Green hydrogen in Romania – embracing the future

I. Introduction – a versatile and colorful source

Hydrogen seems to become the new trend in sustainable energy production and there is an effervescence of clean hydrogen production projects across the world. Thus, it is estimated that clean hydrogen could meet 24% of energy world demand by 2050[1] and there are 750 hydrogen projects in the pipeline of the European Green Hydrogen Alliance[2]. With the European Green Deal aim of climate-neutrality by 2050, decarbonizing the energy sector, which accounts for 75% of greenhouse gas (GHG) emissions, is an essential step, hydrogen being regarded as a key component to deliver decarbonized energy.

Indeed, hydrogen is versatile both in its production and use. First, it can be produced using all types of energy sources (coal, oil, natural gas, biomass, renewables and nuclear) through a very wide variety of technologies (reforming, gasification, electrolysis, pyrolysis, water splitting and many others). Second, it might serve as an energy generation source, energy storage tool, or energy carrier. While hydrogen use today is dominated by industrial applications, the top three uses today being oil refining[3], chemical production[4] and iron and steel production[5], it can be used in many more applications (e.g., transport, shipping, aviation, heating in buildings, electricity generation – including energy storage and system balancing). While these non-common applications still account for a small share of total hydrogen demand,[6] recent progress to expand its reach has been strong and national strategies aim at more diversification[7].

In Romania, the current hydrogen demand comes almost entirely from the industrial sector – ammonia, refineries, chemicals, with the largest demand in the steel and glass sectors. In 2021, the Fuel Cells and Hydrogen Joint Undertaking (FCHJU) estimated the total yearly hydrogen demand in Romania to be 184,506 tons, based on market research, consultation with industry and discussions with stakeholders.[8]

Pursuant to the 2021 report on clean hydrogen in Romania prepared by the Energy Policy Group (EPG), the most promising hydrogen uses in Romania are in industry (steel, ammonia, fertilizers, refineries, and high value chemicals), transport (long-haul aviation, maritime shipping, heavy-duty vehicles, and some railway segments), existing district heating systems and, potentially, long-term, or seasonal energy storage beyond 2030. [9]

II. A fast-growing EU regulatory framework

A. Preliminary remarks

With the hydrogen versatility in mind, the European Commission adopted in 2020 a hydrogen strategy for a climate-neutral Europe (the **EU Hydrogen Strategy**) and published in December 2021 a draft legislative package on hydrogen and decarbonized markets consisting mainly of a proposal for the recast of Regulation 715/2009 on conditions for access to the natural gas transmission networks (**Recast EU Gas Regulation**)[10] and the recast of Directive 2009/73 on common rules for the internal market of natural gas (**Recast EU Gas Directive**)[11] (together the EU Hydrogen Package or the Package). Thus, this Package is aimed at regulating hydrogen in a more applicated manner, as an instrument but also as a goal for the energy transition.

The EU Hydrogen Package initiative is complementary to the proposals for the amendment of the (i) Renewable Energy Directive (RED II)[12] , (ii) Energy Efficiency Directive (EED)[13] and (iii) Emissions Trading Scheme (EU ETS). [14]

B. Overview of the EU Hydrogen Strategy

The aim of the EU Hydrogen Strategy is to create an enabling environment to scale up renewable hydrogen supply and demand for a climate-neutral economy. The EU's priority is to develop renewable hydrogen, produced by mainly using wind and solar energy. However, in the short and medium term, other forms of low-carbon hydrogen are needed, primarily to rapidly reduce emissions from existing hydrogen production and support the parallel and future uptake of renewable hydrogen.

The hydrogen ecosystem in Europe is likely to develop through a gradual trajectory, at different speeds across sectors and possibly across regions and requiring different policy solutions. The EU Hydrogen Strategy outlines several key actions and presents three strategic phases in the timeline up to 2050. The three phases run from 2020-2024 - first phase, 2025-2030 - second phase and 2030-2050 - final phase:

- In the first phase, the strategic objective is to install at least 6 GW of renewable hydrogen electrolyzers in the EU and to produce up to 1 million tons of renewable hydrogen, so as to decarbonize the existing hydrogen production, e.g., in the chemical sector and facilitate hydrogen consumption in new end-use applications such as other industrial processes and possibly in heavy-duty transport.

• In the second phase, hydrogen needs to become an intrinsic part of an integrated energy system with a strategic objective to install at least 40 GW of renewable hydrogen electrolyzers by 2030 and to produce up to 10 million tons of renewable hydrogen in the EU.

