ENERGY LAW GROUP

AN OVERVIEW OF THE HYDROGEN REGULATORY FRAMEWORKS

Prepared by The Energy Law Group – the most extensive network of experts in energy, mining and natural resources law in EMEA

2021

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INTRODUCTION – EU HYDROGEN STRATEGY

THE EU H2 STRATEGY

OVERVIEW AND KEY PHASES

The EU Hydrogen Strategy was published in July 2020. With a strong focus on green H_2, it aims to decarbonize H_2 production and expand H_2 use in sectors where it can replace fossil fuels.

The EU Strategy involves three phases:

- Phase 1 (2020-2024): decarbonize current H_2 uses, install at least 6GW of renewable H_2 electrolysers, and increase H_2 production to 1m tonnes.
- Phase 2 (2025-2030): install at least 40GW of renewable H_2 electrolysers and increase H_2 production to 10m tonnes.
- Phase 3 (2030-2050) : see renewable H_2 tech reach maturity and be deployed at scale to hard-to-decarbonize sectors.

REQUIRED SPENDING AND CURRENT INITIATIVES

- By 2050, the EU Strategy envisages potential cumulative investments of €180-470bn for green H_2, and €3-18bn for blue H_2.
- The Strategy suggested making use of the EU ETS Innovation Fund and the Strategic European Investment Window of InvestEU.
- The European Clean Hydrogen Alliance has been established as a forum for stakeholders and for building a pipeline of reliable investments.

POTENTIAL FUTURE SUPPORT SCHEMES

Proposals to support decarbonisation and the development of H_2 in the future include:

- Ongoing use of EU ETS, with a carbon border adjustment mechanism to mitigate the risk of carbon leakage, currently under consideration for implementation by 2023.
- Tendering systems for carbon contracts.
- The Clean Hydrogen Partnership, to be launched later this year, with €2bn of investment funds to develop technologies for producing, storing, and distributing renewable H_2 .

OVERVIEW OF NATIONAL STRATEGIES

1. Most of the European countries are **currently developing their H_2 national strategies** and plan to announce them in 2021-2022. At present, H_2 targets fall under the umbrella of the national **Climate / Energy strategies or other governmental policy documents**.
2. National Hydrogen Strategies / Roadmaps of Germany, Portugal, and Spain were published in 2020, Hungary's – in May 2021.
3. Most policy documents in local jurisdictions **acknowledge H_2 as a cornerstone in energy transition** and achieving climate neutrality.
4. **Green vs Blue**: following the EU targets, countries usually envisage development of the green H_2, but some countries, such as Poland, Germany, and the UK, declare that they will use blue H_2 as well (at least for some time).
5. National strategies & policy documents **define goals in**:
   a) H_2 production, transportation, and storage;
   b) The development of hydrogen supply chains;
   c) The establishment of H_2 refuelling stations;
   d) The use of H_2 in hard-to-abate industries, where H_2 is a prospective alternative to natural gas, and the use of H_2 in transport;
   e) The development of common standards.
6. One of the **core issues** is that in most European countries there is no legal basis for H_2 injection into the gas network. H_2 cannot be injected into most of the grids in its pure form, therefore significant investments are required.
7. In some countries (e.g., Turkey), the **initial strategy is to blend H_2 into the existing natural gas grid**. Recent tests carried out by Turkish GAZBİR proved to be successful in blending 5% to 20% of H_2 injection into the gas grid. The target is to inject H_2 into the natural gas grid by the end of 2021.

REGULATORY FRAMEWORKS

1. Currently there still is no legislation *specifically* aimed at regulating the production, transportation, or use of H_2.
2. Even though specific regulations have not been established yet, the **H_2 issues fall under non-specific regulatory regimes**:
   a) Transportation;
   b) Safety regulations (like any other dangerous product or flammable gas);
   c) Environmental;
   d) Permitting.
3. Most EU countries already **define H_2 as an alternative fuel.** Its regulation falls under the national measures implementing EU Directive 2014/94/EU on Alternative Fuels Infrastructure.
4. Portugal has specific regulatory framework for green H_2 (adopted in 2020), which regulates licensing of producers of renewable gases, allocation of production, and self-consumption.
5. Some countries plan to adopt specific regulation in 2021.
6. Germany has a complex definition of green H_2 - the legislator applies certain time and further location restrictions.
7. In practice, some countries (e.g., Poland) apply provisions related to gas (e.g., storage, transport).
8. However, in most countries, energy gas definition does not include H_2 and there is no legal basis for H_2 injection into the gas network, therefore it currently cannot be transported using the existing gas infrastructure.

PRIVATE & PUBLIC FINANCING

There is a lack of government decisions on clear subsidy schemes for H_2. However, there are a number of alternatives for H_2 financing.

EUROPEAN UNION

EU members expect to benefit from EU funding:

a) Important Projects of Common European Interest (IPCEI);
b) Next Generation EU;
c) InvestEU;
d) CohesionPolicy;
e) Connecting Europe Facility;
f) Horizon Europe;
g) The Recovery and Resilience Plan;
h) Subsidies for vehicles and trains powered by hydrogen according to the EU flagship project “Recharge and Refuel”.

NATIONAL LEVEL

Numerous national funds and programmes related to decarbonization:

a) Encouraging H_2 technology R&D or investment in this segment;
b) Various Climate and Energy Funds, environmental protection programmes;
c) Green transport programmes;
d) Various infrastructure development programmes.

OTHER

- UK – specific H_2 financing.
- Germany – the production of H_2 benefits from reduced cost-burdening (renewable energy surcharge).
- Austria – private funding.
- Sweden – specific allocation in the national budget.

