NATURAL GAS AND GREEN ENERGY IN ROMANIA

GAZELE NATURALE ȘI ENERGIA VERDE ÎN ROMÂNIA

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Sumar. *Energia verde este o țintă pe care trebuie să o atingem cât mai curând posibil. Prin urmare, aceasta trebuie să fie acoperită de o resursă sigură, cum ar fi gazele naturale; iar România deține această resursă. Obiectivul principal al acestui articol este de a demonstra că gazele naturale pot sprijini tranziția, fără îndoială pentru că există resurse, iar investițiile în exploatarea acestora ne vor ajuta să depășim dependența de cărbune. În realizarea acestui demers, în prima parte a lucrării, sunt abordate problemele legate de modul în care gazele asigură continuitatea sistemului energetic și oportunitățile pentru tranziția energetică către o economie verde, gazele naturale rămânând esențiale în acest proces. În a doua parte a lucrării, sunt prezentate principalele proiecte care fac din gazele naturale un partener de încredere pentru resursele regenerabile. Ca rezultat, în final, lucrarea demonstrează că pentru sectorul energetic, și nu numai, gazele naturale reprezintă și soluția optimă în acest proces, întrucât România se află într-o poziție privilegiată de deținere a propriilor resurse, iar versatilitatea gazelor naturale poate asigura o tranziție energetică justă.*

Cuvinte-cheie: *gaze naturale, energie verde, resurse regenerabile, hidrogen, tranziție energetică, Marea Neagră, Dobrogea.*

1. Introduction

Just energy transition advocates the need for a transition to low carbon energy sources and green growth in a manner that does not generate new forms of social exclusions, human rights violations, energy poverty, or inequality. In energy poor, but natural gas rich countries, transitioning away from dependence on biomass and leveraging natural gas resources to improve universal access to modern energy services for all is the primary focus of energy transition debates.

Yet, information asymmetry on the role of natural gas in the ongoing global energy transition continues to hinder the full deployment of natural gas technologies that could play significant roles in addressing energy poverty, promoting energy security, and supporting the global energy transition targets. It will be difficult to achieve a just and equitable global energy transition without reconciling these divergent narratives on the role of natural gas in promoting a just and equitable transition.

Green energy is definitely a goal that needs to be reached as soon as possible. But even if everybody wants renewable energy, the society must also be aware enough that

it has a very high volatility. Therefore, it must be covered by a security resource, such as natural gas, which Romania has. And this is why the paper focuses on Romania as a case study including an analysis of the actions taken in this respect in the last 5 years.

Everybody wants to have the cleanest affordable energy, produced, if possible, entirely from renewable sources and without a carbon footprint. But until getting there, the society will go through a transition where a resource will be needed to ensure that production can continue without a hitch and, more than that, at sustainable prices. Therefore, meeting the challenges of climate change is becoming ever more urgent. Gas can make a major positive contribution by leveraging existing energy infrastructure and an existing scaled supply chain. The immediate push of natural gas can help achieve fast decarbonization by accelerating the phase out of coal with a proven alternative technology. A focus on developing low-carbon gases and making existing infrastructure suitable for conversion can achieve deep decarbonization in the longer term, providing a pathway to net-zero. A two-pronged approach that sees gas infrastructure working together with electrification needs to be part of the global environmental policy toolkit.

In short, these are the facts motivating the urgency of this research.

2. Methodology and data

Natural gas is a fossil fuel that is now widely used worldwide. It is a reliable and cheap energy source used in various applications, including electricity generation, heating, and cooking. However, burning natural gas produces carbon dioxide and other pollutants, contributing to global warming and other environmental problems. On the other hand, *hydrogen* is a clean-burning fuel that does not produce GHG emissions or harmful pollutants when burned. In addition to a range of uses, including transport, heating, and electricity generation, it is an adaptable fuel. However, hydrogen production can be expensive and energy-intensive, while the infrastructure needed to transport and store hydrogen is still under development. For these reasons, using the combination of hydrogen and natural gas as a fuel source has the potential to reduce GHG emissions and mitigate the environmental impact of natural gas use.

As such, this section reviews the role of natural gas in reducing carbon emissions to mitigate climate change and to bridge between coal and renewable technologies, by laying out how various positive and negative effects of natural gas interrelate. The research warns that natural gas' negative delayed and global effects can easily outweigh the positive immediate and local effects unless precautions are taken. Existing studies [1] agree that natural gas helps avoid GHG emissions in the short term, while unintended long term effects might also hinder the transition to renewables. These findings help to inform the policy-making process by reviewing the systemic effects of using natural gas as a transition fuel and suggests policy actions to avoid the negative long term consequences.