• In the third phase, renewable hydrogen technologies should reach maturity and be deployed at large scale to reach all hard-to-decarbonize sectors where other alternatives might not be feasible or have higher costs. In this phase, renewable electricity production needs to massively increase, as about a quarter of renewable electricity might be used for renewable hydrogen production by 2050.

C. Overview of the EU Hydrogen Package

(a) Definition of green and blue hydrogen

Hydrogen (like quarks) comes in different “colors”, which are codes of their carbon footprint used by the market and sometimes by state agencies, such as brown, grey, pink, blue and green. A main objective of the Package is to provide a unified terminology across the EU regarding the hydrogen chain promoted by the Greed Deal, that is: renewable hydrogen (green hydrogen produced from renewable sources other than biomass and which achieves a certain GHG emission reduction threshold compared to fossil fuels) and low-carbon hydrogen (blue hydrogen produced from non-renewable sources, but which meets a certain GHG emission reduction threshold).

The Commission proposed the same threshold – 70% for both renewable and low-carbon hydrogen, so that the main difference between them remains the production process / provenance.

Low-carbon hydrogen will be used for attaining the 2030 Fit for 55 targets, but in the long term, renewable hydrogen should prevail. The EU Commission shall further develop specific calculation methodologies for the definition and certification of renewable and low-carbon hydrogen under delegated acts.

(b) Recast EU Gas Regulation

The Recast EU Gas Regulation brings the following main changes related to hydrogen:

• the scope and definitions in the Regulation have been modified to incorporate renewable gases and hydrogen as key components of the future gas market;
• the existing EU gas market principles of third-party access, unbundling of transmission and distribution system operators, and independent regulatory authorities have been refined and extended to cover hydrogen and renewable gases. Tariff discounts of 75 % are to be applied to hydrogen and renewable gases seeking to access the gas grid;
• new rules have been introduced on firm capacity for hydrogen and renewable gases, hydrogen blending with other gases, and cross-border coordination on gas quality;
• a comprehensive legal framework for cross-border EU hydrogen networks has been developed, and network codes and guidelines have been established. A new European Network of Network Operators for Hydrogen

(ENNOH) will be created and cooperate closely with ACER, ENTSO-E and ENTSO-G. ENNOH will formulate a 10-year network development plan for hydrogen.
• the extension of Regulation (EU) No 1227/2011 (REMIT) has been envisaged to ensure integrity and transparency on hydrogen markets.

(c) Recast EU Gas Directive

The Recast EU Gas brings the following main changes related to hydrogen:

• the scope and definitions in the Directive are modified to incorporate renewable gases and hydrogen as key components of the future gas market;
• rules are set forth to ensure competitive, consumer-centered, flexible and nondiscriminatory gas markets. These include sustainability and certification rules for renewable and low-carbon gases, which are set to hold a much bigger share of an internal gas market hitherto dominated by fossil fuels;
• consumer rights in the future EU gas market are further strengthened and the regulatory framework for citizen energy communities is defined;
• existing EU gas market principles of third-party access, unbundling of transmission and distribution system operators, and independent regulatory authorities are refined and fully extended to cover hydrogen and renewable gases;
• a comprehensive legal framework for cross-border EU hydrogen networks is developed, which incorporates existing EU networks as well as cross-border networks with third countries.

D. EU financing instruments for hydrogen

Pursuant to the Romanian chapter of the study 'Opportunities for Hydrogen Energy Technologies Considering the National Energy & Climate Plans' prepared in 2020 by FCHJU in close cooperation with the European Commission[15], the annual costs to produce clean hydrogen in Romania (including the cost of dedicated renewable electricity sources), to develop the transport infrastructure (or adapt the existing one) and end-user applications would reach EUR 155 million (for a low hydrogen demand scenario), and EUR 355 million (for a high hydrogen demand scenario). The same source states that the cumulative investments in hydrogen technologies are estimated to range between EUR 1.2 billion and up to EUR 2.7 billion until 2030 (depending on the hydrogen demand scenario).

