, it can count toward the green gas quota.[215] This serves as a obligation for suppliers to substitute a certain percentage of sold fossil gas with renewable gas.[216] As soon as a renewable gas quota is established, the respective provisions apply.

[204] Cf. § 5 (1) Z 30 REEA.
[205] Cf. § 83 (1) REEA.
[206] Cf. § 83 (2) REEA.
[207] Cf. § 83 (6) REEA.
[208] Cf. § 5 (1) (29) and § 86 (1) REEA.
[209] Cf. § 86 (2) REEA.
[210] Cf. § 86 (4) REEA.
[211] Cf. § 86 (5) REEA.
[212] If gas is produced from energy in the form of biomass fuels, sustainability requirements and greenhouse gas savings criteria (cf. § 6 (2) and (3) REEA) must also be met.
[213] Cf. § 5 (1) (27) REEA.
[214] Cf. § 5 (1) (27) REEA and § 85 (1) REEA.
[215] Cf. § 86 (3) REEA.
[216] Cf. § 87 (1) REEA.

9.2 BULGARIA

There is an active scheme in Bulgaria that is based on the Guarantees of Origin. Their issuance, transfer, and cancellation are governed by the Ordinance № РД-16-1117 from 14.10.2011 and Section IV of the RES Act. Guarantees of Origin play the role of certifying that produced electrical, heating, and/or cooling energy has been produced from renewable sources, e.g., wind, solar, and GRS. In that respect, GRS usage in production of energy leads to the possibility that energy to be entitled to a Guarantee of Origin. Interested in consumption of renewable energy clients, due to regulation requirements, corporate strategy, ESG internal targets, can certify their sustainable consumption by acquiring Guarantees of Origin.

All activities connected with the Guarantees of Origin scheme are managed by the Sustainable Energy Development Agency (SEDA). It supports an online register which holds information about all issued Guarantees of Origins and their current status, e.g., transferred, cancelled, etc.

There are the following hypotheses when an owner of the PFGRS can request a Guarantee of Origin to be issued from SEDA:

- the RGS has been used for production of electricity
- the RGS has been used for production of heating / cooling energy

Guarantees of Origin for the consumed electrical energy in the production hydrogen are required in order the hydrogen to be classified as “green”. The provision is made in the Energy Act along with the definition of “green hydrogen”.

Currently, Bulgarian regulation do not envision Guarantees of Origin to be issued to the GRS and green hydrogen themselves, but rather to energy produced from their utilization.

Besides Guarantees of Origins, there are Certificate of Origins which are used to certify that electrical energy has been produced from highly efficient CHP (art. 165b of the Energy Act).

9.3 CROATIA

The regulatory framework for implementation of the Guarantee of Origin is defined within the **Energy Act (OG 120/12, 14/14, 102/15, 68/18),** which determines that the guarantee of energy origin is introduced to end-users, for the purpose of proving the share of energy generated from specific energy source.

Electricity Market Act (OG 22/13, 102/15, 68/18, 52/19) designates the Croatian Energy Market Operator (cro. Hrvatski operator tržišta energije d.o.o. - HROTE) as the responsible organization for issuing guarantees of origin for electrical energy and record keeping of electrical energy guarantees of origin. **Regulation on the establishment of a system of guarantee of origin of electricity (OG 84/13, 20/14, 108/15, 55/19)** and **Rules on the use of the register of guarantees of origin of electricity**[217] determine and regulate the system of guarantees of origin.

Guarantee of Origin is defined as an electronic document whose purpose is to prove the origin of energy to the buyer, requiring that a specific share of electrical energy used for its consumption is produced from a specific source of primary energy, presented in a standardized value of 1 MWh. The Guarantee is issued for either the produced electrical energy from a renewable energy plant or a high-efficiency cogeneration plant, exclusively

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https://files.hrote.hr/files/PDF/Dokumenti/PRAVILA%20o%20kori%C5%A1tenju%20registra%20jamstava%20podrijetla%20elektricne%20energije%2012.07.19.%20-%20odobreno%20od%20HERA-e.pdf

upon the demand of an eligible producer. Eligible producers in the incentive system who have the right to feed-in tariffs are not permitted to participate in the system of guarantees of origin.

Regarding (renewable) natural gas and (renewable) hydrogen, there are currently no guarantees of origin in the strategic and regulatory frameworks. However, the **Gas Market Act (OG 18/18, 23/20)** determines the specific characteristics that need to be satisfied for the gas to enter the gas grid, such as heating value, shares of specific components in the gas, moisture, etc. This is determined by the National Gas Transmission System Operator (Plinacro). Plinacro tests and measures the composition of gas that enters the gas grid with refractometers. The specific composition that needs to be satisfied is determined in the Act on gas market.

9.4 CZECH REPUBLIC

Given the legal non-existence of the terms "renewable hydrogen" and "renewable natural gas", there is no obligation to provide any guarantees of origin. The guarantee of origin for “renewable sources” addresses the sustainability criteria in Czech legislation, which are governed by the Air Protection Act and are based on the Renewable Energy Directives (also known as RED I and RED II). Biofuels in transport are bound by the obligation to assess sustainability. The “guarantee of origin” is an option but not an obligation (Law 382/2021).

Given the legal non-existence of the terms "renewable hydrogen" and "renewable natural gas", there is no certification system for them either. A "guarantee of origin" is an electronic document that proves to the customer the origin of the energy supplied (Law 382/2021). However, terms “renewable hydrogen”, “renewable natural gas” and “carbon source” are not known to Czech legislation (Law 382/2021 and Law 362/2021).

9.5 GERMANY

In § 3 No. 29 Renewable Energy Act, “guarantee of origin” (“Herkunftsnachweis”) is defined as an electronic document to prove to the end user that a certain amount or share of the electricity was generated through the usage of renewable energies.

To be entitled to biogas privileges as described in 2.8, plant operators have to provide guarantees of origin to confirm that the gas has been produced from renewable sources. The plant operator himself guarantees in the respective data sheets or forms that the electricity came from renewable sources. Only in case that the network operator has credible doubts about the biogenic origin of the gas, he can request further guarantees.[218] The plant operator has to prove that the biogas corresponds to the requirements for injection of the German Association for Gas and Water Industry.[219]

Guarantees of origin for renewable electricity can also be proven through eco-labels or state certificates. The Federal Environment Agency (Umweltbundesamt) can issue guarantees of origin upon request by the plant operator.[220] The Federal Environment Agency provides a register for guarantees of origin (“Herkunftsnachweisregister”).

The guarantees of origin for renewable electricity is a requirement to classify hydrogen as “green hydrogen”.[221] The Federal Environment Agency will provide a report on the guarantees of origin and the future handling for green hydrogen until December 2021.[222]

[218] Cf. BNetzA 2014, p. 2
[219] § 36 GasNZV
[220] § 79 (1) EEG
[221] Cf. BT 19/29793 § 12i (2)
[222] Cf. BT 19/29793 § 12l (2)

The CO_2 source has to "mainly" from renewable sources, this is in most cases, at least 80%. Usage of carbon dioxide directly from the atmosphere is most probably classified as "renewable".[223] However, in the law texts, no need for guarantees of origin of the carbon source could be found. In this project, only P2G plants with methanation through the usage of biogenic residues are considered.

9.6 HUNGARY

The institution of the Guarantees of Origin (hereinafter: GOO) for renewable gases is not yet introduced into the Hungarian legal framework, although it appears to be a prioritized aim, mentioned in the Hungarian National Hydrogen Strategy[224].

The GOO for gases from renewable source shall be established in the same method as it already exists for GOO for electrical energy. GOO for electricity is regulated in a Governmental decree nr. 309/2013. (VIII. 16.) on the certification of the origin of electricity produced from renewable energy sources and high-efficiency cogeneration (hereinafter: Decree of GOO).

The GOO is a marketable electronic certificate, which guarantees, the electrical energy purchased from any seller is acquired from a renewable energy source. To be registered into the electric system operated by the MEKH, the user of the electrical energy needs to fulfil the requirements introduced in the Decree of GOO.

In the process of obtaining a GOO, based on provision 3. § (1) of the GOO Decree, at the request of the producer, the MEKH shall determine in a decree whether the power plant unit is suitable for the production of electricity from renewable energy sources or high-efficiency cogeneration. The request can be submitted through a form, which can be downloaded from the website of the MEKH. In provision 3. § (3) of the GOO Decree, it is stated which documents are required to be attached to the form. The certification is valid for 5 years.