These opportunities are largely addressed in the following subsections.

✓ ***Natural gas has half the CO_2 emissions compared to coal***

The role that natural gas could play in the context of climate mitigation is multifaceted and complex, as it requires more than simple quantification and comparison of total emissions. In this respect, the importance of natural gas is obvious: first, it emits on average 50% less carbon dioxide (CO_2) than coal when burned in power plants. Depending on the degree of wear and tear of the power plants, the difference can be even greater. According to the latest available data [2] included in the Integrated National Plan in the field of Energy and Climate Change (PNIESC), specific CO_2 emissions in 2021 were at 823.18 g/kWh for coal (the highest), respectively at 384.19 g/kWh for gas natural (the lowest).

Therefore, natural gas will play an increasing role in the transition to a cleaner economy. Beyond the production of electricity, this non-renewable fuel can have many applications - for example, in **obtaining hydrogen**, considered one of the most important fuels of the future, but also in transport.

It is necessary, however, for Romania to capitalize on the newly discovered deposits at its disposal in order to fully cover the growing internal needs and increase energy security. In this respect, ***the speedy implementation of the legal framework necessary for final investment decisions in the exploitation of natural gas resources in the Black Sea area represents an important objective for Romania.*** It remains to be seen if and, above all, when the authorities want and will implement this desired project.

✓ ***Natural gas ensures the continuity of the energy system***

In this context, **natural gas can support the transition**, without any doubt, because there are resources, and investments in their exploitation, especially those in the Black Sea that will help us overcome our dependence on coal. It is a fundamental economic advantage which Romania should make the most of. In addition, natural gas can also be used as a very good basis for future technologies, such as, for example, **hydrogen production.**

Moreover, if speaking about **energy security** and **security of supply**, one word is defining: **constancy.** And here comes a very fine balance in the way the energy mix is regulated. In terms of the mix between gas, hydro, nuclear, and renewable sources, Romania is one of the most energy-balanced countries in the EU. Therefore, **destabilizing this balance**, before having something to replace it, **could endanger energy security.**

That is why analysts believe that until a mass and global adoption of solutions from renewable resources, ***natural gas, as a transition source***, could represent a source that would keep costs under control. The two technologies are not mutually exclusive in arriving at a healthy energy system so that the average cost for the technologies to be acceptable to the end-consumer.

✓ ***The opportunities of the energy transition***

The European Parliament approved new rules for the selection of energy projects that can receive EU funding in order to ensure alignment with the standards imposed by the European Green Deal [3]. Projects that reuse existing natural gas infrastructure for

hydrogen transport and carbon storage will be eligible to receive EU financial assistance until 31 December 2027. Therefore, beyond the challenges related to the security of energy supply, Romania must find and adopt a strategy to optimally cross the transition to a green economy. And natural gas remains essential in this process [4].

Natural gas will continue to play a key role in the European Union's decarbonisation strategy [5], by replacing current coal-based energy production capacities, but also by contributing to the creation of hydrogen infrastructure at lower costs. For these reasons, natural gas will continue to play its role in certain parts of Europe. It is widely accepted that the complete cessation of support for natural gas infrastructure will certainly be questionable, especially in regions that plan to expand the use of natural gas to phase out coal, especially in the context of the EU's green economic recovery [6].

For this purpose, Romania, **the second largest natural gas producer** after the Netherlands in the EU, after the exit of Great Britain from the Community space, is one of the states that will rely heavily on natural gas in its efforts to reduce carbon emissions from the energy sector, given that they represent one of the main factors that contribute to the increase in global temperatures. And the Integrated National Plan in the field of Energy and Climate Change (PNIESC) 2021-2030 [2] sent by the Romanian authorities to Brussels clearly shows this.

✓ ***Natural gas is a " trustworthy partner" for renewable resources***

Regarding energy from renewable sources point of view, and in order to achieve the ambitious level regarding the share of energy from renewable sources of 30.7% in 2030, Romania proposed to the European Commission **the installation of new wind energy capacities of 2,302 MW and photovoltaics of 3,692 MW** [2]. For the stability of the system, **there is a need for the installation of back-up capacities on natural gas** mixed with hydrogen, or storage capacities and the use of intelligent techniques for the management of electrical networks, as specified in the PNIESC.