With that in mind, the availability of hydrogen related financing instruments is of particular importance. Pursuant to the Hydrogen Public Funding Compass, currently there are ten European funding programmes and funds for 2021-2027 as follows: (i) Connecting Europe Facility – Energy, (ii) Connecting Europe Facility – Transport, (iii) European Regional Development, Cohesion Fund, REACT-EU, (iv) Horizon Europe, (v) Innovation Fund, (vi) InvestEU, (vii) Just Transition Fund, (viii) LIFE programme, (ix) Modernisation Fund, and (x) Recovery and Resilience Facility.[16] From among the above-mentioned ones, the last two have greater relevance for Romania.

The Romanian National Recovery and Resilience Plan covers investments for natural gas distribution infrastructure in combination with **green hydrogen** as well as for green hydrogen production capacities and/or its use for electricity storage. In this regard, the Romanian Government has adopted Emergency Ordinance no. 124/2021 on the establishment of the institutional and financial framework for the management of European funds allocated to Romania under the Recovery and Resilience Mechanism (GEO 124/2021), and draft documents regulating the

access to such funds is currently under public consultation.

The Modernization Fund is a dedicated funding program to support ten lower-income EU Member States (including Romania) in their transition to climate neutrality by helping to modernize their energy systems and improve energy efficiency including, as priority investments, the production and use of green hydrogen from renewable electricity. Pursuant to the recent public statements of the Ministry of Energy, a draft emergency ordinance establishing the areas of intervention and associated budget allocations for investments has already been prepared. [17]

III. A nascent domestic legislation

A. Preliminary remarks

Meanwhile, Romania also tapped into regulating hydrogen even before creating a strategy for it.[18] However, the primary legislation governing certain hydrogen-related aspects is rather incomplete and at an early stage, these provisions being introduced sporadically starting with 2020. Regarding the secondary legislation, at present there are several regulations governing the authorization and licensing of hydrogen-related activities. Furthermore, no distinction is made between different hydrogen colors. Still, as shown in Section V below, Romania is to adopt a hydrogen strategy, followed by the amendment or adoption of primary and secondary legislation on green hydrogen.

B. Ordinance 106/2020

Government Emergency Ordinance no. 106/2020 (Ordinance 106/2020) amending energy law no. 123/2012 (Energy Law) has for the first time introduced dedicated provisions on hydrogen. The previous regulation on natural gas did not cover hydrogen.

Ordinance 106/2020 provided that the Ministry of Energy issues authorizations for the establishment of new hydrogen production facilities. Further amendments to the authorization and licensing of hydrogen related activities were brought under Law 155/2020 and Ordinance 143/2021 (see below).

In addition, Ordinance 106/2020 regulated some hydrogen related duties of the natural gas distributors. More specifically, they have to (i) develop and submit to ANRE prospective studies on the improvement of the intelligent natural gas distribution system for the injection of hydrogen mixed with natural gas and/or subsequent conversion into hydrogen distributions to ensure compliance with environmental requirements; and (ii) take up the hydrogen quantities in accordance with the regulations/legal technical standards regarding the injection of hydrogen in natural gas distribution networks, i.e., their conversion from natural gas distribution to hydrogen distribution. However, no such regulations/legal technical standards have been adopted so far.

It would appear that the legislator has, therefore, anticipated a future legal obligation to convert the current natural gas distribution infrastructure into a renewable gas/hydrogen distribution infrastructure. Indeed, the Complementary Climate Delegated Act approved by the European Commission on 02.02.2022 covering nuclear and gas energy activities under the EU taxonomy, provides that the gas facilities covered by taxonomy must be switched to renewable or low-carbon gaseous fuel from 2035 onwards.

Thus, in addition to increasing the production capacity for green hydrogen, one of the challenges is specifically the creation of a dedicated network. For example, pursuant to Government Emergency Ordinance no. 128/2020 on certain measures for the establishment of the National Program for connecting the population and non-household customers to the intelligent natural gas distribution system (Ordinance 128/2020), the expenditures for the

improvement of the intelligent natural gas distribution system for the distribution of natural gas mixed with hydrogen in order to ensure compliance with environmental requirements is considered to be an eligible expenditure for EU funds financing.

