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Deliverable number D.T3.2.1

Strategic Roadmaps for participating countries

Activity A.T3.2: Strategy development

December, 2022

A magyar partner részvétele a projektben a Magyar Állam társfinanszírozásával valósul meg.
Project co-funded by the European Union funds (ERDF, IPA)
www.interreg-danube.eu/danup-2-gas

DOCUMENT CONTROL SHEET

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Short Description
This document include country-specific political roadmaps, which are based on country-specific policy assessments and identified barriers and involves recommendations directed at political actors and energy planers.

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CONTENT

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1. INTRODUCTION

The project DanuP-2-Gas aims to advance transnational energy planning by promoting generation and storage strategies for renewables in the Danube Region by coupling the electric power and gas sector. The effective realisation of this project depends strongly on the legal and regulatory framework. During the work within the WP3 the legal and regulatory status concerning the construction and operation of hubs for coupling the electricity and gas sector was assessed and existing national barriers have been identified.

These assessments are the basis for the development of country specific strategic roadmaps designed to foster energy storage through specific recommendations on different levels - for adjustments of the legal framework, reduce social, technical barriers as well as giving special insights on the potential of the sector coupling hubs in every country. Further, these roadmaps will be combined to a durable strategy to enhance sector coupling in the Danube Region.

In order to obtain valuable results for the roadmaps from the legal analysis and identified barriers, it is imperative to identify which measures and steps are necessary to achieve the EU and national targets for decarbonization, increasing the share of renewable energies as well as increasing energy security in the region. It must be emphasized that there are some barriers that apply to all countries, however country-specific challenges with corresponding national climate targets will play an important role for the developed roadmaps. The roadmaps will be discussed during national stakeholder workshops and individual expert interviews and additional adjustments, based on the interviews, will be incorporated.

Deliverable 3.2.1 serves as a basis for all the above-mentioned objectives. The aim of this Deliverable is therefore to define the needed actions to promote and deploy the sector-coupling hubs in Danube Region countries.

2. METHOD

The objective of this Deliverable is to present the developed country-specific roadmaps, which are developed based on the conducted legal assessment in every involved country and, especially, taking into account the identified barriers. In the development of the national roadmaps work package the core team met twice to discuss the aims, timeline and needed actions. The roadmaps, which than were developed by the respective project partners were disseminated to the important stakeholders/political/policy representatives in each country and gained feedback was incorporated into the roadmaps.

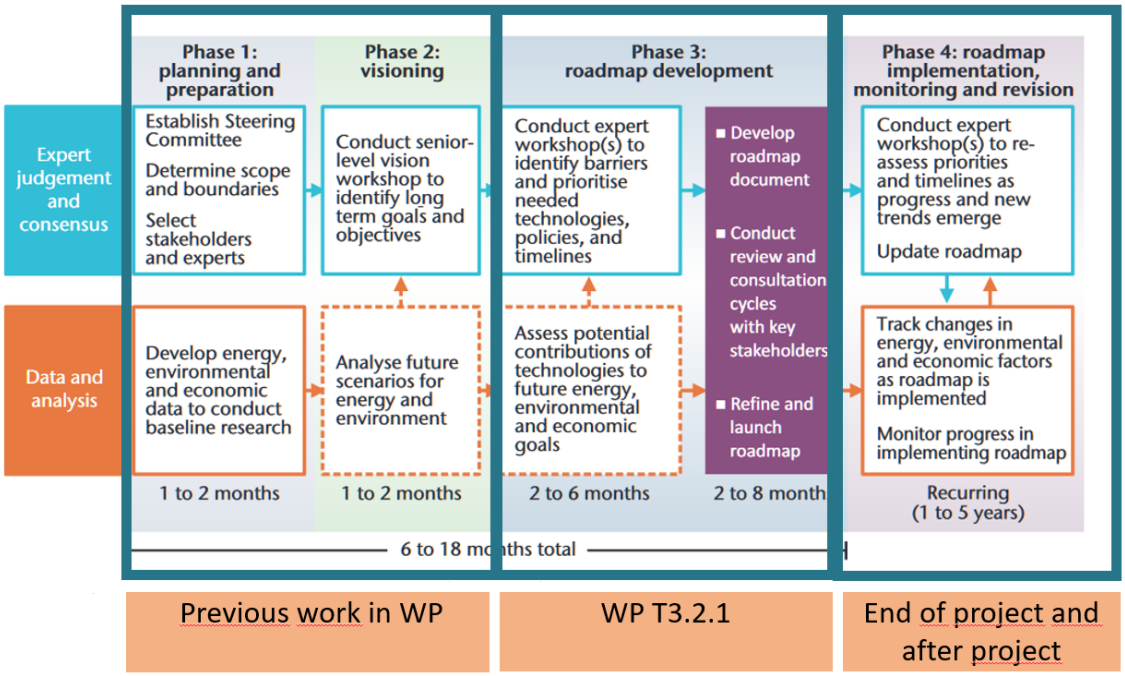
3. GENERAL APPROACH

A roadmap is a strategic plan that describes the steps needed to take to achieve stated outcomes and goals. It clearly outlines links among tasks and priorities for action in the near, medium and long term. A roadmap also includes metrics and milestones to allow regular tracking of progress towards the roadmap's ultimate goals. The IEA defines a technology roadmap as *"a dynamic set of technical, policy, legal, financial, market and organisational requirements identified by all stakeholders involved in its development."*[1]

The development of the roadmap in DanuP-2-Gas project relies on the general approach proposed by IEA in "Energy Technology Roadmaps. A guide to development and implementation", see Figure 1.