OPPORTUNITIES / BARRIERS

OPPORTUNITIES FOR COUNTRIES THAT HAVE:

- ☑ A stable electricity grid
- ☑ Affordable, green, and reliable electricity – large RES availability
- ☑ Commercially viable (without subsidies) onshore wind and large-scale solar projects
- ☑ A strong innovation environment, large industrial companies, PE-funds, pension funds that are willing to invest in H_2
- ☑ An extensive gas infrastructure
- ☑ The possibility to use depleted natural gas deposits for H_2 storage

BARRIERS IN VARIOUS COUNTRIES INCLUDE:

- ☒ A lack of clear strategy and clarity over business models that underpin private investment
- ☒ The necessity of significant investments into energy infrastructure – whether by adapting existing infrastructure or building from the ground
- ☒ Costs – the main obstacle of producing “green” H_2 is the amount of investment that needs to be made
- ☒ Limited electricity generation capacity and power
- ☒ Regulatory barriers and insufficient regulatory framework – the process to obtain various permits is complicated and lengthy
- ☒ Technical / operational requirements related to connecting to the gas grid

OPPORTUNITIES / BARRIERS (2)

BELGIUM

(i) seeks to become a hub of green H_2 economy in Europe;

(ii) already has one of the most developed H_2 networks;

(iii) due to the plans to phase out nuclear energy by 2025, H_2 economy is based on importing reasonably-priced green H_2 and low transportation costs.

UNITED KINGDOM

uniquely well placed to be the world leader in both H_2 and CCUS, given the existing expertise and infrastructure that can be repurposed

TURKEY

anticipates export possibilities

VARIOUS INITIATIVES

1. ELECTROLYSIS PLANTS

Building electrolysis plants and other production facilities (Austria, Denmark, Germany, Italy, Portugal, Slovakia, Spain, Poland, Turkey, UK)

2. TRANSPORT SECTOR DEVELOPMENT

Introducing buses, trains, trucks powered by green H_2 (Croatia, Czech Republic, Ireland, Italy, Slovakia, Spain, Sweden)

3. H2 REFUELING STATIONS

Building H_2 refueling stations (Slovenia, Czech Republic, Denmark, Hungary)

4. H2 INJECTIONS INTO THE GRID

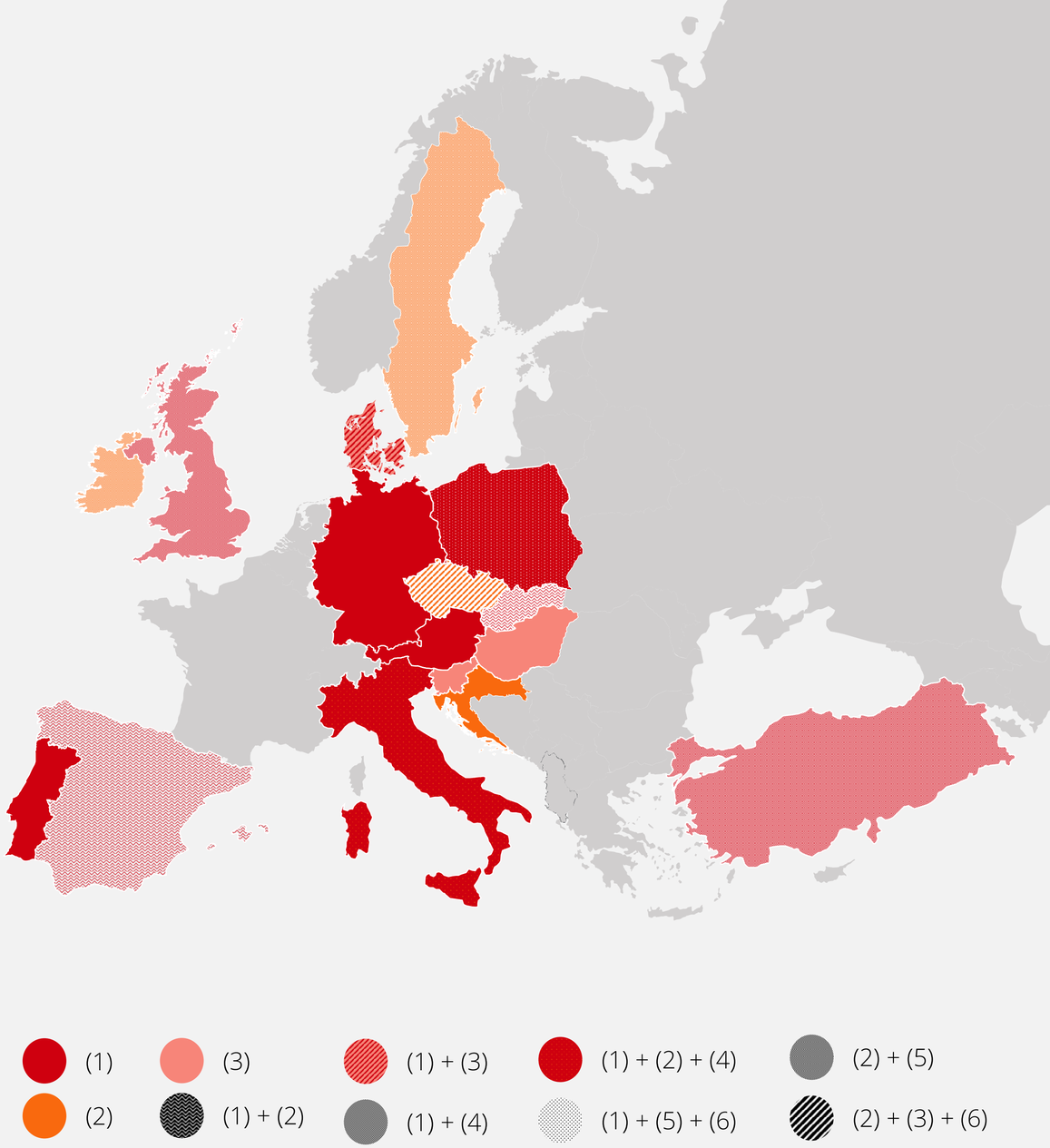
Testing the possibilities of H_2 injections into the grid, supporting the conversion of gas networks (Italy, Turkey, UK)

5. H2 STORAGE

H_2 storage development (Ireland, Sweden, Poland)

6. HYDROGEN VALLEYS

Creating “Hydrogen Valleys” to transform the face of the industry or facilitating the developments in specific regions (Czech Republic, Poland)



REVIEW OF SEPARATE JURISDICTIONS

AUSTRIA

NATIONAL STRATEGY

Under the umbrella of the climate strategy, green H_2 as a cornerstone to becoming climate neutral by 2040.