C. Law 155/2020

The Energy Law was further amended under Law no. 155/2020 (Law 155/2020) which introduced new hydrogen related provisions. Pursuant to Law 155/2020:

- The Ministry of Energy (i) develops, in collaboration with ANRE, the legislation on the promotion of technologies regarding the use of hydrogen; (ii) develops programs for the diversification of primary energy sources, including electricity production from hydrogen, and proposes measures to the Government in this regard; (iii) implements the Government's energy policy regarding the use of hydrogen.[19]

- ANRE is authorized to (i) issue setting-up authorizations for hydrogen production facilities, (ii) issue licenses for the commercial operation of hydrogen production facilities, (iii) establish the general regulatory framework for hydrogen, (iv) develop technical and commercial regulations for the hydrogen terminal operation, (v) develop a methodology based on which the hydrogen terminal operator / hydrogen storage facility operator sets the tariffs for the services provided in connection with the terminal operation; (vi) establish the conditions and standards for the installations for hydrogen injection in the existing natural gas transmission / distribution networks. No such provisions have been adopted so far.

The introduction of provisions pursuant to which ANRE issues setting-up authorizations for hydrogen production facilities was somehow confusing, considering that pursuant to Ordinance 106/2020 the Ministry of Energy is the competent authority in this regard (provision not repealed by Law 155/2020). This was eventually clarified by Ordinance 143/2021 (see below) which repealed the provision pursuant to which ANRE issues setting-up authorizations for hydrogen production facilities. However, ANRE Order no. 199/2020 approving the Regulations for the issuance of setting-up authorizations and licenses in the gas sector (Order 199/2020) which entered in force after Ordinance 106/2020 and Law 155/2020 still provides that ANRE issues setting-up authorizations for hydrogen production facilities.

As regards the development of the hydrogen related legal framework, so far ANRE has issued the Framework validity conditions associated to the setting-up authorization for new hydrogen production facilities[20] and Framework validity conditions associated to the license for the commercial operation of new hydrogen production facilities.[21] Fees and contributions related to hydrogen activities have also been regulated. [22]

- The 'Natural gas producer' is redefined to include hydrogen production.

This broad definition that includes the hydrogen producers in the category of natural gas producers could be problematic if we look at the regulatory obligations that would apply to the latter, given that the Energy Law

regulates a vast category of obligations for natural gas producers (initially meant to apply to conventional producers) but only few specific obligations are provided for hydrogen terminal / hydrogen production facility operators.

- Hydrogen terminal operators must ensure third-party access to the hydrogen terminal, based on objective, transparent and non-discriminatory criteria, according to ANRE regulations to be further enacted.

- Hydrogen terminal operators are entitled to charge fees for services provided in connection with hydrogen terminal operations, including hydrogen storage facilities, and also to limit and / or suspend the provision of services according to specific regulations to be further enacted.

- Regulated market activities include hydrogen distribution and hydrogen terminal use. However, hydrogen distribution was excluded from the list of regulated market activities under Ordinance 143/2021 (as detailed below).

D. Ordinance 143/2021

Government Emergency Ordinance no. 143/2021 (Ordinance 143/2021) which has recently reformed the Energy Law has continued to expand and detail the regulations introduced under Ordinance 106/2020 and Law 155/2020. Amendments brought under Ordinance 143/2021 can be grouped into three broad categories, namely (i) definition of core concepts, (ii) authorization, rights and duties of the hydrogen terminal/production facility operator, with a particular emphasis on the hydrogen terminal, and (iii) hydrogen related activities and their purposes.

Ordinance 143/2021 defines the core hydrogen related concepts as follows: (i) 'hydrogen terminal' is defined as all installations necessary for the import, discharge and regasification of hydrogen for subsequent delivery to the system, but which do not include any part of the installations / equipment used for the storage of liquid or gaseous hydrogen; (ii) 'hydrogen terminal operator' is defined as the natural or legal person who carries out hydrogen production or its import, unloading and regasification, responsible for the hydrogen terminal operation; (iii) 'commercial operation of the hydrogen terminal' is defined as the commercial activity of selling hydrogen to customers; and (iv) 'access to the hydrogen terminal' is defined as the right of an economic operator in the natural gas sector or of a final customer to use the hydrogen terminal.

Pursuant to the recent amendments, hydrogen is used for the following purposes: (i) commercial activities, (ii) ensuring security of the natural gas supply to final customers, (iii) harmonization of variations in seasonal, daily and hourly consumption with other available gas sources, and (iv) decarbonization of natural gas transmission/distribution networks. As regards the security of the natural gas supply, hydrogen use is part of the Preventive action plan regarding the measures to guarantee the security of natural gas supply in Romania approved under Government Decision no. 1077/2021 (Decision 1077/2021). More specifically, the action plan provides, amongst others, that the development and use of the technical and economic potential of renewable sources in the national energetic system depend on the development of storage capacities, as well as technologies on the injection of hydrogen in the form of synthetic gas from renewable energy sources and the use of hydrogen in industrial processes.