The results of analysis of biomass potentials, as well as infrastructural challenges made within the WP 2 are essential part of the roadmap, showing the existing situation with future scenarios. Evaluated use cases of sector coupling hubs within the WP2, highlight important findings for potential investors or other interested stakeholders, showing the possibilities and weaknesses of feasibility of such projects in every country.

[1] Energy Technology Roadmaps. A guide to development and implementation. IEA, 2014 Edition



1. Figure: Roadmap process outline (Adjusted from IEA technology Roadmap Guide, 2014)

The analysis of the legal framework and identification of existing barriers is the core part of this roadmap. The further development of action items and needed steps to overcome the barriers, which are in line with the specific country goals, shows the step-wise plan to achieve the overall targets and aims of the roadmap.

4. THEMATIC SCOPE AND GOAL OF THE ROADMAP

The goal of the roadmap is to support the development towards increased energy security and efficiency in the Danube Region via storage of surplus renewable energy in the gas-grid and contribute to the EU climate-neutrality by 2050. The roadmap identifies needed actions to overcome existing barriers for wider implementation of sector-coupling hubs within the Danube region. The roadmap focuses foremost on adjustments of legal framework, however overall interdisciplinary barriers and challenges are shown and further steps identified.

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5. HUNGARY

The following chapter discusses the future prospects for P2G hubs in Hungary, including significant changes and benefits to the country's energy system in the coming years.

5.1 NATIONAL (SPECIFIC) GOALS

- Our gas import share will fall to close to 70% by 2030 and below 70% by 2040
- Gas consumption for heating will fall by 2 billion m^3 per year by 2030.
- While natural gas consumption in the power sector could exceed the current levels but could fall below 1 billion m^3 per year by 2040. Our total gas consumption will therefore fall from the current 10 billion m^3 per year to nearly 8.7 billion m^3 in 2030 and could fall below 6.3 billion m^3 by 2040.
- The share of carbon-neutral domestic electricity generation increases to 90% by 2030.
- Domestic installed photovoltaic capacity will exceed 6000 MW by 2030, and close to 12000 MW by 2040.
- At least 1 million smart meters will be installed to increase the flexibility of the electricity sector
- Our import share will stabilise below 20% by 2040
- The key to this is to maintain nuclear capacity and to encourage and preparing the transmission and distribution network to meet the challenges of a decentralised and highly weather-dependent generation structure is a prerequisite for a rapid increase in renewable penetration
- Our final energy consumption will not exceed the 2005 level of 785 PJ in 2030, while maintaining dynamic economic growth. If final energy consumption increases after 2030, the source will be carbon neutral.
- Our share of renewable energy use in gross final energy consumption to at least 21%.
- Our GHG emissions will be reduced by at least 40% compared to 1990.

Exploitation of alternative gas sources: estimated Hungarian biogas potential has a realistic potential to replace 1% of Hungarian natural gas consumption by 2030, which would be around 85 million m^3 per year. Further growth is expected by 2040, so that the domestic biogas potential could reach 100 million m^3. In addition to biogas, Hungary also sees hydrogen as an alternative, so the integration of hydrogen into the natural gas network is also being investigated. Our objective is to phase out low-utilisation (below 10%) distribution lines from the publicly funded system by offering low-carbon heating alternatives. The ability to feed hydrogen into the network could play a key role as an alternative to phasing out low-utilisation distribution lines and in meeting climate change objectives.

6. OVERVIEW OF POWER-TO-GAS RELATED ACTIVITIES

The National Energy Strategy (NES) along with National Energy and Climate Plan (NECP) and National Clean Development Strategy (NCDS) recognizes that Hungary is a country poor in traditional energy resources, and therefore energy sovereignty is a welfare, economic and national security issue. In the strategy's vision for the future, nearly half of Hungary's electricity generation will come from carbon-neutral nuclear energy, an assumption that in itself is a strong starting point for renewable hydrogen production. This makes it possible to produce hydrogen at times of the day (e.g., at night or peaks) when the electricity grid cannot economically absorb the electricity generated, so it could play a vital role in grid network regulation, as balancing valley, or peak season production, which also makes longer term energy storage possible. Additionally, hydrogen has an enormous potential due to the existing natural gas infrastructure which implies a high share of industrial and residential appliances. This fact could help and facilitate the boosting of demand for biogas and hydrogen. Also, the share of electricity generated from renewable energy in the country is growing dynamically, which could also be an excellent opportunity to create a supply side for P2G installations in the future. As NCDS articulate the technology will be competitive after 2030. In the NCDS KCs (Early Action) scenario, hydrogen will contribute 11% of final energy use in 2050, while in the HCs scenario it will contribute 15%, which is ambitious even globally, and below average at European level. Since the appearance of the NCDS, the National Hydrogen Strategy hs been completed, which identifies four priority objectives, but also identifies three additional "supporting" objectives". The strategy outlines two focus region where the development of the hydrogen ecosystem will take place: Transdanubian hydrogen ecosystem, North-Eastern Hydrogen Valley. The funding to support the implementation of the strategy, so far announced, is HUF 145 billion.