REGULATORY FRAMEWORK

No legislation specifically aimed at regulating the use of H_2 (blue or green).

1. The Electricity Industry Act 2010 only includes an exemption from system usage charges for plants that convert electricity into H_2.
2. Renewable Energy Expansion Act, expected in summer 2021, will provide the first comprehensive legal framework for renewable energy, including H_2 technologies.

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AUSTRIA

PUBLIC AID MECHANISMS

The Climate and Energy Fund has supported numerous H_2-related projects:

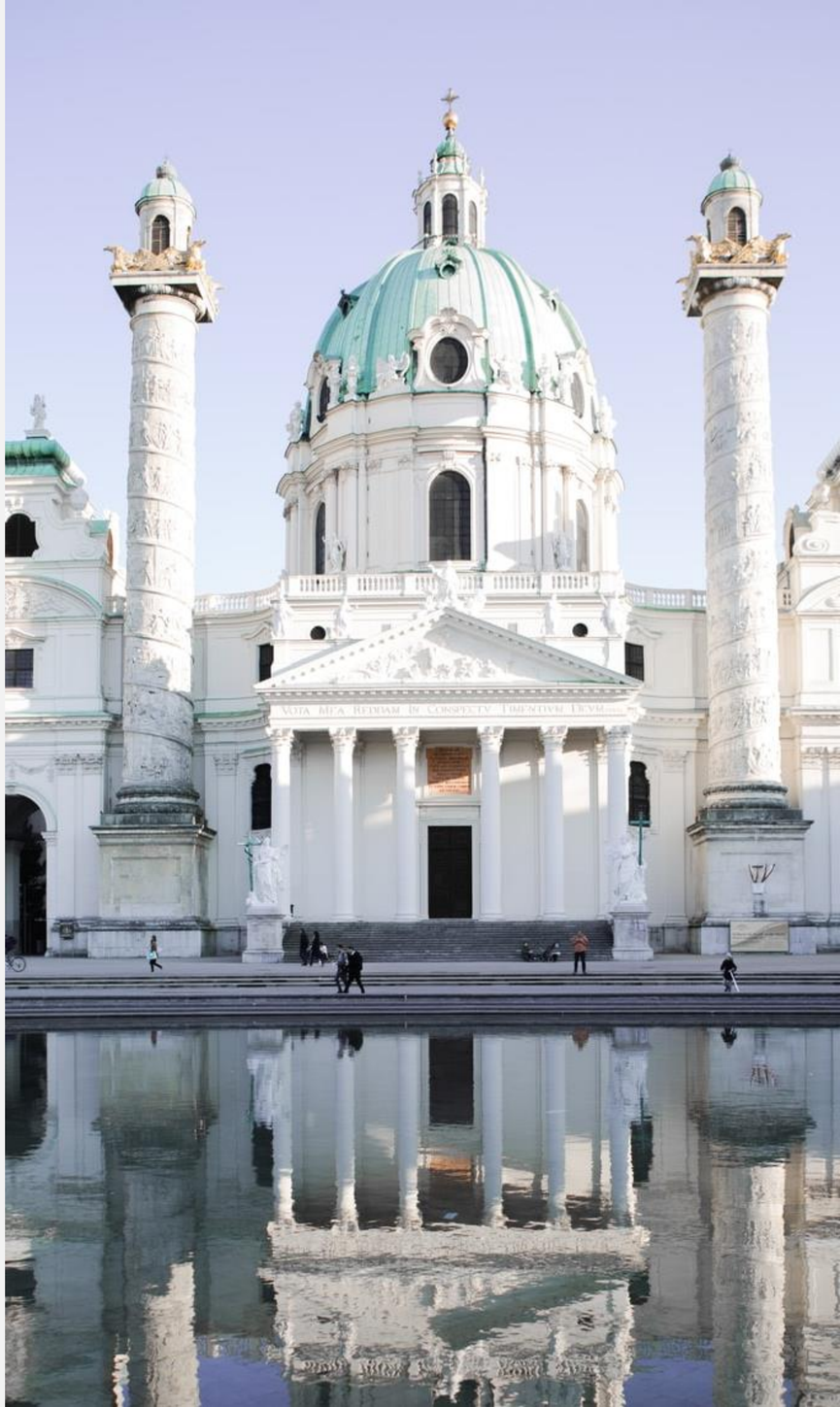
- HERO – developing a cost efficient, safe H_2 filling station;
- H_2 -Village – exploring the potential of producing H_2 with solar power;
- FCTRAC – introducing H_2 to agriculture and developing a fuel cell tractor;
- Renewable Gasfield – producing green H_2 via PEM electrolysis;
- HyTruck – developing an emission-free fuel cell solution for commercial vehicles;
- Private / public-private funding is also available.

MAIN BARRIERS

(I) cost; (II) infrastructure; (III) regulatory barriers.

OTHER RELATED INITIATIVES

- OMV is having electrolysis plant built at a cost of € 25 million;
- VERBUND has launched several projects, most prominently the construction and operation of one of the world's largest electrolysis plants;
- The Hydrogen Center Austria (HyCentA) have completed a prototype that can generate H_2 from RES or surplus electricity according to different load profiles;
- Hydrogen eMobility have developed a technology that allows to produce green H_2 by drying and gasifying wood.



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CROATIA AND THE BALKANS

NATIONAL STRATEGY

There is no national strategy for H_2 in the Balkans, but strategies are being drafted in Serbia and Croatia.