Ordinance 143/2021 provides that hydrogen production, discharge, storage, and regasification can be carried out by authorized operators of hydrogen terminals/ facilities. As regards authorization and licensing, ANRE is the competent authority for the issuance of authorizations related to **design, execution, and operation** (Romanian: proiectare, execuție, exploatare) of hydrogen production facilities, as well as licenses for the c**ommercial operation** (Romanian: exploatare comerciala) of hydrogen production facilities. In addition, Ordinance 143/2021 has repealed the provision (introduced under Law 155/2020) pursuant to which ANRE issues setting-up authorizations (Romanian: autorizație de înființare) for hydrogen production facilities, which falls under the

competence of the Ministry of Energy, as regulated by Ordinance 106/2020. However, as already mentioned, Order 199/2020 still provides that ANRE issues such setting-up authorizations. Furthermore, Ordinance 143/2021 provides that economic operators and / or individuals carrying out design, execution and operation activities in the hydrogen production sector must hold authorizations / licenses issued by ANRE based on specific regulations.[23]

Amongst the legal obligations of hydrogen terminal operators are those related to (i) operation, maintenance, rehabilitation and modernization of technological installations, (ii) third-party access and connection to the hydrogen terminal based on objective, transparent and non-discriminatory criteria, according to the regulations approved by ANRE, (iii) transparency, information publication and information confidentiality, (iv) investments plans, (v) public service and (vi) proposals to ANRE regarding technical, commercial norms and pricing methodologies specific to their own activity.

Amongst the rights of hydrogen terminal/production facility operators are those related to (i) collection of fees for services provided, (ii) limitation or interruption of services; (iii) interruption of hydrogen production facilities and hydrogen terminals, and (iv) refusal of third-party access to the hydrogen terminal.

Ordinance 143/2021 has excluded hydrogen distribution from the list of regulated market activities, previously introduced under Law 155/2020. However, pursuant to ANRE Order no. 21/2020 for the approval of the Regulation on the accounting separation of activities carried out by licensees in the natural gas sector (Order 21/2020), as amended under ANRE Order 93/2021, hydrogen distribution is still amongst the regulated activities in the natural gas sector.

E. Order 323/2020 and Decision 1302/2021

Insofar as the promotion of hydrogen use in transport is concerned, some provisions have already been adopted in this regard. For example, Order no. 323/2020 of the Ministry of Environment, Waters and Forests (Order 323/2020)[24] regulates the eco-label (Romanian: ecotichet) as a part of the purchase price of a new electric vehicle, covered from non-reimbursable funds from the Environment Fund, with the 'new electric vehicles' being listed in the FCEVs as well. In particular, the amount of the eco-label for the purchase of a new fuel cell electric vehicle, except for motorcycles, is (i) RON 51,000 (approx. EUR 10,300) for scrapping a single used vehicle and (ii) RON 54,000 (approx. EUR 10,900) for scrapping two used vehicles.

As regards rail transport, Government Decision no. 1302/2021 on the approval of the Action program for the development of railway infrastructure and the modal shift of passenger and freight transport flows to rail transport (Decision 1302/2021) provides for the acquisition of 12 hydrogen electric multiple units (H-EMU) at an estimated cost of EUR 135 million until 2026.

IV. What's next – planned investments and regulatory changes

A. National Recovery and Resilience Plan (NRRP)

(a) Envisaged regulatory changes

In September 2021, the European Commission adopted a positive assessment of the Romanian National Recovery and Resilience Plan. Amongst the reforms included in the 'Energy Component' of the NRRP is the development of a favorable legislative and regulatory framework for future technologies, in particular hydrogen and storage solutions, with an expected EUR 1 million allocation. The objective of the reform is to amend the existing legislative and regulatory framework for introducing measures to support and facilitate the deployment of renewable hydrogen, with a focus on the transport and energy (gas and electricity) sectors. In particular, the reform

will develop a National Hydrogen Strategy (NHS) and a Strategy Action Plan (SAP), setting the timetable for the implementation of the NHS measures.