Priority objectives

1. Large-scale low-carbon and decentralised decarbonised hydrogen production:

A concrete quantifiable target of 36,000 t/year of "green", other carbon-free and low-carbon hydrogen production in 2030 is set, including 20,000 t/year of low-carbon hydrogen, 16,000 t/year of "green" and other carbon-free hydrogen, and associated 240 MW of electrolysis capacity.

2. Decarbonisation of industrial use partly with hydrogen:

In the field of industrial use, the aim is to achieve a "green", other carbon-free and low-carbon hydrogen use of 24,000 t/year by 2030, which would avoid 95,000 tons of CO2 emissions per year; in 2017, according to the Hungarian Central Statistical Office, our annual CO2 emissions were 64,830.5 thousand tons. This amount of hydrogen is the planned 14.81% of the 162,000 t/year hydrogen consumption projected for 2030. Full industrial decarbonisation could be achieved by 2050.

3. Greening of transport:

The transport sector could reach 10,000 t/year of hydrogen consumption by 2030 and 212,000 t/year by 2050. The focus will be on heavy duty vehicles. The deployment of a hydrogen refuelling network along TEN-T corridors could be a priority, and the general Block Exemption Regulation.

4. Supporting electricity and (natural) gas infrastructure:

Hungary's geographical conditions do not allow for the construction of pumped storage, so hydrogen could be part of the solution to this problem when considering other means of seasonal energy storage. The strategy foresees the creation of at least 60 MW of average storage capacity by 2030.

Supporting objectives

1. Exploiting industrial and economic development opportunities:

In the short term, the aim is to produce "blue" hydrogen, then to build international cooperation in electrolysis production (under license) and to support the domestic SME sector to become a supplier in the hydrogen economy by strengthening the SME sector.

2. Horizontal conditionality: creating a supportive operating environment:

A key objective is to create a supportive regulatory environment along the entire hydrogen value chain, one of the tools for which is to actively participate in the EU legislative process, representing national interests. At the same time, international cooperation will be strengthened, one of the tools being the establishment of IPCEI (Important Projects of Common European Interest). IPCEI is a special funding authorisation designed to provide a funding framework for projects of strategic European interest in which the public authorities can State aid is allowed.

3. RDI and education to support hydrogen's success in the transition:

Education and training of professionals and further training and appropriate information for the general public are priorities in this area. The Strategy mentions the establishment of a National Laboratory for Hydrogen Technology as part of the National Renewable Energy Laboratory.

Furthermore the project HyLaw (which brings together 23 partners from Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Hungary, Italy, Latvia, Norway, Poland, Romania, Spain, Sweden, Portugal, the Netherlands and United Kingdom) coordinated by Hydrogen Europe, aims at boosting the market uptake of hydrogen and fuel cell technologies providing market developers with a clear view of the applicable regulations whilst calling the attention of policy makers on legal barriers to be removed. Besides an online and publicly available database, national policy papers (including Hungary) describing each legal and administrative process, highlighting best practices, legal barriers and policy recommendations are provided.[2]

[2] https://www.hylaw.eu/.

7. SECTOR-COUPLING POTENTIAL IN HUNGARY

For Identification of the potential for sector-coupling hubs for the particular country it is important to take into account the following: biomass potentials, availability and suitability of gas and power infrastructure and energy system specification.

The optimization tool, developed during the project was used to evaluate different use cases in all participating countries, the results gives robust overview of techno-economic feasibility of sector-coupling hubs. According to the findings respective recommendations for potential investors are provided.

Hungary aims to integrate the different forms of energy (electricity, gas, electricity energy and heat, as well as fuels) to make them interconnected. The gas and electricity markets are already interconnected at many points, and therefore the main priority is to harmonise the operating cycles and regulatory systems of the two markets priority.

Market integration not only has a regional dimension, but also involves, inter alia, the coordination of the gas and electricity markets. The two markets interact at several points, most obviously in the operation of gas-fired power plants. Of particular importance are the institutional developments that to harmonise the operating cycles and regulatory regimes of the two markets. However, in the near future sector coupling could also be extended to new areas, such as the renewable energy use of gas-fired heating/cooling. gas-fired heating and cooling with renewable electricity or heat pumps in low-utilisation areas, regions with under-utilised infrastructure or not connected to the gas grid. The use of the natural gas network as an energy storage facility is also a new and innovative option, which could, inter alia, contribute to integration of electricity generation from weather-dependent renewable sources production of hydrogen or methane and feeding it into the gas grid.

7.1 BIOMASS POTENTIAL

The share of renewable energy sources from gross energy consumption in 2020 was 14%. Fluctuation of total primary renewable energy production was observed in 2014-2022 period. The highest share of primary renewables was made by solid biomass production, the decreasing trend of solid biomass was observed in 2020. The second largest increasing share of primary production was observed in biofuels sector. By the end of 2020, the total power capacity of solar panels connected to the electrical grid was higher than 2 000 MW, which exceeded the capacity of Paks Power Plant (MEKH, 2022). The total solar energy production has an increasing trend, in 2020 the primary solar energy production exceeded the 2019 level by 59.3%.