REGULATORY FRAMEWORK

Lack of specific regulatory framework aimed at developing the production of green H_2:

- There is no regulatory framework for H_2 in Albania, B&H, Montenegro and North Macedonia;
- Croatia – H_2 explicitly included in the definition of alternative fuels. No differentiation between "blue" and "green", but regulation is oriented towards the "green";
- Slovenia – the first draft of the Act on RES will (if adopted) make it possible for producers of green H_2 to obtain guarantees of origin and get support for production. There are plans to prepare the first draft of the Act on Alternative Fuels by the end of 2022;
- Serbia – H_2 is mentioned as a potential new technology to be developed. H_2 is explicitly mentioned in the definition of motor fuels. Also, Law on Use of Renewable Energy Sources (40/2021) deals with green H_2 and recognizes the "renewable hydrogen" as one of the RES.

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CROATIA AND THE BALKANS

PUBLIC AID MECHANISMS

- No mechanisms supporting or subsidising H_2 in Albania, B&H, Montenegro and North Macedonia;
- Croatia – projects of alternative fuel distribution infrastructure, vehicles powered with H_2, and the conversion of the existing fleet of ships and the construction of new alternative fuel vessels will be co-financed through public calls organized by the State Fund;
- Slovenia – Act on RES will extend the existing scheme for the production of RES electricity to the production of gaseous fuels (incl. H_2);
- Serbia – there are plans to determine the incentive measures for the production, transport, storage, and use of renewable H_2 until 30 October 2021;
- The investment in H_2 technologies is expected to rise along with the funds available in the EU for H_2 development.

OTHER RELATED INITIATIVES

- Croatia aims to introduce 20 buses powered by green H_2 in the transport sector by 2025;
- Slovenia plans to build eight H_2 filling stations by 2025;
- Serbia plans to build a floating mobile platform with H_2 tanks – wind or solar power plants, with up to 3 MW in total capacity.

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BELGIUM

NATIONAL STRATEGY

To be disclosed by July 2021. The regulation would then be adopted by the end of the year.

REGULATORY FRAMEWORK

H_2 market is not subject to specific regulations, falls under non-specific regulatory regimes (like transportation, safety regulations, environmental, permitting).

PLANS

- Establishing Belgium as a pioneer and hub of green hydrogen economy in Europe (geographically and business-wise);
- A new H_2 transport infrastructure (backbone) will be created using EU funding (in the context of the post-covid Recovery and Resilience Facility plan);
- Already has one of the most developed hydrogen networks in the world (i.e., 600km of H_2 pipelines). This network is entirely private (property of Air Liquide) and expected to stay unregulated.

MAIN OPPORTUNITIES

(i) geographical location, (ii) political will and lobby, (iii) existing infrastructure.

MAIN BARRIER

Power availability. Therefore, H_2 economy is based on importing green H_2.

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BULGARIA

NATIONAL STRATEGY

- Currently, there is no governmental strategy regarding hydrogen and hydrogen-based power generation.
- The National Energy and Climate Plan 2021–2030 puts an emphasis on the use of hydrogen in the transport sector. It is expected that by 2030 the annual hydrogen consumption in Bulgaria might reach 32 GWh in the transport sector. Meanwhile, the recently adopted Plan for Recovery and Sustainability is exploring hydrogen opportunities more comprehensively.
- In the latest version of the Plan for Recovery and Sustainability (April 2021), the Bulgarian government contemplates drafting a national roadmap for hydrogen technology development, the construction of infrastructure for transporting hydrogen, and the introduction of mechanisms supporting pilot projects to generate green hydrogen.

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BULGARIA

REGULATORY FRAMEWORK

- There is no comprehensive regulatory framework for green hydrogen projects in Bulgaria.
- The subject matter has been partially introduced by incorporating a definition for "Green Hydrogen" under §1, item 24 (e) of the Law on Energy (pursuant to the 2021 amendments):
  "Green Hydrogen" means hydrogen produced by electrolysis or other technology using renewable energy sources. Electricity used for production of green hydrogen shall be certified by guarantee of origin for electricity from renewable sources.
- Furthermore, Article 36(f) of the Law on Energy was amended in early 2021 to exempt power generation based on green hydrogen from the obligation to pay 5% fee on revenue from power generation. The exemption was introduced with retrospective effect from 1 January 2021. The exemption aims to operate as an incentive to generate electricity based on hydrogen, despite the lack of other regulations with respect to the subject-matter.
- Currently, there is no other laws that govern or otherwise regulate the matter of green hydrogen projects in Bulgaria.

REGULATORY AUTHORITIES

This matter is not comprehensively regulated under the Bulgarian law. As a matter of principle, green hydrogen projects should be the responsibility of the Energy Regulator. However, other agencies may be involved as well (e.g., the Technical Supervision Agency, etc.).

MAIN OPPORTUNITIES

There is no information about green hydrogen projects having been developed or announced in Bulgaria.

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CZECH REPUBLIC

NATIONAL STRATEGY

Under finalization. The principal documents are:

(i) National Plan for Clean Mobility

(ii) National Energy and Climate Plan;

(iii) National Reform Programme.

REGULATORY FRAMEWORK

- No specific act dedicated to H_2; it is partially regulated by various general acts. There is currently no regulation on the different types of H_2;
- The energy gas definition does not include H_2, therefore, it currently cannot be transported using the existing gas infrastructure;
- As of 2017, H_2 Act on Fuel Substances recognizes hydrogen as an alternative fuel for vehicles.

PUBLIC AID MECHANISMS

1.Investors should soon be able to apply for subsidies related to H_2 under the new Technologies and Application for Competitiveness Operational Programme.

2.H_2 technologies are supported through the Modernisation Fund and RES+ programmes.

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CZECH REPUBLIC

MAIN OPPORTUNITIES

1. Energy industry – the potential of H_2 is primarily in connection to the storage of surplus electrical energy generated from RES.
2. Intentions to construct a number of hydrogen fuelling stations and have hydrogen-fuelled buses and cars in use by 2030.

MAIN BARRIERS

(i) no central regulation;

(ii) limitations of the current infrastructure.