This reform aims to remove any legislative and administrative obstacles against the development of renewable hydrogen technology and contribute to the achievement of the future national and European targets for the production, storage, transportation and use of renewable hydrogen by 2030. To achieve this goal, the hydrogen related legal framework (in terms of production, transportation and use) will be reviewed/adopted in order to regulate, for example, (i) the green hydrogen production by electrolyzers; (ii) injection of renewable gases, including hydrogen, in gas transmission and distribution networks; (iii) the use of hydrogen ready appliances and equipment (such as boilers or heating) to become mandatory from 1 January 2026 for all new installations; (iv) adoption of a new energy law (by Q2 2023) to ensure the development of the entire hydrogen value chain, as well as the amendment of Law no. 64/2008 on the safe operation of pressure equipment, lifting equipment and fuel consuming appliances and Law no. 346/2007 on measures to ensure security in the natural gas supply (and secondary implementing legislation); (v) fiscal incentives for the production of clean hydrogen, considering that clean hydrogen is still not a mature technology (this is expected to occur at the horizon of 2030).

(b) Envisaged investments

The NRRP defines the parameters of investments in the distribution infrastructure of renewable gases (using natural gas in combination with green hydrogen as a transitional measure), as well as in green hydrogen production capacities and/or green hydrogen use for electricity storage. The investment implies two sub-investments with a EUR 515 million expected allocation as follows: (i) EUR 400 million for the new distribution network prepared for hydrogen - natural gas mix, and (ii) EUR 115 million for green hydrogen production capacities to allow its use for electricity storage (e.g., transformation of renewables into hydrogen).

The objective of the first sub-investment is the construction of a gas distribution network (at least 1,870 km) enabling the transport of green hydrogen in the Oltenia region and the installation of electrolyzers for green hydrogen production. In particular, the distribution network will carry at least 20% of renewable hydrogen (by volume) when commissioned by 30 June 2026 and 100% renewable hydrogen and/or other renewable gases in 2030.

The objective of the second sub-investment is the installation of green hydrogen production facilities of at least 100 MW in electrolyzers, producing at least 10,000 tons of hydrogen from renewable sources by 31 December 2025.

On 16 February 2022, the Ministry of Energy initiated its public consultation on the state aid scheme and the specific guidelines related to the second sub-investment, that is supporting investments in green hydrogen production capacities.[25]Pursuant to the draft documents, the total estimated budget of the scheme is the RON equivalent of EUR 149,500,000, composed of (i) EUR 115,000,000 non-reimbursable European funds and (ii) EUR 34,500,000 national funds through the 30% over-contracting mechanism under GEO 124/2021. In addition, it is provided that the maximum aid that can be granted for an investment project, per undertaking, may not exceed EUR 50,000,000. Therefore, the difference up to the total value of the project will have to be covered by the beneficiary, either from own or third-party resources in a form that is not subject to any state aid.

B. Modernization Fund (MF)

As far as hydrogen is concerned, the following activities could be funded via the Modernization Fund as priority investments, such as: (i) production of green hydrogen from renewable electricity, (ii) use of hydrogen produced from renewable electricity, (iii) zero direct emission mobile assets based on renewables (e.g., electric hydrogen-fueled trains, trucks, or cars), and (iv) infrastructure for the transmission and distribution of green hydrogen including charging stations. Recently, the Romanian Ministry of Energy has announced that the 4th key

funding program is related to green hydrogen, and it will cover the support for green hydrogen production and its use in industrial applications to reduce GHG emissions.[26]

The actual budget allocation for hydrogen related activities in Romania is presently not known, but it will be regulated under a Government Emergency Ordinance recently announced by the Ministry of Energy. However, it seems that the total amount allocated to Romania through the Modernization Fund will be of approximately EUR 15 billion (depending on the future price of allowances). [27]

C. Integrated National Energy and Climate Plan for 2021-2030 (NECP)

Romania has undertaken under the NECP to implement several projects for resources diversification, including to promote the use of hydrogen. Pursuant to the NECP, Romania could opt for the use of hydrogen in industrial processes, considering that natural gas accounts for 34% of the energy mix currently used in the industrial sector and its replacement with hydrogen from renewable sources or low carbon hydrogen would represent a significant decarbonization method. At the same time, the demand for high temperatures heat constitutes almost 60% of the industrial energy demand, hydrogen being one of the energy carriers/low-carbon heat agents appropriate for generation of high temperatures heat.

Pursuant to the same document, Romania may consider using the existing methane infrastructure for hydrogen transmission and distribution by injecting hydrogen into the public natural gas network in the short term (2025-2030) and the medium term (2030-2040) and by increasing hydrogen contribution to the long-term transmission and distribution network (>2040).