In the next step - in possession of the certification – the producer is entitled to apply for a GOO following the steps declared in provision 5. § of the GOO Decree. The GOO shall be issued for a quantity of 1 megawatt hour (MWh). A maximum of one GOO may be issued for each unit of energy fed into the public network.

The MEKH is eligible to monitor the GOO owner's activity to see if they comply with the requirements stated in the law. Based on provision 7. § of the GOO Decree, if the GOO is being presented to the user in order to prove that the amount of electricity supplied has been produced from a renewable energy source or in the framework of high-efficiency cogeneration, the owner of the GOO shall notify the MEKH within five days of its use on a form published on the website of the MEKH. In case the GOO owner fails to comply with this obligation, due to provision 13. § point (1)-(3), MEKH is entitled to impose a penalty.

9.7 ROMANIA

Given the fact that there is no legislation that is clearly focused and that regulates the practices in the field of hydrogen-based energy, there is no information on certificates of origin.

In terms of electricity, however, there are so-called green certificates. The green certificate is a title that certifies the production of electricity from renewable energy sources. The certificate is obtained regardless of the amount of energy produced. The green certificate supports the scheme for promoting the production of energy from renewable sources.

[223] Cf. Lietz 2017, 237
[224] https://cdn.kormany.hu/uploads/document/6/61/61a/61aa5f835ccf3e726fb5795f766f3768f7f829c1.pdf

This is a support measure for green (renewable) energy investors. Currently, every MWh of green energy produced from renewable sources is rewarded with a number of green certificates. These green certificates are bought by electricity suppliers, the companies being required to have a certain share of renewable energy in the basket of electricity delivered to consumers.

The presence of green certificates was mentioned because their issuance represents a model that can be used in the coming years for hydrogen-based energy producers.

9.8 SERBIA

In 2017, the Decree on Guarantees of Origin (OJ RS 82/2017) entered into force, the Rulebook on Method of Calculation and Presentation of Share of All Energy Sources in Electricity Sale (OJ RS 96/2017) was adopted, and electricity transmission operator EMS AD Beograd was appointed as issuing body for guarantees of origin.

In 2019, EMS AD became the full member of the Association of Issuing Bodies (AIB), and in 2020 part of the AIB system (AIB HUB), providing both the export of guarantees of origin from Serbia into the countries which are the Association members and the import of the guarantees of origin into Serbia were enabled. The purpose of the AIB is to develop, use and promote a standardised system of energy certification for all energy carriers - the European Energy Certificate System (EECS). The total number of issued guarantees of origin in Serbia in 2020. was 200,087 (each of 1 MWh).

Law on Utilization of Renewable Energy Sources (OJ RS 40/2021) defines that Guarantees of Origin are issued only for renewable electricity, which is generated in the following types of power plants:

- hydroelectric power plant;
- biomass power plant;
- biogas power plant;
- wind farm;
- solar power plant;
- geothermal power plant;
- biodegradable waste power plant;
- landfill gas power plant;
- power plant which use gas from a municipal wastewater treatment plant
- a power plant that uses other renewable energy sources (including hydrogen).

Based on this provision, it can be concluded that P2G plant could receive guarantees of origin only in case when P2G plant performs re-conversion to electricity. System for issuing guarantees of origin for gas is not established in Serbia.

9.9 SLOVAKIA

There is no such obligation at the moment, but the obligation to issue Guarantees of Origin for renewable hydrogen should be in place in national legislation in 2022. This is related to transposition of the Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable into the Slovak legislation. The transposition is currently under the process.

Introduction of biomethane guarantees for the development of the biomethane market, tradable in the EU with the expected result of the development of the biomethane guarantee market is due 2022.

According to 309/2009 Coll. § 8a, guarantees of origin for renewable sources (including biomethane) are set as following:

A guarantee of the origin of electricity from renewable energy sources is proof that the electricity has been produced from renewable energy sources and is used to demonstrate that a given proportion of the electricity has been produced from renewable energy sources. The Office shall issue a guarantee of origin for electricity from renewable energy sources in electronic form for each megawatt-hour to a producer of electricity from renewable energy sources. The Office records guarantees of origin of electricity from renewable energy sources in an electronic database, abolishes the guarantee of the origin of electricity from renewable energy sources and supervises the transfer of the guarantee of origin of electricity from renewable energy sources. The guarantee of origin of electricity from renewable energy sources can only be used within 12 months from the date of production of electricity from renewable energy sources.

The guarantee of the origin of electricity from renewable energy sources includes: the energy source from which the electricity was generated, start and end date of electricity production, the designation, location, technology and total installed capacity of the installation in which the electricity was generated, the amount of investment aid or other aid from the national aid scheme and the type of aid scheme, if received by the electricity producer's installation, the date of putting the electricity producer's equipment into operation and the date of completion of the reconstruction or modernization of the technological part of the electricity producer's energy equipment, date and country of issue, identification number, other information for the purposes of the records kept by the Office.

The Office shall also issue a guarantee of the origin of electricity from renewable energy sources to the producer of electricity from cogeneration, if the application is accompanied by a certificate of origin of electricity from renewable energy sources and proves the consumption of biomethane.

Attachments to the application for the issuance of a certificate of origin of biomethane must include:

Annex no. 1 - Share of biomass types used for biogas production; the applicant for the issuance of a certificate of origin of biomethane shall submit a completed table according to § 4 par. 2 of the Decree of the Office for the Regulation of Network Industries No. 490/2009 Coll., which establishes details on the support of renewable energy sources, high-efficiency combined production and biomethane, as amended.

Annex no. 2 - Biomethane production plan; the applicant shall submit an annual plan for the production of biomethane in m3 broken down by individual months of the calendar year.

Annex no. 3 - Specification of the costs of biomethane production, amount of costs per m^3 of biomethane produced; The amount of total procurement costs for the construction of a biomethane production facility; Planned annual average operating costs related to the biomethane production facility; Amount of costs per m^3 of produced biomethane

Annex no. 4 - Certificate issued by an accredited laboratory confirming that the device produces biomethane corresponding to the quality of natural gas; the applicant submits a certificate

only after the biomethane production facility has been built and in coordination with the operator of the distribution network to which the biomethane production facility is connected.

Annex no. 5 - Copy of the contract on the connection of the biomethane producer's equipment to the distribution network.

Annex no. 6 - Copy of the valid approval decision.

Regarding the certificate systems already in place, there is a Biomethane Register in creation based on the model of Austrian Biomethane Register and it should be introduced in November 2022. The founder and operator of the register should be SPP-distribúcia. It will be an electronic system whose task is to issue, transfer and cancel guarantees of origin for biomethane (in the future this system will be also able to cover other gases, e.g. hydrogen), which represent 1 MWh of biomethane injected into the distribution network and will be valid for 12 months.

However, within the law 309/2009 Coll § 12 Certificate of origin of biomethane, the application for a certificate of origin of biomethane shall be accompanied by a certificate issued by an accredited laboratory certifying that the installation produces biomethane corresponding to the quality of natural gas.

Further requirements before the actual creation of an account in the register and then at regular intervals are: the biomethane station must undergo audits, during which the method of biomethane production, the raw materials used for its production and the so-called carbon footprint from the life cycle are confirmed. Guarantees of the origin of biomethane with a low or negative carbon footprint will be highly valued.

9.10 SLOVENIA

Definition of the “guarantee of origin" can be found it the Act on the Promotion of the Use of Renewable Energy Sources. A guarantee of origin[225] is defined as a public document in electronic form with the aim to prove to the final customer from which source, how and in what period of time, a certain amount of energy is produced. The second chapter of the Act on the Promotion of the Use of Renewable Energy Sources contains a section that is dedicated solely to *Guarantees of* origin. The articles 10 to 13 in this section, among other things, provide following definitions and stipulations.