OTHER RELATED INITIATIVES

1. The Moravian-Silesian region intends to create a “Hydrogen Valley” with the goal of transforming the face of the industry there.
2. HYDROGEN1, a Czech fund, will invest in H_2 production, building refuelling stations, and logistics, among other areas.
3. ÚJV Řez, a.s., a Nuclear Research Institute, developed a transportation project called TriHyBus, implemented in Neratovice.
4. Dopravní podnik Ostrava intends to employ up to 10 hydrogen-fuelled buses in its fleet by 2023.

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DENMARK

NATIONAL STRATEGY

On 18 June 2020, the Climate Act was adopted. Green H_2 is seen as one measure to reach climate targets.

PUBLIC AID MECHANISMS

On 22 June 2020, the government concluded an Energy agreement for energy and industry, according to which a subsidy scheme (€100 million) for PtX projects will be established.

PRIVATE FINANCING

1.The Energy Agency's Energy Technology Development and Demonstration Program (EUDP) supports private companies and universities in developing and showcasing new energy technologies.

2.Foreign project participants can receive EUDP aid according to the same rules as Danish participants. However, the main applicant must be a company or university registered in Denmark. EUDP can comprehensively support energy technologies.

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DENMARK

MAIN OPPORTUNITIES

Denmark has the following prerequisites to produce H_2:

(i) affordable, green and reliable electricity;

(ii) onshore wind and large-scale solar projects that are commercially viable without subsidies;

(iii) some of the most cost-effective (LCOE) areas for offshore wind projects;

(iv) extensive infrastructure for gas (grid and storage).

OTHER RELATED INITIATIVES

1. Copenhagen Infrastructure Partners have unveiled plans to establish Europe's largest production facility of CO_2-free green ammonia. The facility will support 1GW electrolysis.
2. Everfuel A/S has announced the HySynergy Phase II plans to develop a 300MW electrolyser and Power-to-X (PtX) facility.
3. Everfuel A/S has launched the company's H_2 station roll-out plan, targeting up to 19 fueling sites for trucks, buses and cars by the end of 2023.
4. The government has pre-qualified 28 Danish hydrogen projects for the Important Project of Common European Interest (IPCE) programme.

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GERMANY

NATIONAL STRATEGY

H_2 key for energy transition. Green H_2 as sustainable, but blue H_2 to be used for a period of at least 10 years.

REGULATORY FRAMEWORK

1. Complex definition of green H_2 - the legislator applies certain time and further location restrictions.
2. The upcoming changes of the Energy Industry Act will be another cornerstone of the H_2 regulatory framework.
3. The Government Draft of 10 February 2021 aims at setting basic grid safety and grid tariff regulation.

PUBLIC AID MECHANISMS

No dedicated support scheme, but the production of H_2 benefits from reduced cost-burdening (renewable energy surcharge):

1. The production of green H_2 are exempt from surcharges regardless of its use case.
2. Other H_2 may be eligible for surcharge reductions provided that the H_2 is produced by the so-called electricity cost-intense companies.
3. Reductions and exemptions extend to other surcharges, such as the power heat coupling surcharge and the offshore wind surcharge.
4. Partial public funding is available and focuses on R&D and demonstration projects.
5. Private funding is available for the development and market preparation of the H_2 production and fuel cell technologies.

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GERMANY

MAIN BARRIERS

(i) the lack of fully-developed technical standards (transportation safety, storage infrastructure);

(ii) the decision to not allow mixed gas and hydrogen infrastructure tariffs;

(iii) regulatory uncertainty on the EU and the national levels.

OTHER RELATED INITIATIVES

1. Westküste 100 – examines the use of an electrolysis capacity of 30 MW obtained from offshore-wind power plants;
2. Carbon2Chem– focuses on extracting H_2;
3. Kopernikus P2X– addresses H_2 generation, transport, and usage.

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HUNGARY

NATIONAL STRATEGY

Relies on the findings of the National Hydrogen Technology Platform and White Paper.

REGULATORY FRAMEWORK

1. Implementing EU legislation – the regulatory environment does not differentiate between “blue” and “green” H_2.
2. National Energy Strategy (NES) – the main focus of NES is on the H_2 -based transportation (electric and H_2 -powered vehicles).
3. The National Energy and Climate Plan (NECP) – considers H_2 as an alternative energy source. Plans to launch pilot projects at the level of natural gas with H_2-produced transmission, distribution, and storage.
4. National Hydrogen Plan (NHP) – provides detailed information on how to utilize the environmental and economic benefits of H_2.

HUNGARY

PUBLIC AID MECHANISMS

1. Public tender was published in 2020 to support the “power-to-gas” technologies facilitating the integration of carbon-free energy (from H_2, biomethane).
2. Another tender has been published recently to subsidize the innovative, carbon-free, electrochemical storage of the electricity surplus.
3. Currently there is no financing mechanism available other than the public financing solutions mentioned above.

OTHER RELATED INITIATIVES

1. Hungary's first mobile H_2 refuelling station was opened on 29 April 2021.
2. Linde and MVM (two large energy companies) signed a long-term strategic framework agreement in May 2021.

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IRELAND

NATIONAL STRATEGY

1. Intent to align with the EU Hydrogen Strategy for a Climate-Neutral Europe is evident in government policy documents.
2. Program for Government: the commitment to meet 70% of electricity demand by 2030 includes an action to invest in research and development in green H_2 as a fuel for power generation, manufacturing, energy storage, and transport.
3. National Energy & Climate Plan 2021-2030 ("NECP"): Ireland has included hydrogen in its National Energy and Climate Plan.
4. Interim Climate Actions 2021.
5. Gas Networks Ireland, Network Deployment Plan 2020 ("NDP").

REGULATORY FRAMEWORK

Still no regulatory framework for H_2, although it may fall under some existing regulatory regimes. Currently no legal initiatives in the pipeline that expressly address H_2. However:

1. the Climate Action and Low Carbon Development (Amendment) Bill 2021 is expected to be passed shortly.
2. Ireland has signed the Hydrogen Initiative (within the framework of Directive 2014/94/EU on Alternative Fuels Infrastructure).