Moreover, Romania plans to carry out an assessment regarding the possibility of injecting hydrogen in the form of synthesis gas from renewables (after it has been brought to the standard of methane by reaction with CO2) in the natural gas transmission/distribution systems. The electricity surplus from variable renewables, which is thus converted, could be transported on long distances and/or stored. In this way, transmission/distribution systems could be used at the optimum capacity for the entire technical lifetime without limiting the period of gas extraction from the internal onshore/offshore perimeters.

D. Governance Program for 2021 - 2024

The 2021-2024 Governance Program sets forth several objectives regarding the use of hydrogen. It provides for (i) the creation of industrial ecosystems and a network of industrial and innovation hubs for new clean energy production and storage technologies, including hydrogen; (ii) the development of a hydrogen related technology and industry to focus on the national research activities bringing together the relevant stakeholders; and (iii) the participation in the European initiatives to encourage the development of hydrogen-based technologies in order to reach the threshold of economic competitiveness and widespread use.

Specifically, the 2021-2024 Governance Program provides for Romgaz's involvement in a project for the development of a natural gas, green energy and hydrogen power plant in Halânga, by integrating the electricity produced from renewable sources with hydrogen production through a natural gas-fired electricity generation unit with a capacity of 150 MW, a photovoltaic park of 100 MW, as well as of a hydrogen production unit.

On a separate note, other envisaged projects worth mentioning are (i) the involvement of Hidroelectrica (the largest Romanian energy producer) in the 50 MW 'Green Hydrogen @ Blue Danube' cross-border project aimed at the production (through large-scale water electrolysis using a mix of green energy i.e., off-grid wind and on-grid hydro), transport and sale of green hydrogen, and (ii) the involvement of Transgaz (the Romanian gas transmission operator) in the Three Seas Initiative Investment Fund's projects to implement a cross-border gas hydrogen blend

transmission infrastructure.

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E. Draft National Energy Strategy for 2020-2030 with a view to 2050 (Draft NES)

The Draft NES provides for eight strategic objectives in the Romanian energy sector, which are to be achieved through a set of operational objectives, which, in their turn, are to be pursued through a set of priority actions. One of the priority actions is the sustainable development of clean hydrogen production in Romania in the context of decarbonization and the achievement of climate neutrality goals.

In addition, amongst the priority investments under the Draft NES are those related to the storage capacities, considering the potential of hydrogen and new gases in the process of sectoral integration. It is also stated that one of the energy transition priorities is the infrastructure optimization and upgrade to take on new energy carriers such as hydrogen and renewable gas.

F. Romanian private organizations in the hydrogen sector

In Romania there are several entities that carry out hydrogen related activities. For example, the National Centre for Hydrogen and Fuel Cells, as part of the Ramnicu Valcea National Research and Development Institute for Cryogenic and Isotopic Technologies (ICSI) coordinates the research activity in the field of hydrogen production, storage, and applications on fuel cells. The main action lines pursued are: (i) conversion of hydrogen into energy, gas-to-power; (ii) energy storage technologies to obtain the parameters to develop power-togas stations; (iii) hybrid energy storage technologies (the Lithium-Ion Program); and (iv) development of clean propellers for mobility (the 'H-mobility' Program).

In addition, the Romanian Association for Hydrogen Energy was founded in 2012. The association aims to support the actions related to the economy of hydrogen and fuel cells, as well as the infrastructure and energy associated therewith through technology transfer, promotion of Romanian contributions, close cooperation with international and national associations, and support for the implementation of educational and research policies.

V. Conclusions – hydrogen is taking shape

Clean hydrogen is a strategic energy source at EU level and Romania has made important steps in preparing the stage for hydrogen investments: there is a hydrogen strategy under development, legislation is taking shape, investment programs are to be launched soon, there are private organizations in the hydrogen sector which can contribute from a technical and business perspective to the development of clean hydrogen in Romania.

Certainly, there are a lot of things to be done on the legislative side: the fact is that the existing legislation is still in

its infancy and a lot of secondary regulations will be required, down to a granular level of detail. Also, in the existing Romanian legislation hydrogen does not have a color, no distinction being made between clean hydrogen and hydrogen that is produced with high GHG emissions. From this perspective, the future EU Hydrogen Package would need to be transposed when the time is ripe in the Romanian legislation.