The use of hydrogen as an alternative fuel is also proposed in Component 4 Sustainable Transport [7] as a demonstrative investment-project on a non-electrified line with high demand and high growth potential (Henri Coandă International Airport – Bucharest - Pitești), which will involve the purchase of 12 HFC (Hydrogen and Fuel Cells) vehicles.

3. Results and discussions

There are several ***energy projects started in Romania aiming at hydrogen.*** Romania's large and small energy companies, as well as researchers in this field, have already initiated projects that aim at hydrogen, as an energy resource and as a means of storage. In the absence of a government strategy, however, demand for green hydrogen is too low. *The government promised to have a strategy completed only by the end of 2023 (an objective already overdue by now).*

Hidroelectrica, Romgaz, OMV Petrom, Liberty Galati [8], several wind energy producers, and even Lukoil, through its subsidiary Petrotel in Ploiesti, are putting toge-

ther plans for the production of **green hydrogen**. It is about that hydrogen produced by the electrolysis of water, but with an exclusive consumption of renewable energy. Also, the operator of the national natural gas system, Transgaz is to associate with the Investment Fund of the Three Seas Initiative (I3M) in a project company for the construction of hydrogen pipelines (this topic will be detailed in another work).

Progress exists, but is still too small compared to the potential, even if, since 2009, at the National Research and Development Institute for Cryogenic and Isotopic Technologies (ICSI) Ramnicu Valcea, the National Center for Hydrogen and Fuel Cells (CNHPC) was established with the mission to implement, develop, and disseminate hydrogen-based energy technologies in Romania. Not by chance, the researchers from ICSI Ramnicu Valcea are the ones developing two prototypes of electric cars [9] that use the *hydrogen fuel cell as a means of propulsion, with a maximum autonomy of approximately 320 km.*

Another example refers to ***Transgaz and the association with the I3M Investment Fund*** are aiming at ***the hydrogen infrastructure stake.*** The latest innovation is also among the most important, because without a transport infrastructure, hydrogen production projects cannot be developed, nor is their financing any easier.

In this respect, Transgaz shareholders approved on January 25, 2022 (with the Government's voting power of 58% of the total) the association of the company with the Investment Fund of the Three Seas Initiative (I3M) in a project company for the construction of hydrogen main pipelines, of 626 millions of euros [10; 11]. This topic will be largely addressed in another paper. Once built, the hydrogen transport pipelines will be sold to Transgaz.

The next example shows that ***Dobrogea is on the focus for the great companies in energy.*** Romania's major natural gas producers, Romgaz and OMV Petrom, have announced since the end of 2020 [12] that they want to invest in a ***joint hydrogen production project in a wind farm in Dobrogea,*** a first for the market from Romania**.** A part of the 11 billion euros that OMV Petrom proposes to invest until 2030 will be dedicated to the goals related to the hydrogen market, according to the company's strategy. On the other hand, Romgaz also wants to produce green electricity in photovoltaic parks and use the hydrogen produced in its own cars, as it wants to convert 20% of its car fleet to this type of propulsion.

Also, Hidroelectrica announced that is interested in investing in onshore and offshore wind farms, in photovoltaic parks, in the production of electricity based on biomass, in the production of hydrogen through hydrolysis, and in the development of e-mobility networks, according to the investment strategy of the company. More precisely, Hidroelectrica wants to develop, in partnership with Verbund (Austria), a green hydrogen project through water electrolysis on a large scale in Romania [11], for which purpose it will use a mix of green energy (off-grid wind and on-grid hydro). The problem is that, afterwards, **the hydrogen produced will be exported**. It will be embedded in a mineral oil and transported on the Danube to countries from the Transnational Danube Interreg program ("Green Hydrogen on the Blue Danube"), such as Austria, Bulgaria, the Czech

Republic, Germany, Hungary, Slovakia, Montenegro, and Serbia [13]. Last year, Hidroelectrica also bought the Crucea wind farm, in Constanta county, with an installed power of 108 MW, because it intends to diversify its activity through hydrogen production.

So far, *there are investors, but (yet) no market, although the potential is huge.* The National Energy Regulatory Agency (ANRE) received several requests from investors demanding approvals for the construction of hydrogen production and storage facilities.