A guarantee of origin is a document in electronic form that enables producers and suppliers to prove from which energy source, in which installation and how the energy or energy source they produced or supplied is produced. The producer may obtain a guarantee of origin for energy, or the energy product produced in the facility which holds a valid declaration. Guarantee of origin is issued by the Energy Agency at the request of the energy producer holding the Declaration for a production facility for the production of electricity from RES, for the production of electricity from non-renewable energy sources, for high-efficiency cogeneration, for the production of gaseous fuels from RES, for the production of heat for heating and cooling from RES, for the use of excess heat in district heating systems, for a hydrogen production plant. The entities that shall note the Agency on the data related to the production of energy for which the Agency issues guarantees of origin are:

- the electricity operator of the system, which is connected to the facility for the production of electricity for which a certificate of origin is issued;
- producer of gaseous fuels from RES and hydrogen for sale;
- the operator of the system, which is connected to the facility for the production of gas from RES for which a guarantee of origin is issued is connected;
- a heat distributor to whose network a device for the production of energy for heating or cooling from renewable sources is connected;
- another person who has the information the agency needs.

The guarantee of origin must contain **at least** information on:

[225] Article 3 (32.) Act on the Promotion of the Use of Renewable Energy Sources 2021.

- whether the certificate relates to electricity, gas (including hydrogen), heat for heating or cooling, or excess heat;
- the energy source from which the energy was produced and the day of the beginning and end of its production;
- the identity, location, type and capacity of the facility in which the energy was produced;
- the extent to which the facility has received investment support and the extent to which the energy unit has benefited from support schemes and the type of support scheme;
- the start date of facility operation
- the date and country of issue of the certificate and the unique identification number of the certificate.

A guarantee of origin is issued to a producer by entering the certificate in the Registry of guarantees of origin, which is kept by The Agency. The technical management and maintenance of the Registry of guarantees of origin is ensured by legal entity performing the activity of a support center ensures. The issuing body of guarantees of origin is Energy Agency, while company Borzen, the Slovenian power market operator, acts as the administrator (Central Monitoring Office).

If the P2G facility is classified as a producer, who is by the Gas Supply Act a legal or natural person who produces gas of suitable quality for the uptake into the system and delivers it to the transmission or distribution system to the supplier under a supply contract following the conditions of the system operator, then a P2G plants would fall into a category of a producer of gaseous fuels from RES and hydrogen for sale. This would mean that P2G plant would fall into the group of entities that shall note the Agency on the data related to the production of energy for which the Agency issues guarantees of origin.

10. (OTHER) INCENTIVES

This chapter discusses additional incentives (to those already elaborated) related to the production, transportation, end use, etc. of renewable hydrogen as well as renewable synthetic gas.

10.1 AUSTRIA

- The REEA introduced investment grants for P2G plants. The annual funding for such investment grants amounts to 40 million euros.[226] However, it is a prerequisite that the P2G plant has a minimum capacity of 1 MW and that the plant is used exclusively for the production of renewable gases and purchases only renewable electricity. In addition, the law stipulates that subsidies are not available for plants that are built and operated by network operators or that add hydrogen to natural gas in the public gas network.[227] The investment subsidy is to be determined by decree of the Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology, in agreement with the Federal Minister for Agriculture, Regions and Tourism in subsidy rates of up to 45% of the investment volume directly required for the construction of the plant (excluding land). A special investment subsidy may be granted in the ordinance for plants that contribute to operational security of the network.[228] Plants with a minimum capacity of 0.5 MW and a maximum capacity of less than 1 MW may also receive an investment subsidy. However, this must be defined by ordinance in subsidy rates of up to 20% of the investment volume directly required for the construction of the plant (excluding land).[229]
- In Austria, it is not possible to inject hydrogen into the gas grid directly. If no methanation is carried out (and the feed-in into the gas grid is desired) it is necessary to withdraw natural gas in the first place, mix

[226] Cf. § 62 (2) REEA.
[227] Cf. § 62 (1) REEA.
[228] Cf. § 62 (4) REEA.
[229] Cf. § 62 (5) REEA.

that with the produced hydrogen. This hydrogen-natural gas mixture (which has to comply with the gas quality standards) can then be fed into the gas grid. For the gas withdrawn for the purpose of blending with hydrogen and subsequently fed back into the grid, no (gas) system utilisation charge is to be paid.[230]

- Furthermore, pure electric vehicles are exempt from paying the standard consumption tax according to § 3 (2) (a) standard consumption tax act (Normverbrauchsabgabegesetz F.L.G. No. 695/1991 as amended by F.L.G. I No. 208/2021). Vehicles that are exclusively electrically powered are also exempt from the engine-related insurance tax.[231] If pure electric cars are purchased as company cars, they are input tax deductible.[232] In addition, there are subsidies amongst others for E-cars with purely electric drive and fuel cell for private individuals and for 'electric cars and light electric utility vehicles' (class M1, N1) for companies, local authorities and associations as well as for light electric utility vehicles.[233]

10.2 BULGARIA

10.2.1 FOR PRODUCTION OF GRS

According to the art. 18, par. 4, point 5 of the RES Act, GRS has to be bought at preferential prices, defined by the EWRC. Preferential prices and the obligation GRS to be bought at these prices by the Public/End providers are meant to assure economic feasibility for P2G hub operation. In other words, a guaranteed profit for the P2G operator is expected to stimulate private investments in that sector. A certificate for quality and pressure is required under that arrangement, along with a contract for supply with PS or ES.

The same applies for the electrical energy produced by the GRS (art. 31, par. 5).

10.2.2 FOR PRODUCTION OF ELECTRICITY FROM RS (INCL. GRS)

In the cases when the electricity is being produced from RS and the production facility is under 500 kW then the electrical energy is being bought at preferential prices (art. 31, par. 1 of the RES Act). There are different durations for the contracts under which the electrical energy is bought depending on the RS, e.g., geothermal, wind, biomass, etc. If the electrical energy is produced from biomass (resp. GRS) then the contract can be 20 years long.

EWRC is the entity responsible for setting premiums on an annual basis for electricity from RS for production facilities equal or more than 500 kW.

Different preferential prices apply for different power ranges of facilities using biomass as a source: (1) Above 1.5 MW; (2) Between 500 kW and 1.5 MW; (3) Under 500 kW. Additional differentiation is made on the technology and the type of biomass used, which opens the door for sharing of the biomass energy for production of both – electricity and renewable gas. ERWC is the entity which set the abovementioned parameters on an annual basis.

Another incentive applies for P2G hub when it produces electrical energy from:

- combined cycle of indirect utilization of biomass which consists of at least 50% manure, and

[230] Cf. § 73 (8) NGSA 2011.
[231] § 4 (3) (6) Insurance Tax Act; Bundesgesetz vom 8. Juli 1953, betreffend die Erhebung einer Versicherungssteuer (Versicherungssteuergesetz 1953) F.L.G. No. 133/1953 last amended by F.L.G. I No. 104/2019. Cf. https://www.usp.gv.at/en/steuern-finanzen/weitere-steuern-und-abgaben/motorbezogene-versicherungssteuer.html).
[232] § 12 (2) (2a) Value Added Tax Act; Bundesgesetz über die Besteuerung der Umsätze (Umsatzsteuergesetz 1994 – UStG 1994) F.L.G. No. 663/1994 last amended by F.L.G. I No. 52/2021.
[233] https://www.oesterreich.gv.at/themen/bauen_wohnen_und_umwelt/elektroautos_und_e_mobilitaet/Seite.4320020.html.

- combined cycle of indirect utilization of plant waste from own agricultural activities.

In the above-mentioned scenarios, and according to art. 18, par. 1, point 2 of the RES Act, the grid operator has to prioritize the usage of the P2G hubs, which allows for additional revenues to be generated even when over-supply of electrical energy is available on the market. Similar stipulation is made in point 6 which obligates prioritization to be given to electrical energy produced from RS.

Art. 18, par. 1, point 7 (RES Act) defines another incentive in the form of preferential pricing for buying of electrical energy produced by facilities over 10 MW (water plant are excluded). Under that category also falls P2G hubs that utilize technology of direct combustion of biomass.

Preferential pricing is also regulated in the cases of thermic gasification of biomass – not less than 30% above the price in the case of direct combustion of wood waste under a combined cycle.

10.2.3 FOR PRODUCTION OF ELECTRICITY FROM HIGHLY EFFECTIVE CHP

In the cases when the electricity is being produced from highly efficient CHP and the production facility is under 500 kW then all the electrical energy has to be bought by the public supplier (PS) or the end-user suppliers (ES). A necessary prerequisite is the presence of a Certificate of Origin. An upper limit of the quantities is imposed by the EWRC.

In the segment of production facilities of 500 kW and over, the FPEES pays a premium for the produced electrical energy (art. 162a of the Energy Act). Again, a necessary prerequisite for the payment is the presence of a Certificate of Origin.