The total supply of biomass in Hungary added up to approximately 31 million tonnes of dry matter (tdm). Almost 90% of this biomass was produced in Hungary, while 10% of the biomass supply was imported. The origin of only 0.5% of the total biomass could not be identified. The agriculture sector is the biggest producer of domestic biomass with 79% of the total, followed by forestry with almost 10% of the dry matter content but a significant portion of biomass from agriculture is recycled into production and is not available for energy use.

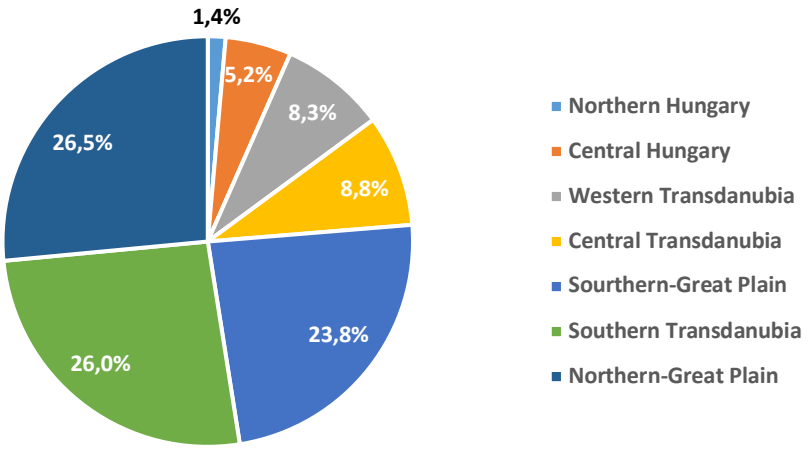
Energy crops have been considered in the single area payment scheme (SAPS) since 2006, but the list of eligible crops has changed several times. Therefore, Figure 15. shows the changes in area under energy crops since 2010, based on the single application database of the Hungarian Paying Agency. The total area under energy crops peaked in 2011, since then has been on a decreasing trend, and currently covers less than 6000 hectares. Woody energy crops have been dominated throughout the period examined (between 50 and 87%) consisting mainly of poplar, black locust, and willow species. The area under energy grass had steadily and significantly decreased from almost 3000 hectares to 500 hectares. The area of herbaceous energy crops (Sida, Miscanthus, and Arundo) also halved in 2013, but has been relatively stable since then (350–400 hectares). According to the above-mentioned data, the creation of new energy plantation has completely ceased in recent years. However, due to the characteristics of the country and the high percentage of arable land, the potential of herbaceous agricultural by-products is outstanding in Hungary (straw from grain cereals, maize stover, sunflower

stem and oilseed rape straw). Cereal straw consumption is mostly in livestock sector, other part of agricultural residues is chopped and used as soil amendment, but significant quantity remains for potential energy purposes. In addition, the utilization of horticultural woody by-products from pruning can be significant. Although the heating value of these horticultural by-products is very similar to wood, and the pruning chips can easily be stored and transported, its current use for energy purposes is low (Barta et al., 2014). The most important aspect of usability is organizing by-product collection. The scattered geographical location of the orchards and vineyards (see Figure 2.) where these by-products are generated must also be considered (Szalay et al., 2019).

There are in total 66 biomass power plant, heating plant and biogas plant for energy purposes in 2020. Based on AKI statistical data collection the domestic biomass consumption for energy purposes was 3.5 million tonnes (+9% increase compared to 2019), of which 84.8 thousand tonnes were imports in 2020.

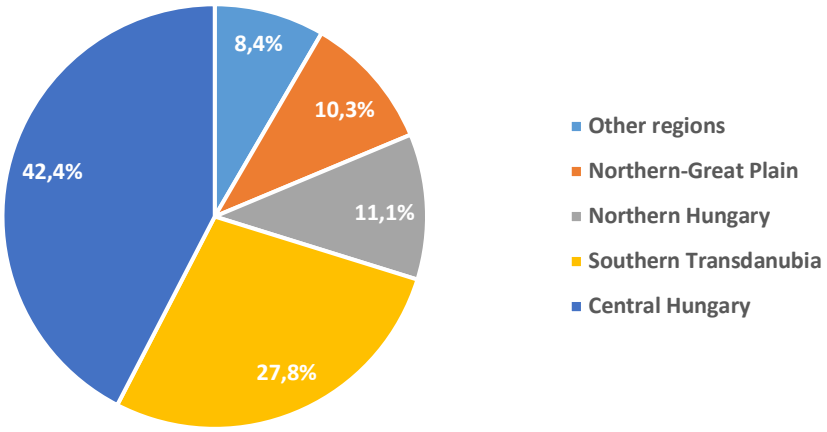
In 2020, biomass power plants and heating plants used in total the quantity of 2 167 734 tones. The share of biomass raw materials in Hungary used 44.9% of wood chips (973,834 tonnes), for their energy production, a decrease of more than 10% compared to the amount used in the previous year. Firewood (12.9%), grain straw (7.4%), paper waste (6.7%) and sunflower peel (6.2%) materials obtained the highest share of biomass usage. Category of other materials consisted municipal waste (160 508 tons), agricultural products (80 933 tons), milling by-products (59 175 tons) and rape straw (40 156 tons). The main raw material group used in biogas production is agricultural products, with a share of 42.0% (570.9 thousand tonnes). In 2020, animal manure accounted for 72.3% of this amount.