The good news is that hydrogen is present as a priority in the strategy, policies and legislative planning of Romanian authorities.

[1] Source available here.

[2] Source available here.

[3] Oil refining was the single largest consumer of hydrogen in 2020 (close to 40 Mt H2). Refineries use hydrogen to remove impurities (especially Sulphur) and to upgrade heavy oil fractions into lighter products. Oil refining is the only sector that shows declining hydrogen demand in the announced pledges and net zero emissions scenarios. Source available here.

[4] With demand of 46 Mt H2 in 2020, ammonia and methanol production, together with other smaller-scale chemical processes, account for most of the industrial use of hydrogen. Demand for hydrogen in the chemical subsector is expected to grow, particularly because of rising demand for ammonia and methanol. Source available here.

[5] The iron and steel subsector accounts for 10% of industry hydrogen demand, stemming specifically from use in the direct reduced iron (DRI) - electric arc furnace (EAF) steel-making process route, which accounts for 7% of total crude steel production globally. As a result of announced policies and projects as well as increased steel production through the DRI-EAF process, hydrogen demand from iron and steel will almost double by 2030 in the announced pledges scenario and will increase more than fivefold by 2050. Source available here.

[6] In 2020, hydrogen use in heating energy was less than 0.005%, in transport sector less than 0.01% of the energy consumed, and in power generation less than 0.2% of the electricity supply. Source available here.

[7] For example, in the transport sector, more than 40,000 fuel cell electric vehicles (FCEVs) were on the road globally by the end of June 2021, deployment being concentrated largely on passenger light-duty vehicles. More than 20 countries offer specific purchase subsidies for FCEVs and tax benefits. In addition, several demonstration projects for the use of hydrogen-based fuels in rail, shipping and aviation are already under development and are expected to open new opportunities for creating hydrogen demand. As regards residential heating, prospects for deploying hydrogen in this sector remain limited, reflecting the high efficiency of electricity-based solutions and the energy losses that result from converting and transporting hydrogen. Nevertheless, since hydrogen equipment can be compatible with existing buildings' energy systems, localized hydrogen applications could support decarbonization in very specific contexts where gas infrastructure already exists. Four main groups of technologies can operate on hydrogen at building level: hydrogen boilers, fuel cells that co-generate heat and electricity, hybrid heat pumps, gas-driven heat pumps. Source available here.

[8] Transport (0), ammonia (92,765), refinery (55,821), methanol (30,926), H2O2 (3), other chemicals (0), energy (4,808), other (183). Source available here.

[9] Source available here.

[10] Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and for hydrogen, available here.

[11] 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, available here.

[12] Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, available here. More information on this initiative is available here.

[13]Proposal for a Directive of the European Parliament and of the Council on energy efficiency (recast), available here. More information on this initiative is available here.

[14] Proposal for a Decision of the European Parliament and of the Council amending Decision (EU) 2015/1814 as regards the amount of allowances to be

placed in the market stability reserve for the Union greenhouse gas emission trading scheme until 2030, available here. More information on this initiative is available here.

[15] Available here.

[16] Sources available here and here.

[17] Source available here.

[18] Pursuant to the International Energy Agency, 17 governments have released hydrogen strategies and more than 20 governments have publicly announced they are working to develop strategies (Source available here, information updated in November 2021).

[19] These competences are also provided in Government Decision no. 316/2021 on the organization and functioning of the Ministry of Energy, effective as of 17 March 2021.

[20]ANRE Order no. 200/2020 on the approval of the framework validity conditions associated to the setting-up authorization for new hydrogen production installations (Order 200/2020), effective as of 1 January 2021.

[21] ANRE Order no. 201/2020 on the approval of the framework validity conditions associated to the license for the commercial operation of new hydrogen production installations (Order 201/2020), effective as of 1 January 2021.

[22] ANRE Order no. 143/2021 on the approval of tariffs and monetary contributions levied by the National Energy Regulatory Authority in 2022, effective as of 1 January 2022.

[23] See ANRE Order no. 132/2021 on the approval of the Regulation for the authorization of economic operators carrying out activities in the natural gas sector, effective as of 1 January 2022.

[24] Order no. 323/2020 for the approval of the Guidelines for the financing of the Program on the reduction of greenhouse gas emissions in transport, by promoting clean and energy efficient road transport vehicles, 2020-2024, effective as of 3 March 2020.

[25] More information is available here.

[26] Source available here.

[27] Source available here.