EWRC is the entity responsible for setting premiums on an annual basis for electricity from highly efficient combined of heat and power (CHP).

Under the hypothesis of electrical production from highly effective CHP, by using RS, then the preferential pricing for electrical energy from RS (under 500 kW) applies only for the portion of the RS used.

10.3 CROATIA

Currently, there are no direct and available financial incentives for renewable hydrogen and renewable natural gas production. The legislative and strategic framework for incentives is oriented mainly towards the electricity production from renewable energy sources (wind, solar, hydro, etc.), mostly through the Feed-in market premium:

- **Regulation on encouraging electricity production from renewable energy sources and high efficiency cogenerations (OG 116/18) and**
- **Regulation on quotas for encouraging electricity production from renewable energy sources and high efficiency cogenerations (OG 57/20).**

In the Feed-in market premium, subsidies are provided based on the energy produced, multiplied by the positive difference between contracted tariff and average monthly tariff for electricity on Croatian Power Exchange (CROPEX). If the difference is a negative power, the producer keeps the income.

Since electric energy from RES is viable for the production of green/renewable hydrogen, there is a potential usage of this funding instrument in the P2G context.

There are also other potential financial incentives that could be seen through the P2G context, especially for hydrogen and renewable natural gas, within various schemes for innovative projects. Still, there is no specific

regulatory framework that would incentivise P2G, hydrogen or biomethane/renewable natural gas. However, this presents a vast opportunity for decision- and policy-makers to create incentives that would be beneficial for spreading of renewable/green hydrogen and renewable natural gas/biomethane, which are the core segments of the EU Green Deal for transport and heating and cooling sectors. Moreover, these incentives should not be limited to aforementioned sectors, but could also be used for others such as R&D, energy, buildings, etc.

10.4 CZECH REPUBLIC

Financial incentives for the energy sector generally only cover investments in "renewable energy" plants. In addition, the production of energy from supported sources (according to law 165/2012) is supported by means of operating support on the basis of Price Decisions of the Energy Regulatory Office. This form of support is partly financed by the 'renewable energy' contribution, which is a regulated part of the electricity price. The Ministry of Industry and Trade expects to provide investment subsidies for the implementation of photovoltaic power plants, including storage, from the "National Renewal Plan" program. The same subsidy title is also mentioned in the intentions of the calls announced under the "Modernization Fund of the State Environmental Fund". Support for energy storage can therefore also be expected in these two programs. Terms “Renewable hydrogen” and “Renewable natural gas” are not known to Czech legislation (Law 382/2021 and Law 362/2021) and are therefore not subject to public support. However, it is worth noting that on the basis of Law 165/2012 the Energy Regulatory Office of Czech Republic, provides “pricing decisions” which can be interpreted as financial support to ”supported energy sources” among which these commodities could hypothetically appear in the future.

10.5 GERMANY

For P2G facilities with re-electrification, financial incentives of the Renewable Energy Act and the Electricity Network Ordinance are applicable. Operators of decentralised generation plants receive a remuneration from the grid operator, but only if they started operation before 1st January 2023 (for volatile generation: before 1st January 2018).[234]

If plant operators only use renewable energy, they are entitled to a market bonus, a remuneration or a tenant electricity surcharge. Plant operators have to meet certain requirements which are listed in §§ 20 and 21. The claim also applies to electricity that has been stored. The usage of storage gas is also explicitly included. In case they already receive remunerations according to § 18 Electricity Network Ordinance, they cannot claim bonuses of the Renewable Energy Act, and vice versa.[235]

The storage itself is not subsidised.[236] According to Thomas, it might be possible to also store energy from non-renewable sources in the same storage facility, but in that case there are only bonuses or remunerations for that energy coming from renewable sources. However, this interpretation is discussed controversially among experts. Legal clarification is needed.[237]

Priority grid connection

Plants have to be connected to the electricity grid with priority, if they meet the requirements of a plant defined by § 3 No. 1 Renewable Energy Act. This is, they have to produce renewable energy or store renewable energy

[234] § 18 StromNEV
[235] § 19 EEG
[236] Cf. Thomas 2017, p. 38
[237] Cf. Thomas 2017, p. 41

and reconvert it into electricity. This applies to P2G facilities with re-electrification. The plant operator bears only the costs of the connection of the plant to the nearest technically suitable connection point.[238]

For injection of biogases, certain privileges apply as well. The concerned gases have to correspond the definition of "biogas" in the Energy Industry Act. Hydrogen and biomethane produced from mainly renewable sources are included in this definition (see 2.3). For priority connection, the facility also has to fall under the definition of "facilities" ("Anlagen") in the Gas Network Ordinance (Gasnetzverordnung, GasNZV). § 32 Nr. 3 states that "facilities" are those for the upgrading of biogas to natural gas quality ("Anlagen zur Aufbereitung von Biogas auf Erdgasqualität"). Only for P2G plants with methanation this definition could apply. For injection of hydrogen, no upgrading process is performed. However, the Federal Network Agency assumes that facilities for the production of hydrogen and RNG are to be legally treated in the same way as biogas upgrading plants.[239]

In case that a P2G plant is classified as biogas plant, it enjoys the following privileges:

- Priority connection to the gas grid. The network operator pays for 75% of the connection costs. If the connection distance is longer than 1 kilometre and shorter than 10 kilometre, the plant operator has to pay only up to 250.000 € of the other 25%. The network maintenance falls to the grid operator.[240] Only under very specific circumstances, the network operator can deny the connection.[241] For hydrogen, only a certain amount can be injected. The Federal Network Agency prefers the approach of first come – first serve, this is, plants that have already received permission for a certain amount of hydrogen injection, it must not be taken away for the benefit of later connected plants.[242] The network operator is not obliged to increase the compatibility of more hydrogen through technical measures.[243]
- Priority transportation of the biogas.[244]
- Remuneration for avoided network usage.

10.6 HUNGARY

In Hungary, there is no direct financial incentive for P2G. The closest solutions are the renewable supports schemes (KÁT, METÁR), which might be applicable for some cases, or could serve as examples for future incentives.

- **Mandatory Off-take System (KÁT)**

In the broadly interpreted P2G procedure the obtained gas can be reconverted to electricity. For such power plants which's aim would be the reconversion stated, the benefits of the KÁT should be taken advantage of.

The aim of the mandatory off-take system is to encourage the production of electricity from renewable energy sources and waste. The definition of the energy from renewable energy sources can be found in the Decree of the Minister of National Development on the methodology for calculating the share of energy from renewable sources nr. 1/2012. (I. 20.). Energy from renewable energy sources is introduced as the following: solar, wind, tidal, hydropower, biomass, energy directly or indirectly from biomass, biogas and geothermal, hydrothermal

[238] § 8 EEG
[239] Cf. Lietz 2017, p. 238-239
[240] § 33 (1), (2) GasNZV
[241] Cf. Lietz 2017, p. 248-254
[242] Cf. Lietz 2017, p. 262
[243] Cf. BNetzA 2014, p. 5
[244] § 34 (1) GasNZV

and aerothermal energy from non-fossil and non-nuclear sources. As the energy generated with P2G plants is converted from biogas, P2G plants are entitled to benefit from the system of the KÁT.

The Mandatory Off-take System is regulated by the Decree of the Minister of National Development nr. 63/2016. (XII. 28.). It is laying down detailed rules for the determination and payment of the amount of funds needed to finance operating aid for electricity produced from renewable energy sources. The Decree regulates the conditions, measures and deadlines which shall be followed by the producers in order to be eligible for the guaranteed purchase offered by the state.

The Mandatory Off-take System offered an opportunity for producers producing electricity from renewable energy source or from waste to sell the obtained energy at a fixed price.

The application for the Mandatory Off-take System were closed in 31st of December 2016, however the system still applies to producers who joined before the finishing deadline.

- **Renewable Energy Support System (METÁR)**

After the phase out of the Mandatory Off-take System on the 1st of January in 2017, a new premium-type support system was announced for the promotion of renewable energy production.

In the Renewable Energy Support System, we can differentiate between green and brown premium types. Green premium is available for new renewable system entrants, while the purpose of introducing the brown premium is maintaining the viability of already existing power plants using biomass or biogas.

Regarding the fact, P2G plants are converting biogas (a renewable energy source) into electrical energy, P2G plants are eligible to take advantage of the system of METÁR.