Total biomass quantity used in biogas plants in 2020 was 1 360 084 tones. In biogas production the highest share of raw materials was obtained from agricultural sources (58.1%), mainly from manure as biogas materials (42% of total biogas raw materials). Second largest share was manufacturing raw materials (32.9%), mainly form by products of beverage industry (22.1%).



2. Figure: Distribution of biomass raw materials used in biogas plants by region, 2020

Source: AKI Agricultural Statistics Department, 2021



3. Figure: Distribution of biomass raw materials used in power and heating plants by region, 2020

Source: AKI Agricultural Statistics Department, 2021

Currently biomass use accounts for a dominant share of renewables in Hungary, but the government has set the target of diversifying the composition of renewable energy consumption. The share of renewables will moderately increase in Hungary from around 14.1% in 2016 to 14.7% in 2030. By 2030, the dominance of biomass can be reduced with an upturn in solar energy. The National Energy and Climate Plan (NECP) foresees major potential for the efficient use of biomass in both individual heating equipment and in district heating, while the increase of solar PV capacities would be the core element of renewable energy sources within electricity consumption. The share of biomass use will remain dominant but decrease to 75%. The share of solar energy within renewables will significantly rise, from the initial 1% to around 8% by 2030. A moderate increase in the use of geothermal energy is also expected (Fig.21.). Capacities used for biomass-based electricity generation, still operating today, will gradually be phased out until 2035, but the total capacity will again rise to around 500 MW by 2040 (ITM, 2020).

7.2 DESCRIPTION OF HUNGARIAN INFRASTRUCTURE LANDSCAPE

In recent years, Hungary has shown dynamic growth in renewable energy infrastructure, which will continue to grow even more dynamically in the future, according to the strategies and plans published so far. Of all the weather-dependent renewable energies in the country, solar energy has the highest potential and is therefore the most dynamically developing renewable energy source, in some cases at the expense of synergies with other potential weather-dependent renewable energy sources.

Strengths:

- The country's energy network is a well-developed system, including border crossing points, designed in accordance with EU standards and regulations;
- Natural gas accounts for a high share of the country's final energy consumption, which implies a high share of industrial and residential appliances that can use natural gas. This fact could help and facilitate the boosting of demand for biogas and hydrogen;
- The share of electricity generated from renewable energy in the country is growing dynamically, which could also be an excellent opportunity to create a supply side for P2G installations in the future.

Weaknesses:

- The Paks nuclear power plant represents a high share of the country's electricity supply, resulting in a relatively concentrated energy system in the country;
- The political and economic interest in biogas varies in intensity across the country, making it difficult to provide a stable backdrop for long-term biogas development projects;
- The regulatory environment is not yet mature for biogas, which could be an option for a supportive regulatory environment in the future.

Opportunities:

- Paks II, one of the largest ongoing projects in Hungary, is currently on hold and may become impossible in the long term. As a consequence, it is possible that the country will have to rely on alternative energy sources to provide the

necessary energy capacity that the project will need. This could help in the construction of P2G hubs;

- There is growing interest in hydrogen, not only in Hungary but also globally, which could be an excellent opportunity for power-to-gas hubs;
- High energy prices could boost demand for renewable energy sources.

Threats:

- Currently, the country has a high demand for energy imports, which results in a low surplus of available energy;
- In the field of a common European green policy, including energy policy, there is still far from a unified position among countries, and therefore decisions can be taken in a long process of discussion and debate, which can slow down the dynamic stimulation of interest in power-to-gas.

7.3 USE CASE ANALYSIS

The results show that, in principle, the most ideal location for a P2G hub is the potential expansion of an existing industrial facility, which can ensure the reduction of emissions and thus its sustainability. The expansion of industrial facilities and their conversion into P2G hubs can also further help to reduce the energy demand of industrial hub areas and, in turn, their dependence on external energy sources. In addition to the above benefits, it will also help to fit in with Hungarian energy strategies, in particular the hydrogen strategy, given the potential of such facilities to help create hydrogen valleys. While this could lead to a certain concentration of the technology in the country, it could also create more energy production centres than at present and thus help de-concentration. The resulting centres could create a new network of suppliers for the surrounding SMEs.

The calculated results show that neither renewable energy sources (solar farms were included in the analysis) nor full greenfield investments are recommended for P2G from an economic point of view.

For greenfield investments, building a complete industrial vertical would lead to excessive investment costs that would not be recovered within a reasonable timeframe.

The situation is similar for P2G hubs located close to renewable energy sources, despite the fact that an energy source already exists at the implementation site under consideration. However, it is important to underline that P2G hubs near solar power plants have been included in the calculation, hence it is possible that other renewable energy sources (biomass, biogas, wind, hydro) may give different results.