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IRELAND

OTHER RELATED INITIATIVES

1. ESB and dCarbonX to partner on green H_2 storage development – joint assessment and development of offshore storage.
2. Green Atlantic at Moneypoint – transformation into a green energy hub.
3. SEAFUEL – demonstrating the viability of H_2 as a fuel to be used by the local transport authorities.
4. GENCOMM: GENerating energy secure COMMunities through Smart Renewable Hydrogen.

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ITALY

NATIONAL STRATEGY

The main instrument supporting hydrogen investments is the Recovery Plan (PNRR). The national strategy focuses on:

1. H_2 production in brownfield sites (converting abandoned industrial areas to H_2 valleys).
2. Production of electrolysers and development of hydrogen supply chain.
3. Establishment of H_2 refuelling stations.
4. Use of H_2 in hard-to-abate industries, where H_2 is a prospective alternative to natural gas; use of hydrogen in railway.

REGULATORY FRAMEWORK

Implementing EU legislation:

1. H_2 is recognised as an alternative fuel; production and distribution are currently regulated by a Ministerial Decree (23 October 2018).
2. The transportation of H_2 is equivalent to that of any other dangerous product or flammable gas (ADR regulation).
3. There is currently no legal basis, law or regulation, for hydrogen injection into the gas network.

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ITALY

PUBLIC AID MECHANISMS

1. PNRR has allocated € 3.19 billion for promoting the production, distribution, and end uses of H_2.
2. The PNRR established tax incentives to support the production of green H_2 (green taxes).
3. Financial support may be granted by the Innovation Fund.
4. National sources.

MAIN BARRIERS

(i) legal and administrative procedures; (ii) technical safety standards on production and transportation.

OTHER RELATED INITIATIVES

1. Snam has started tests to introduce H_2 into its transmission network at volume rates of up to 10%.
2. Enel and Eni cooperate to develop green H_2 projects using electrolysers powered by renewable energy.
3. Eni has renewed the agreement with Fincantieri on the production and transportation of energy carriers and on fuel cell applications.
4. PNRR aimed at producing green steel without using of coal, and using CO_2 for the production of renewable fuels or aggregates for construction.

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POLAND

NATIONAL STRATEGY

Plans to adopt the “Polish Hydrogen Strategy until 2030 - with a perspective until 2040". It envisages development of green H_2, but also addresses blue H_2 .

REGULATORY FRAMEWORK

No dedicated legislation. In practice, the provisions related to gas (e.g., storage and transport) are applied to H_2.

1. The use of H_2 in transport is regulated by the Act on Electromobility and Alternative Fuels.
2. Government has announced that it will soon clarify the existing legislation. There are plans to announce the regulatory basis for the H_2 market this year (Q3 - Q4 2021), while at the beginning of 2022, the Ministry of Development is to present a "hydrogen package".

PUBLIC AID MECHANISMS

Currently no specific support mechanisms. There are plans to introduce solutions together with the implementation of the H_2 “package”.

1. H_2 may benefit from mechanisms prepared for other fuels (e.g., use the so-called pre-commercial procurement mechanism).
2. Hydrogen-powered transport can already benefit from support from the Low Emission Transport Fund.

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POLAND

OPPORTUNITIES

1. GAZ-SYSTEM S.A. is investigating the possibility of injecting H_2 into the existing pipeline system. The use of depleted natural gas deposits for H_2 storage is also under consideration.
2. The Polish H_2 industry is to be concentrated in an area of five so-called hydrogen valleys.

OTHER RELATED INITIATIVES

1. Lotos has launched an investment programme to build a large-scale installation consisting of electrolysers, H_2 storage and fuel cells, and possibly H_2 turbines, all managed by innovative software. This installation will produce motor fuels.
2. PKN Orlen has announced plans to build a H_2 hub by the end of 2021, which will produce up to 600 kg of purified H_2 per hour.
3. PGNiG has launched an experimental project 'InGrid'. Its aim is to explore the use of H_2 transfer to increase the volume of gaseous fuel in the distribution system and to store and deliver H_2 to remote locations.
4. The first nuclear reactor is expected to be completed by 2033. Using nuclear energy to produce purple H_2 is under consideration.

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PORTUGAL

NATIONAL STRATEGY (by 2030)

1. 10 to 15% of green H_2 injected into the natural gas network.
2. 2 GW to 2.5 GW of electrolyser capacity installed.
3. 50 to 100 H_2 fuelling points created.

REGULATORY FRAMEWORK

1. The regulatory framework for green H_2 is outlined in a Decree-Law (28 August 2020).
2. It regulates licensing of producers of renewable gases, allocation of production, and self-consumption.
3. Renewable gases are defined as fuels in gaseous state produced from RES.

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PORTUGAL

PUBLIC AID MECHANISMS

No specific mechanisms for financial support or funding have been established yet. However:

1. The Decree allows the government to approve (i) incentives for generation of renewable gas; (ii) differentiated tariffs for renewable gas producers.
2. The Government's Recovery and Resilience Plan (PRR) also envisions an investment of €186 million in H_2 and renewable gases. The PRR sets out the objective of 120MW of renewable gas production capacity.
3. National strategy has an objective of investments in new projects totalling €7B - €9B (in the sectors of industry, transport, energy, and research and development).

MAIN BARRIERS

Technical / operational requirements related to the connection to the gas grid.

OTHER RELATED INITIATIVES

National strategy foresees a large-scale industrial project dedicated to the production of green H_2 in Sines.

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M L MORAIS LEITÃO
GALVÃO TELES, SOARES DA SILVA & ASSOCIADOS

SLOVAKIA

NATIONAL STRATEGY (draft)

1. Introduction of measures for the use of H_2 and its compounds in the transportation sector.
2. Realization of policies for the use of H_2 technologies.
3. Development of a common standard for low CO_2 emissions as part of the H_2 realization chain.
4. Introduction of general terminology and criteria for the certification of hydrogen-based processes.