Green premium is only available for new investments for which the implementation has not yet started. For the green premium, producers are obligated to meet the requirements stated the Decree of MEKH nr. 13/2017. (XI. 8.) on the level of operating aid for electricity produced from renewable energy sources. Applicants for the brown premium do not need to tender, as they can apply for the entitlement of the premium directly at the Hungarian Energy and Public Utility Regulatory Authority. [245]

The main difference between the Mandatory Off-take System and the Renewable Energy Support System is the method by which the amount of the incentive is calculated. While in the Mandatory Off-take System eligible applicants receive a fixed price, the energy support system's applicants are entitled to receive a premium on the actual market reference price.

Calculating the green premium's amount

As for the green premium applicants who shall tender to receive the premium, they are obligated to calculate the expected costs and expenses related to the investment they wish to carry out, then, in case of receiving the tender, the MEKH calculates the costs, expenses for the reporting year based on the data included in the tender.

As for those applicants who can receive the aid without tender, the amount shall be calculated based on the pricing updated by the MEKH for the reporting year. In some cases, reference market price for example for solar energy plants, or wind energy plants are to be calculated as well by the updated pricing for the reporting year.

Calculating the brown premium's amount

The amount of the brown premium can be calculated by two methods:

[245] http://www.mekh.hu/download/0/bc/d0000/tajekoztato_a_megujulo_energia_tamogatasi_rendszerrol_202008.pdf

- on the basis of the costs and expenses of biomass or biogas-based production,
- for producers that are capable of using fossil fuels, the distinction between the expenses of biomass or biogas-based production and the expenses of fossil fuel production should be taken into consideration when calculating the incentive

10.7 ROMANIA

Here, the entire chain, from the purchase of renewable electricity for electrolysis to the final use of the produced hydrogen or 'renewable natural gas' should be included in the analysis. Financial incentives for possible reconversion into electricity should also be taken into account in the assessment (excluded investment or project funding).

At the present time, given the fact that there is no legislation to address and especially to regulate clearly practically in the field of hydrogen and renewable natural gas, there is no program, subsidies that correspond to the theme of the above question.

However, investments in hydrogen and especially renewable hydrogen are mentioned in the National Recovery and Resilience Plan of Romania, which stipulates the importance of elaborating a legislative framework in this regard. The budget proposed strictly for investments in hydrogen is not mentioned, but for energy it is intended to allocate 1.62 billion euros. Among the plans that Romania has with hydrogen are:

- elaboration of a legislative framework regarding the production and use of hydrogen

- purchase of trains running on the basis of hydrogen for the already existing but non-electrified lines

- pilot projects on natural gas grids in combination with hydrogen (in 2026 it is desired that 90,000 inhabitants will be fed from such networks)

- the purchase of buses and minibuses that run on hydrogen for a green urban mobility.

Therefore, it is to be congratulated that Romania plans to create a hydrogen strategy, but the fact that so far investments, production, supply of hydrogen-based energy solutions are not regulated by law and are thus almost non-existent is a thing which does not help Romanian energy, as the energy produced from hydrogen would be a surplus in the Romanian energy network or could replace energy from other more polluting sources.

10.8 SERBIA

Financial incentives for production of renewable hydrogen or renewable natural gas are not available in Serbia.

New Law on Utilization of Renewable Energy Sources (OJ RS 40/2021) prescribes that renewable hydrogen can be used in the heating, transport and natural gas sectors (art.83 para.2 and 3), and envisages introduction of incentives for production, transport, storage and utilization of renewable hydrogen.

However, bylaws of the Law have not been drafted yet, and incentives for the renewable hydrogen are still pending.

10.9 SLOVAKIA

Financial incentives for possible reconversion into electricity might be taken into account in the assessment (excluded investment or project funding). Currently no financial incentives are in place.

Support for the production of electricity from renewable energy sources and support for the production of electricity through high-efficiency cogeneration shall be provided by: 1. Preferred connection to the grid system, access to the system and transmission of the electricity. 2. purchase of the electricity by the buyer of the electricity for the price of purchased electricity.

Method of support and conditions of biomethane support is provided by 1. preferential distribution of biomethane, 2. By issuing a certificate of the amount of biomethane. This support covers a period of 15 years from the time the biomethane production plant is put into operation.

Amended Act no. 309/2009 Coll. on the support of renewable energy sources sets the price of electricity produced from biomethane (§ 3 paragraph 10) together with other conditions. Its price is increased by 15% compared to the price of electricity produced from biogas, as stipulated by the ÚRSO Decree no. 225/2011 Coll.

The costs of building the connection connecting the biomethane production facility to the distribution network shall be borne by the distribution network operator to the extent of 75% of the actual costs. The biomethane producer bears the costs of building a connection to the distribution network in the amount of 25% of the actual costs; however, not more than € 250,000. If the length of the connection to be built exceeds four kilometres, the biomethane producer will pay the costs associated with building the connection over four kilometres in full. The connection becomes the property of the distribution network operator.

The law supports the biomethane producer also during the development of the plant. Three quarters of the costs for building the branch pipe are covered by the network operator DSO; the remaining costs are covered by the producer in the amount not exceeding EUR 250 000. If the pipe exceeds 4 km, however, the producer has to cover the total costs regarding the pipe construction over 4 km.

10.10 SLOVENIA

One of the outputs of the DanuP-2-Gas project within the work package WPT4 is the subsidies catalogue – a comprehensive overview on potential national and European subsidies that can support project ideas related to the DanuP-2-Gas concept of sector coupling in the participating countries and beyond. As all collected subsidies might change over time, the catalogue will not be a printed report or document but a database that can be updated, adjusted or expanded as needed. The list of funding instruments will be available via of the Danube Energy Platform. In the process of searching the relevant subsidies in Slovenia for the catalogue, we have concluded that there are no financial incentives directly linked to the P2G, other than those co-financing research projects that could potentially be P2G related research projects. These grants could be applied for the co-financing of the various research projects within the predefined disciplines, which makes it also suitable for the application for the research in P2G hubs. For example, the public call for the (co-)financing of research projects is usually launched every year by the Slovenian Research Agency (Javna agencija za raziskovalno dejavnost Republike Slovenije. The subject of the call is co-financing of research projects that will support the government and sectoral participants in the tender in determining development orientation and policies in certain area of public interest, which is necessary for improving the competitiveness and sustainable development of Slovenia. Among the list of sustainable development objectives relevant for this call were Affordable and clean energy, and Industry, innovation and infrastructure, both possibly related to the P2G. Other than this, the Slovenian Research Agency every year launches various research calls that can be further investigated for the applicability to P2G. *Web address: https://www.arrs.si/en/index.asp*

Another organization, relevant for the co-financing of several investment project is Eco Fund, Slovenian Environmental Public Fund (Eko sklad, Slovenski okoljski javni sklad). The main purpose of Eco Fund is to promote development in the field of environmental protection by offering financial incentives such as soft loans and grants for different environmental investment projects. Eco fund provides soft loans and grants to support environmental investments such as investments in residential buildings, construction of nearly zero-energy buildings, energy efficiency investments, **electric vehicles, charging stations for electric cars**, etc. (Co)-financing of some of these projects can indirectly encourage broadening a network of infrastructure based

on P2G applications and therefore indirectly linked to P2G and use of renewable hydrogen. *Web address: https://www.ekosklad.si/english*

Apart from above-mentioned project and investment funding, the support scheme for produced electricity from RES and CHP can also be indirectly interpreted as a way of promoting and increasing energy production from renewable energy sources. Higher purchase prices enable the realization of investments in environmentally friendly ways of electricity production, necessary to achieve the state goals regarding the share of the use of renewable sources in final energy consumption. Moreover, the produced electricity from RES and CHP could in the future lead to higher load of electric grid and therefore more excess electricity that could be used in P2G systems. The Energy Agency must in accordance Act on the Promotion of the Use of Renewable Energy Sources[246] issue a public call, inviting investors to submit projects for generation units using RES or CHP for entry into the support scheme. The investors that submit projects of RES (hydro, wind, solar, biogas, geothermal, sewage sludge) and CHP generating plants offer the price of electricity generated by the power plant, determined in accordance with the Methodology for determining the support to electricity produced from RES and high-efficiency cogeneration of heat and electricity, in accordance with which they will be able to produce electricity commercially. If the investors are selected and the project is carried out in line with the technology specification and obtains a declaration for this production facility, they may apply for the support.