7.4 EXISTING FUNDING POSSIBILITIES

2021-2.1.2-HŐ, Improvements in waste heat recovery, storage or market-based use through innovative heat storage or conversion technology

Support for pilot projects that lay the foundations for the market introduction of viable heat storage, heat transport, power-to-heat and heat-to-power technologies, both from a technical and environmental point of view. Possible usage of the funding instrument in the P2G context: Possible development of supporting infrastructure in: Applied (industrial) research, Experimental development or preparation of a feasibility study.

Legal Entity	**National Research, Development and Innovation Office - Nemzeti Kutatási, Fejlesztési és Innovációs Hivatal**
Geographic Scope	The whole territory of Hungary
Eligibility Criteria	Budgetary body, Enterprise, Non-profit organisation
Co-Financing Rate	from 25 to 80% depending on project proposal and type of applicant
Volume	1 666 666 666 – 2 500 000 000 HUF (cca. 4 503 713 – 6 755 569 EUR)
Duration	3 years
Limitations	(1) The operational model of the pilot project should facilitate the use of previously unused waste heat, (2) The heat storage, heat transport and/or power to heat and/or heat to power technology and the equipment of the whole process that implements it, used by the pilot project, must be able to connect to the existing electricity / district heating (individual heat) network, with the maximum modification and/or extension of these network systems necessary for the implementation of the pilot project, but not exceeding the extent of the pilot project. (3) The technology and/or the overall process used in the pilot project must be demonstrated to be innovative and scientifically sound.

Periodicity thus far	2021 Q4
Web Address	https://nkfih.gov.hu/palyazoknak/aktualis-felhivasok/egyeb-tamogatas/hulladekho-hasznositasat-tarolasat-felhasznalasat-celzo-fejlesztesek-2021-212-ho/palyazati-felhivas

KEHOP-5.1.5-20 Classical and intelligent network developments of distributors for greater network flexibility and stability

The objective of the call is to support the development of classic and smart grids for flexibility and stability in the distribution network, thereby indirectly facilitating the system integration of weather-dependent renewable energy producers and the spread of electrification (spread of heat pumps and electric transport).

Possible usage of the funding instrument in the P2G context: The subsidy also supports IT and info-communications support for the integration of weather-dependent renewable energy producers into the electricity system, these factors can help in the development of a complex and integrated energy system with the possibility of coupling to P2G hubs.

Legal Entity	**Ministry of Innovation and Technology - Ipari és Technológiai Minisztérium**
Geographic Scope	The whole territory of Hungary
Eligibility Criteria	Limited liability company, Joint stock company, European Company; Under this call, distribution network licensees under the VET (Act LXXXVI of 2007) can submit a grant application. It is also possible to submit a grant application under this call in the form of a consortium.
Co-Financing Rate	50% of the total eligible costs
Volume	maximum amount is defined: 17,5 billion HUF (cca. 47 861 415 EUR)

Duration	Deadline for physical completion of projects: 30/09/2023
Limitations	Types of activities: On a high voltage network; Substation installations; Interventions due to the construction of non-public substations; Substation transformer replacements and expansions; Medium voltage network developments; Feed point compressions; Low voltage network upgrades; Digitization developments; Energy storage capacities installed on the electricity network up to a nominal output capacity of 0.5 MW
Periodicity thus far	Several times a year
Web Address	https://www.palyazat.gov.hu/node/73205#

GINOP Plusz-1.3.1-21 Green National Champions

The aim of the call is to support the technological transformation of micro, small and medium-sized enterprises active in the field of green industry and to increase domestic added value in emerging green economy markets.

Possible usage of the funding instrument in the P2G context: studies for future developments in P2G, building/improving support infrastructure for P2G like: IT, know-how, quality, environmental and other management, governance, certification systems, standards implementation and certification standards.

Legal Entity	**Ministry of Finance - Pénzügyminisztérium**
Geographic Scope	The whole territory of Hungary except Budapest
Eligibility Criteria	Limited liability company, Public limited company. Enterprises that qualify as micro, small and medium-sized enterprises according to Annex 1 of Regulation (EU) No 651/2014., European Company (SE), the Hungarian branch of a foreign enterprise, Sole proprietorship, Sole proprietor. Applications for support cannot be submitted in the form of a consortium.

Co-Financing Rate	0-50% depending on project proposal and type of applicant
Volume	estimated between 20 000 000 HUF – 1 500 000 000 HUF (cca. 54 698 EUR – 4 102 407 EUR)
Duration	2 years
Limitations	Up to 50% depending on the activity type; for some activity types upper absolute limits exist.
Periodicity thus far	Applications will be assessed on an ongoing basis.
Web Address	https://www.palyazat.gov.hu/ginop-plusz-131-21-zld-nemzeti-bajnokok-a-zldgazdasg-terletn-mkd-mikro-kis-s-kzpvllalkozsok-technolgiafejlesztsnek-tmogatsa

GINOP PLUSZ-2.1.1-21 Encouraging business research, development and innovation

Supporting in-house development of knowledge-intensive and innovative enterprises, products, technologies and services is a priority to boost business competitiveness and R&D&I activity. (2) Support for smaller collaborations is also essential to exploit synergies in the existing and potential knowledge base of enterprises. These joint projects can lead to the development of new marketable products, services and technologies with significant intellectual added value. (3) The aim of the call is to stimulate R&D&I activities of domestic enterprises and to increase R&D&I activity among innovative enterprises.