REGULATORY FRAMEWORK

There is no legislation pertaining to the use and promotion of H_2 yet.

PUBLIC AID MECHANISMS

No specific mechanisms for financial support or funding have been established yet. However:

1. In November 2020, the Slovak Innovation and Energy Agency announced a call for interest in the participation in an Important Project of Common European Interest (IPCEI) in the field of H_2 technologies.
2. There are intentions to support the use of H_2 via the Recovery and Resilience Plan.

In Slovakia advised by
www.bargerprekop.com

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SLOVAKIA

MAIN BARRIERS

(i) the lack of efficient storage and transmission of H_2;

(ii) the lack of legislation;

(iii) costs.

OTHER RELATED INITIATIVES

1. H_2 projects include the introduction of 12 trains powered by H_2 on a 120 km-long non-electrified railroad.
2. Projects expected through the Important Projects of Common European interest (IPCEI) instrument – EU strategy to develop renewable H_2, produced using mainly wind and solar energy.
3. Intention to start producing H_2 buses with metal hydride tanks as a safer alternative to the conventional pressure tanks.

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SPAIN

NATIONAL STRATEGY

A roadmap to promote the production and commercialization of green H_2, establishing two time horizons:

1. Horizon 2030 – a capacity of at least 4 GW of electrolysers installed by 2030. €8.9 billion of investments expected.
2. Horizon 2050 – considerable increase in renewables (incl. green H_2) and a corresponding drop in renewable energy price by 2050.

REGULATORY FRAMEWORK

Lack of specific regulatory framework to develop the production of green hydrogen – only transitory measures.

PUBLIC AID MECHANISMS

1. Public financing for projects that integrate the production, distribution, storage, or supply of green H_2 (NextGenerationEU).
2. Public aid for large industrial research and experimental projects (CIEN Projects).
3. Public aid for large strategic and R&D-intensive initiatives (Science and Innovation Missions).
4. Decarbonisation of the transport sector (MOVES II Plan).

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SPAIN

MAIN BARRIERS

(i) No H_2 pipeline network is fully developed;

(ii) A substantial amount of investment is required;

(iii) It is not clear how to integrate H_2 into the natural gas pipeline network;

(iv) No certainty on how to ensure the renewable (green H_2) origin of electricity.

OTHER RELATED INITIATIVES

1. Green H_2 generation plant in Puertollanol.
2. Project BeNorth2.
3. Talgo Vittal-One.

SWEDEN

NATIONAL STRATEGY

Fossil Free Sweden (started in 2015) establishes a strategy for the use of H_2. The overall target is to achieve net-zero greenhouse gas emissions by 2045, and H_2 may play a greater role in the future in terms of industrial processes and storage capacity.

The government instructed the Energy Agency to produce a proposal for an overall strategy for hydrogen, shall be reported by 31 July 2021.

REGULATORY FRAMEWORK

Is limited, certain general legislation is applicable (environmental, planning, etc.).

PUBLIC AID MECHANISMS

1. Industrial Evolution – a long-term initiative that aims to support the industry's conversion to fossil-free emissions. Funding is granted for feasibility studies, research, pilot and demonstration projects as well as investments in new technology. App. SEK 750 million of funding is available in 2021. The initiative finances projects that run until 2028.
2. The Government has allocated SEK 10 billion in the state's budget for 2021 that will be used to offer state credit guarantees for investments in green energy such as hydrogen. The allocation will increase to SEK 15 billion during 2022 and SEK 25 billion during 2023.

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SWEDEN

MAIN BARRIERS

(i) Limited electricity capacity and power;

(ii) The process to obtain the various permits required is complicated and lengthy; the supporting regulatory framework is insufficient;

(iii) Apart from a few local hydrogen networks and storage facilities, the current infrastructure is very limited;

(iv) Limited gas infrastructure and limited possibilities to switch disused pipelines to hydrogen mean high investment costs.

OPPORTUNITIES

1. Stable electricity grid.
2. Large areas available for wind and solar energy, which can be used for electrolysis.
3. Ambitious climate goals and a government willing to support the transition to a fossil-free Sweden.
4. Strong innovation environment, large industrial companies, PE and pension funds that are willing to invest in H_2.

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TURKEY

NATIONAL STRATEGY

A national strategy for H_2 is under development, with plans to announce it in 2021. The main targets:

- Producing H_2 from local coal;
- Using boron for the storage of H_2 (Turkey has the largest reserves of boron in the world);
- Blending H_2 into the existing natural gas grid as the main strategy. Is expected to be a private sector-based strategy.

REGULATORY FRAMEWORK

No specific regulatory framework so far, which is one of the obstacles for H_2 in the long term. However, some piecemeal legislation has been introduced to promote hydrogen.

PUBLIC AID MECHANISMS

No specific support so far. However, H_2 is listed among alternative fuels. There are requirements to promote R&D projects concerning vehicles using alternative fuels and to prioritize use of such vehicles in public transportation.

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TURKEY

OPPORTUNITIES & BARRIERS

1. The main obstacle is the cost of producing green H_2 and the amount of the investment that needs to be made.
2. Therefore, the initial strategy is blending H_2 into the strong existing natural gas grid. Recent tests, carried out by GAZBİR, proved to be successful in blending 5% to 20% of H_2 injection into the gas grid. Target – to inject H_2 into the natural gas grid by the end of 2021.
3. Turkey has a large RES availability. If the required investments are made and green H_2 is produced, there is a possibility that green H_2 can be exported to Europe as blended gas or pure H_2 through the Trans Anatolian Pipeline and Turkey-Greece or Turkey-Bulgaria Interconnectors.

OTHER RELATED INITIATIVES

In May 2021, the CEO of Siemens Gamesa Renewable Energy Turkey announced that, in cooperation with Siemens Energy, the company is working on wind energy integration into the green H_2 production.

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UNITED KINGDOM

NATIONAL STRATEGY

H_2 strategy published in August 2021 with the ambition to deliver 5GW of low carbon production capacity by 2030. Support for H_2 also in the Energy White Paper, Ten Point Plan, Industrial Decarbonisation Plan and Transport Decarbonisation Plan. Scottish Government H_2 Policy Statement published in December 2020.