Implementation of support:

- the guaranteed purchase of electricity supplied to the public network and taken over by the Centre for Support (for a production facility with a maximum nominal power capacity of 500 kW), or
- operating premium for all the net electricity output sold by producers on the market or used for their own consumption (mandatory for generating plants with a nominal power capacity of more than 500 kW).

Web address: https://www.agen-rs.si/web/en/esp_support, https://www.borzen.si/en/Home/menu1/Centre-for-RES-CHP/new-Centre-for-RES-CHP

11. (OTHER) BARRIERS

Since the P2G technology is not yet commercially established in the market, there are also several challenges and barriers that prevent its broader development. These barriers range from purely legal and techno-economical to socio-technical like challenges in acceptance of this new, complex technology. In the following chapter barriers identified by each participating country are outlined. It must be mentioned that the identification of barriers is a first step towards the development of the DanuP-2-Gas roadmaps for involved countries and the transnational strategy, which both are the final tasks in this work package.

11.1 AUSTRIA

In the following chapter existing barriers and needed actions for the deployment of P2G projects in Austria are listed. These are based on the long experience with P2G in Austria and findings from international projects.

- The appropriate legal and regulatory framework including funding possibilities for construction of P2G projects is still in development, which may hinder the faster deployment.

[246] Article 23 Act on the Promotion of the Use of Renewable Energy Sources 2021.

- It is important that sector coupling technologies, such as P2G, are taken into account accordingly in the respective laws. A legal framework that provides legal certainty and incentives should be further developed. This would promote the implementation of such technologies.
- A big variety of stakeholders should be involved in the implementation of P2G projects thus higher complexity in achieving sufficient acceptance for construction may occur.
- Low awareness of climate change and knowledge of clean technologies e.g. P2G, concentrated knowledge exist in small group of energy experts and industries.
- Ambivalence in public acceptance of wind farms and decrease of acceptance for construction of new power lines, but higher acceptance for solar farms and P2G compared to options without such technologies.
- Local projects may face resistance from the local community. However, promotion for local, community-based projects is very important on the one hand to technically and economically try out different approaches in real operation and on the other hand to create demand.
- Complex and long permission procedures, also because of insufficient knowledge level of public authorities involved.
- Lack of appropriate infrastructure for hydrogen use in mobility and for injection into the gas grid.
- Readiness of gas infrastructure and appliances for higher shares of hydrogen should be proved as well as the amount of investment needed for adjustments of the infrastructure should be identified.
- P2G business cases are often non-competitive. However, from the national economy point of view, projects for the generation, distribution and use of green gases as well as the maintenance of existing infrastructure have positive effects on GDP, jobs, import reduction, etc. Therefore, the stronger focus on these positive effects should be used to gain additional/alternative funding, and to increase public acceptance.
- The P2G process is not yet fully technologically mature; there is a need for more demonstration projects. As well as constant market observation and targeted networking with demonstration projects can ensure that we remain technologically "up-to-date". Innovations should be anticipated as soon as possible.
- High production costs of domestic green gas from P2G applications. However, the system service function (being able to create load balancing in the electricity grid and offering seasonal storage options for wind and PV) can be used nationally and thus long-term support can be argued for. This is an important reason to develop P2G projects nationally, because through the import of green hydrogen from abroad, no possibility for nationally necessary system services will be available.
- As high investments for the projects are needed, the examination whether projects can be designed in a modular way, so that investments or generation capacities can be adapted to the increasing demand over time, should be made.

11.2 BULGARIA

In its current state of development, Bulgarian legislative system is unbalanced in reference to stipulations that concern electrical energy produced from RS and the ones for GRS. By adopting the same set of stimuli existing for the electrical energy from RS, the production of GRS can experience the same big leap forward as the one demonstrated by the electrical energy from RS in the past few years.

11.2.1 FINANCIAL INCENTIVES

Although art. 18, par. 4, point 5 of the RES Act stipulates that GRS has to be bought at preferential prices, defined by the EWRC, such prices have never been published. Consequently, potential entrepreneurs don't have the necessary incentive to take the risk and invest in innovative and unknown for the local market technology.

A detailed nomenclature of technologies and RS for GRS should be developed, accompanied by different preferential prices and guaranteed return on investment in the same manner as the one observed for electrical energy from RS.

11.2.2 ACCESS, TRANSMISSION AND TARIFFS

Currently, art. 18, par. 4, point 1-2 stipulates that access to grid and transmission of GRS is guaranteed. The level of engagement on behalf of the grid operators can be increased by changing the status of the access and transmission service from "guaranteed" to "prioritized" for GRS suppliers. In that way, an energy carrier which is more beneficial for the environment will be made available for end-consumers.

Point 3 of the same paragraph (par. 4) prevents the application of discriminatory fees for transmission and/or distribution for GRS. In order to stimulate the penetration of sector coupling technologies, the taxes should be set at preferential level, defined by EWRC on a regular basis. Putting GRS on equal footing with standard natural gas supply in terms of transmission/distribution taxes does not bring the necessary incentives for private investment in P2G hubs.

The last point of art. 18 (point 5) requires the grid operators to publish their tariffs for accession of GRS production facilities. At this stage, such tariffs have never been published. The EWRC should request the grid operators either to comply with the requirement or directly penalize them for non-compliance.

11.2.3 ENERGY/CO_2 SAVINGS METHODOLOGIES

Methodologies for calculation of energy/CO_2 savings for the case when energy is delivered by GRS should be developed and adopted by the Bulgarian regulation system. That will open the door for energy efficiency obligated parties to buy certificates for energy savings originating from usage of GRS.

In the same manner, CO_2 emissions savings can be veryfied P2G hubs and traded with industrial facilities seeking additional CO_2 quotas.

11.2.4 ENERGY COOPERATIVES

P2G hubs are able to provide GRS for a range of purposes to communities, e.g. heating, cooking, cooling, etc. At the same time there are a number of opportunities in many communities for collection of biomass needed for production of GRS. For example, sewage sludge, households' bio-waste, and agricultural waste can be made available for utilization by a P2G hub. Unfortunately, at present there is no regulation that allows such energy cooperatives to be established with the purpose of investing in and implementing P2G hubs.

11.2.5 PROVISION OF BALANCING SERVICES

To provide additional incentives for investments in coupling technologies, operators of the gas/electrical grids should prioritize the use of balancing services provided by P2G facilities.

11.2.6 PROOF OF CONCEPT

Currently, no P2G pilot projects are operating in Bulgaria to provide proof of concept for potential investors. Consequently, the gas grid operators are not acquainted with the implications that accession of a P2G production facility would bring to both the gas network and natural gas quality. Given the lack of tariffs for accession of P2G hubs and of preferential pricing for GRS, it can be assumed that the concept of GRS being delivered through the gas grid does currently exist only on paper.

11.3 CROATIA

- Lack of specific definition of P2G and (renewable) hydrogen within the existing framework and focus on only natural gas and liquefied petroleum gas.
- Strategic documents focusing too little on P2G and hydrogen in future energy systems, but also in industry sector.
- Sector coupling as a possibility not defined within any of the legislative and strategic documents
- Potential shortcoming in connecting the future Hydrogen Strategy (currently in development) with existing legislative framework.
- Lack of communication between private and public sector (industry and legislative/strategic framework).
- Financial incentives and initiatives in P2G and hydrogen projects and encouragement from the decision-makers (lack of project calls and strategic partnerships).
- Knowledge gap on P2G and hydrogen topics, and their implementation.

11.4 CZECH REPUBLIC

- Low enforceability of the law: Even though many things are somehow given by law, it is hard for corporations and people to follow them because (a) citizens have little trust in the state apparatus; (b) laws are difficult to trace and their interpretation is ambiguous; (c) many laws lack any logical and ethical principles; (d) corruption in the police/prosecutor/justice structures allows to evade justice by money or personal/political connections.
- Incompetence: even though many things are mandated by law, the state usually does not have qualified personnel to oversee compliance because (a) public servants are underpaid (defined by the law); (b) public servants are uneducated and lack language or IT skills (not required by law); (c) senior police officers, prosecutors and judges are often still in their positions from the communist regime (defined by the law) and function more like saboteurs of the state.
- Subversion of the population: citizens are divided into a few irreconcilable groups and so the winning political parties conceptually change the legislation after each election (just because the law is set up somehow today doesn't mean that in a week's time it could be the other way around).
- Ambiguity: the law is slow to accept modern terms and adapt to new technologies, P2G is not legally regulated and many of the implications are unclear.
- Desperate financial situation: the state is running huge debts (defined by the law) and inflation goes over 10%; provided that the key energy resources were stolen from the Czech Republic the government is rather dealing with urgent problems of energy poverty and does not have the means to support technologies it cannot afford (renewable energy sources are beyond the economic means of the population).