Possible usage of the funding instrument in the P2G context: Experimental development: the acquisition, aggregation, transformation and use of existing scientific, technological, business and other relevant knowledge and expertise to create new or improved products, processes or services. This may include, for example, activities to conceptualise, design and document new products, processes or services in the P2G context.

Legal Entity	Ministry of Finance - Pénzügyminisztérium
Geographic Scope	The whole territory of Hungary except Budapest
Eligibility Criteria	micro, small and medium-sized enterprises and large companies, research centres, research and knowledge transfer organizations
Co-Financing Rate	from 25% to 80%
Volume	between 50 000 000 – 1 000 000 000 HUF (cca. 135 000 – 2 700 000 EUR)
Duration	3 years
Limitations	not known
Periodicity thus far	- Phase 1: 13 December 2021 - 5 January 2022. - Phase 2: 1 March 2022 - 30 March 2022.
Web Address	https://nkfih.gov.hu/palyazoknak/szechenyi-2020-kfi/ginop-plusz-211-21/palyazati-felhivas

8. EXISTING BARRIERS

In the following chapter existing barriers and needed actions for the deployment of P2G projects in Hungary is listed. These are based on the long experience with P2G in Hungary and findings from international projects.

Legal barriers

- Although a number of Hungarian government documents deal with P2G technology, there are still significant gaps in the detailed regulation that need to be addressed.
- 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.
- 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.
- The installation of wind power is legally impossible, but this is expected to change in the coming years in view of the energy crisis.

Socio-technical barriers

- There are several initiatives to set up P2G centres in the country, but their social awareness is still low and the technology is not widely known. This would be necessary to allow sufficiently complex and comprehensive developments to enter the implementation phase.
- Low awareness of climate change and knowledge of clean technologies e.g. P2G, concentrated knowledge exist in small group of energy experts and industries.
- Public acceptance of wind farms is low and the supply of solar energy to the grid is temporarily limited.
- Complicated and lengthy authorisation procedures, where it is not always clear for the authorities concerned in particular what detailed rules apply to a given project, due to the incomplete legislative environment.

Techno-economic barriers

- 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 is not yet a commercially competitive technology. However, from a macro-economic perspective, projects for the production, distribution and use of green gases and the maintenance of existing infrastructure have positive effects on GDP, jobs, import reduction, etc. Therefore, by focusing more on these positive effects, additional/alternative financing should be obtained and public acceptance increased.
- The P2G process is not yet a mature technology; more demonstration projects are needed. Continued market monitoring and targeted networking through demonstration projects can ensure this.

9. ACTION ITEMS AND RECOMMENDATIONS

Taking into account the identified existing barriers, a variety of action items and needed steps, which should be taken to overcome these gaps and barriers and to achieve the goals of the roadmap, are summarised in this chapter.

Action items needed to overcome legal barriers

- The rules and regulations that are established must be clear and unambiguous. They should provide a balanced and even playing field for different technologies and should not restrict or overly favor certain technologies. This will help to ensure that sector coupling can develop and grow in a way that is fair and open, and that allows for competition and innovation.
- In addition, the legislation should be designed in a way that promotes the growth and development of RDI activities. This can include providing incentives and support for research and development, as well as fostering collaboration and partnerships between different stakeholders. By doing so, it is possible to create an environment that is conducive to innovation and the development of new technologies.
- It is important to engage in advocacy and policy dialogue with relevant authorities and decision-makers. This can involve participating in public consultations and policy debates, as well as engaging directly with lawmakers and regulators. Through these activities, it is possible to raise awareness of the P2G technology and its potential benefits, and to build support for policies and regulations that can help to overcome legal barriers and facilitate its development and deployment. By engaging in advocacy and policy dialogue, it is possible to promote the P2G technology and overcome the legal challenges and obstacles that may hinder its growth and adoption.
- Overall, there is a need for clear and effective legislation that allows for sector coupling but does not restrict or overly favor certain technologies. This legislation should provide a framework for the development and deployment of P2G and other sector coupling technologies and should support R&D&I

activities. By taking these steps, it is possible to create a legal framework that is conducive to the growth and success of the P2G technology.

Action items needed to overcome socio-technical barriers

- One way to overcome socio-technical barriers in building P2G hubs is to engage in stakeholder consultation and collaboration. This involves bringing together various stakeholders, including community members, local authorities, industry experts, and other relevant parties, to discuss the P2G technology and its potential impact. Through this process, it is possible to identify and address any concerns or issues that stakeholders may have, and to build consensus and support for the technology.
- Another way to overcome socio-technical barriers is to conduct demonstration projects and pilot studies. These projects can provide valuable data and information about the technical feasibility and effectiveness of the P2G technology, as well as its potential social and economic impacts. By conducting demonstration projects, it is possible to gather evidence and build a case for the technology, which can help to overcome any doubts or skepticism that may exist.
- In addition, it is important to engage in ongoing market monitoring and networking activities. This can help to ensure that the P2G technology is developed and deployed in a way that is aligned with market trends and needs and can help to build support and momentum for the technology.
- Overall, overcoming socio-technical barriers in building P2G hubs will require a combination of stakeholder engagement, demonstration projects, market monitoring, and networking activities. By taking these steps, it is possible to overcome the challenges and obstacles that may hinder the development and deployment of the technology.