Things are at the beginning, because there is still no market, with not enough demand for green hydrogen, while there are producers of renewable energy, i.e. wind energy, who want to balance their electricity production when is in excess and use it in the production of hydrogen, but the quantities are not large (less than 10% of the energy production is used).

Instead, however, Dobrogea could become a veritable ***"Hydrogen Valley"*** [14; 15]. Dobogea is suitable for the application of the *"Hydrogen Valley"* concept, as it ticks three key factors to become a clean hydrogen development pole:

- an exceptional potential for hydrogen production from onshore and offshore renewable energy;
- regional hydrogen demand from refineries, steel mills, and various transport sectors;
- the strategic role that the Constanta Port can play.

Dobrogea could host a large part of Romania's electrolyzers, which would produce green hydrogen and which should reach a capacity of 1,400 MW, to achieve the "Fit for 55" objectives in industry and transport.

There is also an initiative for the establishment of the Romanian HUB for Hydrogen and New Energy Technologies, ROHYDROHUB [16]. Without decisive governmental action, however, the project appears to be a long way off.

4. Conclusions and recommendations

To combat climate change (one of the biggest global threats), the European Union has embarked on an unprecedented decarbonisation race. Along this path, the Member States must choose the solutions that bring them opportunities for economic growth and, at the same time, with the least impact on consumers, who will ultimately pay the transition bill. For the energy sector and not only, natural gas represents the optimal solution in this process, Romania being in the privileged position of owning its own resources.

Achieving the climate objectives requires a fundamental transformation of the primary energy mix and the electricity production mix. This transformation, in the view of the European Union, aims to reduce the weight of fossil fuels, especially the complete elimination of coal and increase the role of renewable energy and the integration of new technologies throughout the value chain. In this context, the versatility of natural gas can ensure a just energy transition.

Hydrogen represents a non-polluting fuel with a very high yield/calorific power, able to address the energy supply needs of the population, but also of the business environment. According to the PNRR, in Romania, more than half of the population is not connected to gas pipelines, still using polluting energy sources, with high emissions, expensive, and harmful to health. Thus, the authorities support the fact that the PNRR offers Romania the chance to take a step into the future, building from the very beginning natural gas transport and distribution networks fully capable of integrating the gases of the future, such as hydrogen.

According to the above-mentioned document, the density of the natural gas network is uneven in Romania, as such regions with poor access should be prioritized with this investment, especially since this would be an investment outside the current transmission and distribution network. Therefore, the PNRR envisages the development of a regional natural gas infrastructure (transport, distribution, compression stations) in areas poorly connected to natural gas network, capable of receiving hydrogen and other de-carbonated gases (i.e. bio-methane, etc.) up to 10% of capacity. The insertion of hydrogen into the intelligent network will be carried out after the metering and regulation station of Transgaz, thus avoiding the absorption of hydrogen into the national transport network, and the blending will be carried out under maximum security conditions.

Digitizing and streamlining the operations of the distribution and system operator (Transgaz) in order to increase the ability to take over hydrogen flows from the network is one of the characteristics of the new smart networks that will be created.

All these things being considered, there is an opportunity to help renewable technologies by supporting them with natural gas as long as the right steps are taken. As a mature technology, natural gas has been through more evolutionary processes compared to renewables. For this reason, natural gas can directly support renewable technologies in many ways such as balancing intermittency, providing reliable energy, offering affordable investments and prices for their consumers. Without these leverages from a supporting technology or a transition fuel, the reconfiguration of the energy systems into renewable technologies might be infeasible, overpriced, and more importantly significantly delayed.

However, taking advantage of a transition fuel (like natural gas) comes also with challenges. Initial investments in a potential transition fuel such as natural gas could lock out emerging renewable technologies for extended periods. Technology lock-ins occur as distant and delayed responses from the system and amplify the complexity of transition management.

That is why a mix of hydrogen and natural gas is a viable prospect in terms of both environmental and social impacts. The application of hydrogen as a cleaner, more renewable energy source, can substantially reduce GHG emissions and air pollution, which will also create new jobs and stimulate growth. In addition, through the use of the existing natural gas infrastructure, a transition to a more sustainable energy mix without significant disruption can be obtained. It is very important to maintain investments in research, development, and innovation to increase the efficiency and cost-effectiveness

of hydrogen production and storage, and accelerate the transition to a more sustainable green energy future.

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