11.5 GERMANY

- Legal insecurity due to different definitions in the Energy Industry Act and the Renewable Energy Act. A solution for that would be the standardisation of definitions, especially
    - Biogas
    - Biomethane
    - Renewable natural gas
    - Synthetic natural gas
    - Renewable/ green hydrogen.
- No clear definition of P2G plants → legal insecurity regarding financial incentives. In order to overcome that the term “Power-to-Gas” with a definition and clear instructions on how to legally classify such plants could be introduced.

- Legal insecurities regarding unbundling regulations (is a P2G plant an electricity generator or a gas producer?). Here a solution could be a clear definition of P2G plants, including the possibilities of different operation modes → more than one definition for P2G plants.

11.6 HUNGARY

When assembling the summary on the legislative background on P2G technologies, our aim was to provide a thorough and useful material for further policy analysis and investments. Through or work, we had to face two major difficulties:

First of all, the Hungarian legal system contains no direct reference to P2G. The clear and straightforward answers which might appear in cases of more advanced legislative systems are nonexistent in our case.

The second challenge was due to the diffuse nature of P2G processes. Since P2G technologies and utilizations cover a wide range of processes and the fast-paced transition in the energy sector shifts focuses intensively, there is no clear-cut procedure we could concentrate on.

To find the best available solution, we applied a compartmentalizing approach, where we collected the otherwise well-defined partial processes used in P2G technologies and provided descriptions for them (power consumer, gas producer, etc). This approach may not be perfect, since the combinations of these separate processes might lead to an essentially different procedure, which requires special rules, but within the existing framework, it seems to be the best available solution. Several questions were aimed at the clarification of the connection of the provided information to P2G. Since we had to use the separate modules, every time we referred to a component, it brought relevance to the whole.

In our opinion, the main obstacle for P2G is the absence of relevant legislation. As the essence of P2G technologies may be different, than the sum of its parts, the current legislative environment does not support new investments in the field. New energy legislation will most probably focus on the supporting of the hydrogen economy, which effort may not be beneficial to the production of renewable methane. Although the national energy strategy contains references to P2G, the future legal changes will mostly be driven by European legislation.

11.7 ROMANIA

- Lack of general but also precise information about hydrogen, about power to gas legislation, about the usefulness of different types of gas (biogas, biomethane) in the field of energy, energy production or the substitution of other methods to generate energy.
- Lack of information and legacies about power to gas technology.
- There are no measures to encourage the use of green energy in certain areas such as industry of any kind or transport (eg public transport). Measures could be taken to encourage smaller or larger factories and plants to be supplied with green electricity. Public transport could be encouraged to focus more on vehicles (buses, minibuses) with electric propulsion that use green energy. Trolleybuses and trams could also be encouraged.
- Measures that already exist and that promote green energy, although some of them are national programs are insufficiently implemented, are insufficiently promoted whether it is the supply of green energy to a household, a block of flats or other buildings (malls, industrial halls). , technology parks). The owners in question, investors must be encouraged with various benefits, possibly tax exemptions to make them opt for green energy.
- Instability of the political environment. Governments, prime ministers and line ministers (implicitly also the minister in charge of energy) change very often so that many ideas do not get to be put into practice.

The Ministry of Energy was moved (attached and broken) by other ministries or was a stand-alone ministry.

- Directing funds and investments to wrong ends or investments made in inappropriate places - in the case of micro hydropower plants - that have been located on mountain rivers, sometimes in areas where this type of activity is not allowed. Many of them do not work, and those that do do not pay off in terms of the amount of energy they produce. These have been described by environmental and energy specialists as inappropriate. Instead, they had a negative effect on ecosystems on fish fauna and flora.
- Since 2017, - no subsidy or other support scheme for new installed renewable energy capacities, and so, no new relevant investments have been done in this period.

11.8 SERBIA

Based on the performed analysis of the legal and policy situation for sector coupling in the Republic of Serbia, identified administrative barriers are as follow:

- Serbia recently adopted amendments to the Energy Law and Law on Utilization of Renewable Energy Sources; however, the bylaws, which should specify the rules, regulations and requirements for implementation of the mentioned laws have not been drafted/adopted yet.
- Current Serbian legislation does not provide specific definition of P2G plant; however, using available definitions of electricity storage, final consumer, system user and energy market participant, it is concluded that Serbian legislation allows for establishment of P2G plant.
- Due to unbundling provisions in the Serbian legislation, P2G plant which includes feeding into the natural gas grid - cannot be owned by the natural gas transmission operator, independent natural gas transport operator, distribution system operator, the natural gas storage operator.
- Renewable natural gas is not defined in the Serbian legislation; the term low-carbon gases which is an instrument to mitigate climate change, as provided in the Energy Law, could be applicable to renewable natural gas if properly defines the types and characteristics of low-carbon gases that is currently pending.
- If renewable hydrogen and renewable natural gas would be properly defined as low-carbon gases, provisions of Serbian natural gas legislation would be applicable to them.
- Blending of renewable hydrogen into the existing natural gas pipeline is not specifically foreseen in the Serbian legislation. However, blending of renewable hydrogen into the existing natural gas pipeline is possible as long as mixture comply with the technical requirements.
- P2G plant would be obliged to pay system charges, levies, and taxes for both electricity (as consumer) and natural gas (as producer) thus creating obstacle for financial operations of P2G plant.
- Financial incentives for production of renewable hydrogen or renewable natural gas are not available in Serbia; they are envisaged by the Law on Utilization of Renewable Energy Source, but not implemented.
- P2G plant could receive guarantees of origin only in case when P2G plant performs re-conversion to electricity - system for issuing guarantees of origin for gas is not yet established in Serbia.

11.9 SLOVAKIA

11.9.1 LEGISLATIVE, ECONOMICAL

- We need a functional biomethane register, a higher share of waste recovery or a mandatory share of renewable energy for heating. The register will enable the creation of guarantees of origin throughout the European Union and is essential for the development of the biomethane market in Slovakia. Equally essential are incentives for waste management, which motivates the use of waste as a source of biomethane production instead of landfilling or incinerating this waste.
- Hydrogen, nor green hydrogen is not yet anchored in Slovak legislation.
- Economic return on the production of biomethane intended for injection into gas networks – (Usually, the economic return of a biomethane plant construction project is assessed only in terms of revenue from the sale of electricity produced in a biomethane cogeneration plant).
- There are no conditions for better use of other possible resources in the production of biomethane. These are the following sources:
    - sale of heat produced in a biomethane cogeneration plant,
    - fees for waste recovery,
    - possible sale of the sludge from the fermenter as a fertilizer (for specified methods of biogas production).
- When selling the sludge from the fermenter as a fertilizer, it is necessary to propose the MPaRV SR so that these commodities are included in the list of organic fertilizers.
- The link between the law on the promotion of renewable resources and waste legislation is completely missing. Some biomethane production processes could recover waste. It is therefore necessary to amend the legislation so that financial resources for waste disposal and recovery can be better used in the production of biomethane.
- The connection of new cogeneration plants, mainly with an output of more than 1 MW, is associated with complex administrative procedures at electricity distribution system operators and is burdened by very high connection fees.- When negotiating with the population about the intention to build biogas / biomethane production facilities, their fundamental disagreement with the construction is often common. Prior to construction, it is necessary to inform residents about the possible benefits of operating such facilities, or consider some form of financial involvement of the municipality in the operation.
- Amend the legislation in the area of support for renewable energy sources (Act No. 309/2009 Coll. On the support of RES and / or the ÚRSO Decree, which sets the price of electricity produced from RES) so as to more significantly support the production of biomethane from agricultural, industrial and food waste or from biomass that is not grown on arable land (eg contaminated land), or that such production is directly supported, i. j. fixed price for biomethane.
- In the production of biomethane from waste, there is no justification for legislating to limit the size of the biomethane production plant, as the production of biomethane from waste does not affect food safety. Building biomethane production facilities near large waste sources would improve the economic return on biomethane production projects.
- A significant effect of waste utilization in biomethane production is:
    - reduction of methane emissions from livestock excreta,
    - use of excess unused green biomass,
    - efficient disposal of waste with a positive impact on the environment.
- There are no sufficient financial incentives for biomethane to be economically convenient.
- There is no biomethane supply chain developed in Slovakia.