Action items needed to overcome techno-economic barriers

- Conduct more demonstration projects. Demonstration projects are practical tests or trials of a technology that are carried out in a real-world setting. These

projects can help to gather data, assess the effectiveness and feasibility of the technology, and identify any challenges or barriers to its deployment.

- By conducting more demonstration projects, it will be possible to gather more information and data about the P2G process, and to develop and refine the technology. This can help to mature the technology and make it more ready for widespread adoption.
- In addition, continued market monitoring and targeted networking through demonstration projects can help to ensure that the P2G process is developed and deployed in a way that is aligned with market needs and trends. This can help to ensure that the technology is successful and has a positive impact on the market.
- Overall, the solution to the problem of the P2G process not being a mature technology is to conduct more demonstration projects, as well as to engage in market monitoring and networking activities. This can help to advance the technology and prepare it for widespread adoption.

LIST OF ABBREVIATIONS

IEA	INTERNATIONAL ENERGY AGENCY
P2G	POWER-TO-GAS
GHG	GREENHOUSE GAS
NES	NATIONAL ENERGY STRATEGY
NECP	NATIONAL ENERGY AND CLIMATE PLAN
NCDS	NATIONAL CLEAN DEVELOPMENT STRATEGY
TEN-T	TRANS-EUROPEAN TRANSPORT NETWORK
RDI	RESEARCH DEVELOPMENT AND INNOVATION
MEKH	HUNGARIAN ENERGY AND PUBLIC UTILITY REGULATORY AUTHORITY
ITM	INNOVATION AND TECHNOLOGY MINISTRY

REFERENCES

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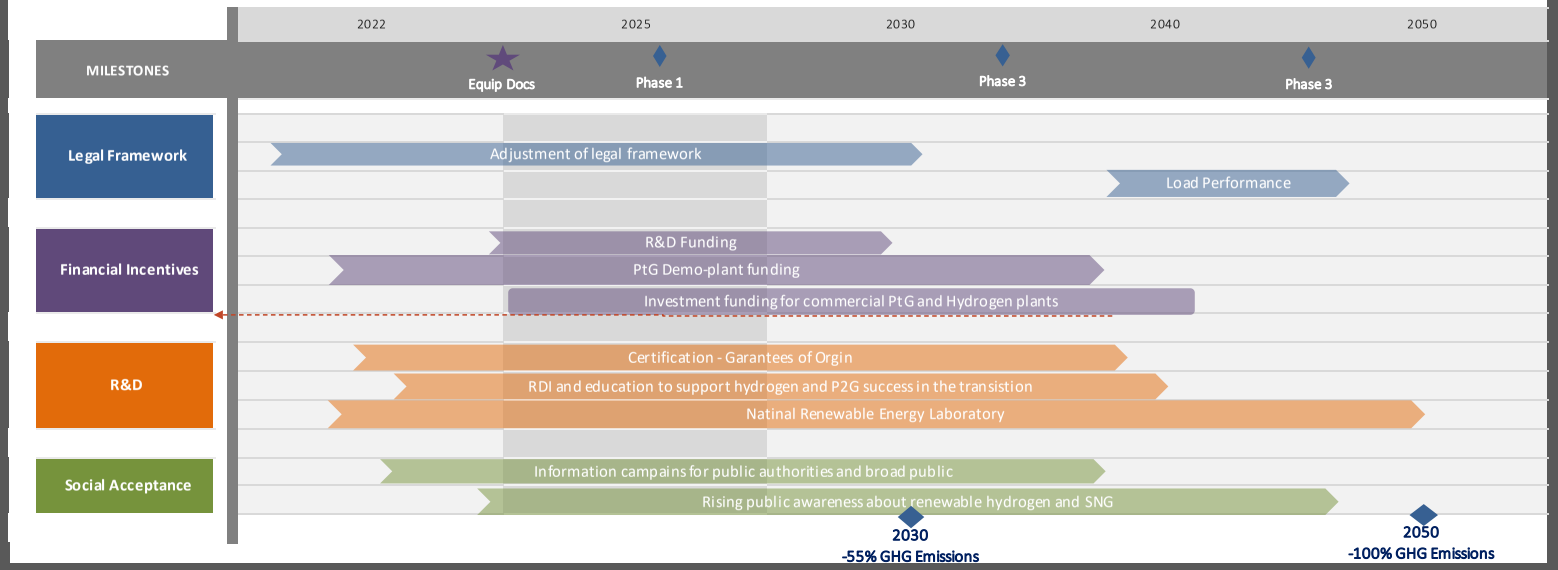
D2G ROADMAP Hungary

START YEAR: 2022



How to customize this roadmap Excel template:

1. To change the **start month**, click in the cell and change the date. Note that the date format is DD/MM/YYYY

2. To add a **new milestone**, just copy and paste an existing one. Change the shape (Format - Edit shape) or the colour (Format - Shape Fill). Place the milestone on the timeband where you need it.

3. Do the same for **new project tasks**. Drag them by the edges to make them longer or shorter.

4. To add a **new swimlane**, insert new rows and then copy and paste an existing