REGULATORY FRAMEWORK

H_2 market is not subject to specific regulation and H_2 is regulated as a gas under the Gas Act 1986. Beyond this, H_2 also falls under non-specific regulatory regimes (like transportation, safety regulations, environmental, permitting).

PUBLIC AID MECHANISMS

1. Government has announced a £240m Net Zero Hydrogen Fund. In May 2021, the Government announced a second Low Carbon Hydrogen Supply Competition, with up to £60m allocated to fund new projects to develop low-carbon H_2 solutions.
2. Government is designing a low carbon H_2 production business model, expected to be finalized in 2022. Proposals are for a Contract for Difference model for supporting all 'colours' of clean H_2 production to enable H_2 to compete on cost with existing high carbon fuels, stimulating fuel switching and new sources of demand.
3. A low carbon H_2 standard is under development and will need to be met for producers to be eligible for grant or revenue support.

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SLAUGHTER AND MAY

UNITED KINGDOM

PLANS & OPPORTUNITIES

1. Government aiming for 5GW of low carbon H_2 production capacity by 2030 with a particular focus on industrial "clusters".
2. Government is supportive of blue H_2 as well as well as green H_2 – the UK uniquely well placed to be the world leader in both H_2 and CCUS, given the existing infrastructure which can be repurposed and expertise.
3. Focus on H_2 use in decarbonizing hard-to-abate sectors, particularly energy-intensive industry (steel, cement, chemicals etc.) and long-haul transport.

MAIN BARRIERS

(i) lack of demand in end-use markets;

(ii) excessive cost, particularly green H_2 given current cost of renewable electricity in UK compared to sunnier climates;

(iii) lack of visibility of the Government's longer-term ambition beyond 2030;

(iv) no policy for massive infrastructure investment required in the longer term to transport and store H_2.

OTHER RELATED INITIATIVES

1. ERM Dolphyn – a project looking at production of green H_2 from offshore floating wind using seawater
2. Acorn – a project to produce blue H_2 from North Sea gas while capturing and sequestering CO_2.
3. Gigastack – a potential "blueprint" for green H_2 projects; uses the electricity from Hornsea offshore wind farm to produce green H_2 onshore, which powers Phillips 66's refinery and is supplied to other industrial users.
4. H21 – a suite of gas industry projects to support conversion of the UK gas networks to carry up to 100% H_2.

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UKRAINE

NATIONAL STRATEGY

There is no national strategy for H_2 in Ukraine, but the Ministry of Energy of Ukraine started its drafting with assistance of the competent stakeholders. By 31 December 2021, the Government of Ukraine must approve the H_2 strategy of Ukraine and approve an action plan for its implementation, which should provide for the introduction of appropriate amendments to legislative acts.

REGULATORY FRAMEWORK

- There is no regulatory framework for H_2 in Ukraine.
- Energy gas definition does not include H_2 therefore, it currently cannot be transported using the existing gas infrastructure.

PUBLIC AID MECHANISMS

1.No mechanisms supporting or subsiding H_2 production and transmission in Ukraine;

2.The investment in H_2 technologies are expected to rise along with the funds available within the EU for H_2 development for EU-Ukraine mutual projects.

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UKRAINE

OTHER RELATED INITIATIVES

- Possible cooperation of Ukraine and Germany in the field of renewable energy and hydrogen as several Ukrainian hydrogen project proposals have been submitted to the German side for consideration. Several bilateral pilot projects are expected to start before the end of 2021.
- The Regional Gas Company LLC is testing its gas distribution system for Hydrogen transmission bringing it to European standards. The gas distribution system is filled with a gas-hydrogen mixture with different hydrogen concentration.
- A state company of Ukraine PJSC Ukrhydroenergo that administers a cascade of major hydro power plants along Dnieper and Dniester rivers introduced the plans for production of green hydrogen within the project "Introduction of Modern Technologies for Production of Green Hydrogen". The company uses land plots on which it is possible to install electrolysers and have access to practically unlimited water resources.
- A number of local developers are conducting Feasibility Studies on implementation of Hydrogen projects.
- Ukrainian Hydrogen Council has bought and registered the first hydrogen car.

OPPORTUNITIES

(i) geographical situation, (ii) presence of necessary natural and energy resources, (iii) existing transmission infrastructure.

MAIN BARRIERS

1. No present financing and infrastructure.
2. Regulatory uncertainty and lack of legislation and developed technical standards (safety of transportation, storage infrastructure).

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THIERRY LAURIOL, DR.
Partner
Jeantet, France
tlauriol@jeantet.fr

CONTACT PERSON / COORDINATOR

ŽIVILĖ GENYTĖ
BD Manager
zivile.genyte@ellex.lt

EXECUTIVE COMMITTEE MEMBERS

DUŠKO ŽURIĆ
Managing Partner
Žurić i Partneri, Croatia
dusko.zuric@zuric-i-partneri.hr

MILAN G. PANDEV
Partner
DGKV, Bulgaria
milan.pandev@dgkv.com

PETER POLAK, DR.
Partner
Polak & Partners Rechtsanwälte, Austria
p.polak@fplp.at

DOVILE GREBLIKIENE
Partner
Ellex Valiunas, Lithuania
dovile.greblikiene@ellex.lt

ALEX MCLEAN
Partner
Arthur Cox, Ireland
alex.mclean@arthurcox.com

MARC GRÜNINGER
Partner
GHR Rechtsanwälte, Switzerland
marcgrueninger@ghr.ch

YAROSLAV PETROV
Partner
Asters, Ukraine
yaroslav.petrov@asterslaw.com

JUAN IGNACIO GONZALEZ RUIZ
Partner
Uría Menéndez, Spain
juan.gonzalezruiz@uria.com

MILOŠ VUČKOVIĆ
Senior Partner
Karanovic & Partners, Serbia
milos.vuckovic@karanovicpartners.com

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