- there is almost no customer demand for biomethane (only small demand mostly from international companies).
- There are no guarantees of biomethane origin nor hydrogen origin yet, however, they should come into legislation in 2022.

11.9.2 TECHNICAL

Hydrogen:

- The need to upgrade the measuring technology (converters) even at H_2 concentrations higher than 6%.
- The fact that the mixture will not be stable, but the amount of hydrogen in it will fluctuate (problematic from the point of view of measuring the actually transported energy) - the resulting necessity to have chromatographs to measure the concentration of hydrogen in the mixture and subsequent recalculation.
- At hydrogen concentrations higher than 3% the need to allocate the area in question and to carry out continuous measurements and evaluations of combustion heat in it separately (or to choose a suitable analytical model).
- Measuring the tightness of gas equipment will require new highly sensitive diagnostic devices, able to detect hydrogen leakage even at minimal quantities.
- Deteriorated combustion properties - reduction of the energy value of the same amount of gas, impact on the amount of air needed for perfect combustion - there are arguments that hydrogen combustion produces increased NOx concentrations compared to natural gas combustion.
- Other explosion limits of hydrogen (4-76%) vs. methane (5-15%) - impact on jetfire.
- Risk of atomic hydrogen entering the steel - possible cause of hydrogen embrittlement.
- Higher permeability of individual materials (both steel and plastic), fittings, seals, etc., due to the much smaller size of the H_2 molecule compared to the CH_4 molecule.

Biomethane:

Although the high-pressure gas distribution network in Slovakia is extensive, it often operates at such high pressures that it requires significant operating costs to compress biomethane to the required pressure. It is necessary to reconsider the condition of transferring biomethane only to high-pressure gas networks.

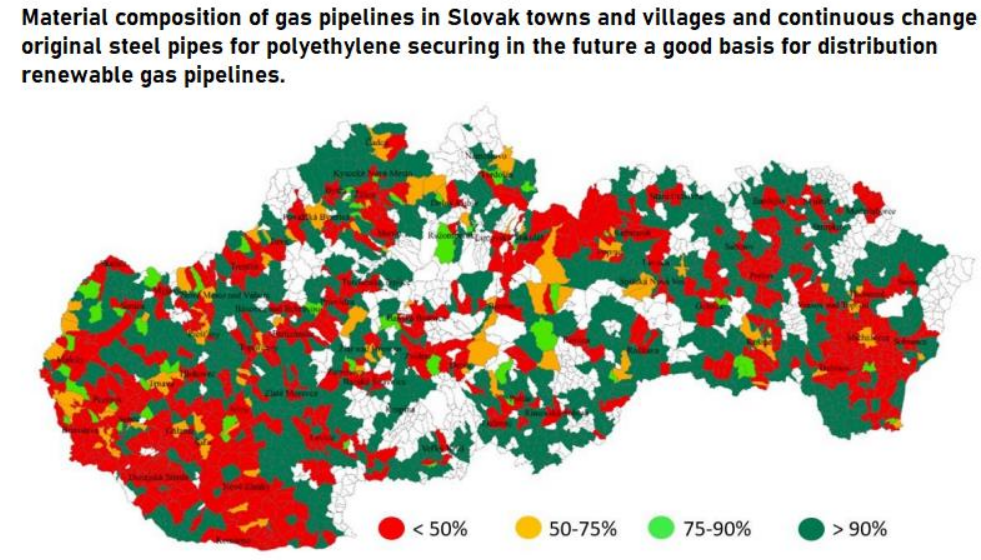

FIG. 5 – Share of polyethylene pipes in Slovak towns and villages in 2020

Source: http://svse-aem.cz/wp-content/uploads/2021/02/Vod%C3%ADk-v-sieti-SPP-D.pdf

11.10 SLOVENIA

- Lack of P2G definition in national legislation.
- The clarity of definition of energy storage (facility) in electricity supply act 2021.
- Electricity and gas sector fragmentation from the legislative regulation perspective.
- Lack of transmission/distribution network analysis and quality standards related to feeding in the hydrogen and 'renewable natural gas'.
- Gas system adjustment pace.
- Clear definition of charges that would apply specifically for a P2G plant.
- Lack of more defined specifications on exemptions regarding the payment of contributions that would apply for P2G.
- Double taxation/levies for P2G facilities.

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LIST OF ABBREVIATIONS

AERS	Energy Regulatory Agency of the Republic of Serbia
ANRE (NAER)	National Authority for Energy Regulations
BNetzA	Bundesnetzagentur, Federal Network Agengy
BT	Bundestag, German Federal Parliament
CHP	Combined Heat and Power
CN	National Code
CNG	Compressed natural gas
COGAS	Combined gas and steam
DSO	Distribution System Operator
DVGW	Deutscher Verein des Gas- und Wasserfachs, German Association of the Gas and Water Industry
EA 2010	Electricity Act 2010
ED 2019	Electricity Directive 2019
EEG	Erneuerbare-Energien-Gesetz, Renewable Energy Act
EnergieStG	Energiesteuergesetz, Energy Tax Law

EnWG	Energiewirtschaftsgesetz, Energy Industry Act
ES	End-user supplier
EUR	Euro
EUR	Euro
EWRC	Energy and Water Regulatory Commission
F.L.G	Federal Law Gazette
FPEES	Fund for Protection of the Electrical Energy System
FUI	Provider/Supplier of Last Instance
GasNZV	Gasnetzverordnung, Gas Network Ordinance
GHG	Greenhouse gas
GoO	Guarantee of Origin
GoS	Government of Serbia
GRS	Gas from Renewable Sources
HRK	Croatian kuna
HT	High tariff
ITO	Independent Transmission Operator
KÁT	Mandatory Take-Off System
LNG	Liquefied natural gas
LT	Low tariff
METÁR	Renewable Energy Support System
MoME	Ministry of Mining and Energy of the Republic of Serbia
NAV	Verordnung über Allgemeine Bedingungen für den Netzanschluss und dessen Nutzung für die Elektrizitätsversorgung in Niederspannung (Niederspannungsanschlussverordnung), Ordinance on General Conditions for Grid Connection and its use for the supply of electricity in the Low-Voltage Connection Ordinance (Niederspannungsanschlussverordnung)
NDAV	Verordnung über Allgemeine Bedingungen für den Netzanschluss und dessen Nutzung für die Gasversorgung in Niederdruck (Niederdruckanschlussverordnung), Ordinance on General Conditions for the Network Connection and its Use for the Supply of Gas at Low Pressure (Low Pressure Connection Ordinance)
NGSA 2011	Natural Gas Sector Act 2011
No.	Number
OG	Official Gazette
OJ	Official Journal of the Republic of Serbia
ÖVGW	Österreichische Vereinigung für das Gas- und Wasserfach (Austrian Gas and Water Association)
P2G	Power-to-Gas
Pach	the purchase price of electricity taken into account by the supplier of last resort, including Tg [lei / MWh];
PECI	Projects of Energy Community Interest
Pf	the supply component established by the supplier of last resort, for a period of application (includes the cost of the supply activity, the cost of participation in the centralized markets managed by the Romanian electricity and gas market operator OPCOM SA and the profit) [lei / MWh].
PFGRS	Production Facility of Gas from Renewable Source
PMI	Projects of Mutual Interest
PS	Public Supplier
PUI	Price of Last Instance
RED II	Renewable Energy Directive II

REEA	Renewable Energy Expansion Act
RES	Renewable Energy Sources
Rm	Run meter
RS	Renewable Sources
RS	Republic of Serbia
RSD	Serbian Dinar
RTEE	Rules for Trading with Electrical Energy
RTNG	Rules for trading with natural gas
SE	Supplying Enterprie
SEDA	Sustainable Energy Development Agency
SNG	Synthetic Natural Gas
StromNEV	Stromnetzverordnung, Electricity Network Ordinance
StromStG	Stromsteuergesetz, Electricity Tax Law
SU	Universal Service
TSO	Transmission System Operator
UI	Last instance
UT	Unique tariff
VAT	Value Added Tax