INTERMEDIATE REPORT

THE GAS SECTOR
IN THE CONTEXT OF THE EUROPEAN ENERGY TRANSITION
APPROACHING A JUST TRANSITION FOR WORKERS

FEBRUARY 2022

syndex
KNOWLEDGE FOR ACTION

#1 INTRODUCTION

Climate change has taken a major place in media debates and the political agenda in recent years as a response to the rise in social and governmental concern and the awakening to the wide-ranging impacts of climate change already visible in ecosystems, economic sectors and social conditions in Europe and worldwide. In the Paris agreement framework, the latest measure - and one of the most concrete and ambitious - is the European Green Deal launched by the European Commission in December 2019 to make the EU the first climate-neutral region in the world by 2050.

In fact, the decarbonisation of industrial sectors is one of the main challenges of this century and the main characteristics and economic and social impact of transition will differ profoundly depending on sectors, activities, and regions. Nevertheless, despite the differences, there is no denying that sectoral restructuring and transformation will impact jobs substantially in a quantitative as well as a qualitative way. The European Commission estimates that the net impact on employment and the European economy will be positive, but the absence of measures could lead to big economic losses in some activities and territories and have critical social impacts throughout the transition that will deeply impact industrial European pillars such as the automotive and energy-intensive sectors.

Against this background, the gas industry will be deeply concerned by the transition and will have an important role to play in it.

Given the challenges and the level of information available, the aim of this intermediate report is to give a broad approach of the context in which workers and their current employers will have to transition and therefore to provide a global overview of the gas as is nowadays and by 2030 taking into account the industrial, regulatory, environmental and technological developments to come but also the main foreseen changes in terms of consumption, production and storage.

As for impacts on employment and skills, at this early stage of the research and given the difficulties in gathering complete and reliable information, this intermediate report aims at presenting some of the already identified good practices either at national or company level so that they could be used as a first basis for discussion with all gas stakeholders during the planned mid-term workshop.

These limitations having been highlighted, the present research aims at presenting a first overview of the current and potential gas sector in Europe (EU 27 + Norway and the UK) from an industrial and technological point of view and at identifying some of the foreseen issues in terms of employment, job profiles and skills. This report should be seen as a first basis for discussion, and it must be “feed up” by experiences and demands coming from gas stakeholders.

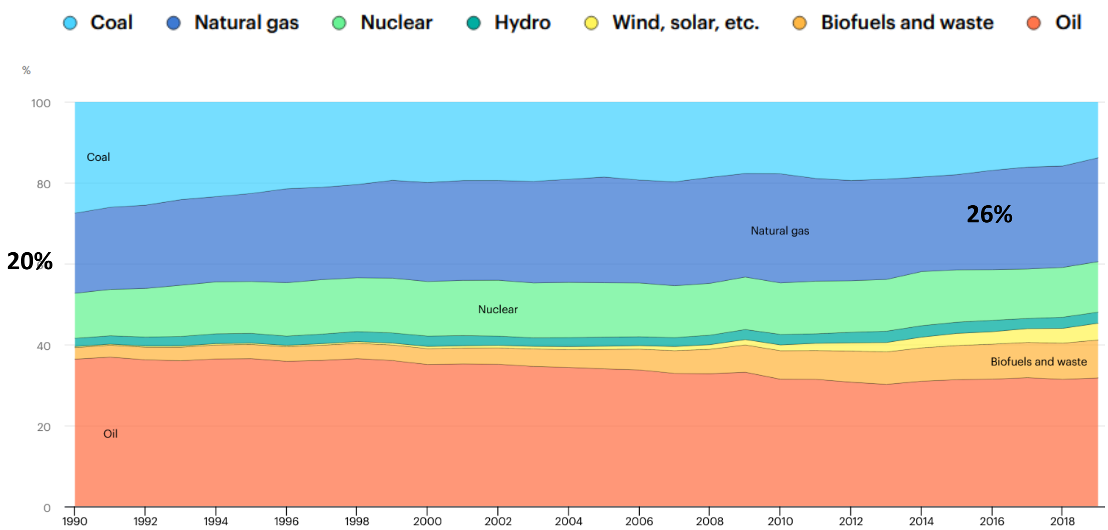
#2
A GLOBAL OVERVIEW OF THE GAS SECTOR

>>1 GAS ROLE WITHIN THE EUROPEAN ENERGY MIX

According to the International Energy Agency's (IEA) latest data[1], Europe[2]'s final consumption of energy amounted to 1354 million tonnes of oil equivalent (Mtoe[3]) in 2020, corresponding to 14% of the World energy consumption. So as to ensure its consumption, Europe has to supply an even larger amount of energy (1851 Mtoe[4]) as part of it is lost in the production and distribution process. As a whole, the continent mostly relies on fossil fuels[5] (71%) : oil (32%), natural gas (26%) and coal (14%). Other energy sources include : nuclear (12%), biofuels and waste (9%), hydro (3%), wind, solar and others (4%).

Over time, the gas sector has played a growing role in securing Europe's energy mix as its share in the continent's energy supply went up from a fifth to a quarter between 1990 and 2020. In the European Union (EU), most gas supplied is natural gas (95% of total[6]) which represents 20% of EU's electricity production and 39% of its heat production[7]. To secure natural gas supply, Europe relies on foreign gas producers as net imports represented 63% of its natural gas consumption in 2019 according to Cedigaz data[8] (80% for the EU). Within the geographical scope of the study (EU members, United Kingdom and Norway), natural gas represents more than 10% of energy supply for 23 countries out of 29. Details are provided in the following graphs[9].

Europe Energy supply (%)



[1] See IEA's 2021 Energy outlook, table A.22 : total final consumption.

[2] IEA's definition of Europe includes the European Union, Norway, the United Kingdom and 14 other European countries such as Turkey and Israel.

[3] This equals 56,7 exajoule (1 EJ = 10^{18} joule).

[4] This equals 77.5 exajoule.

[5] Data are for 2019 ;

[6] The remaining 5% are manufactured gases (produced from other fossile fuels sources) or renewables gases (biogas, biomethane, green hydrogen…).

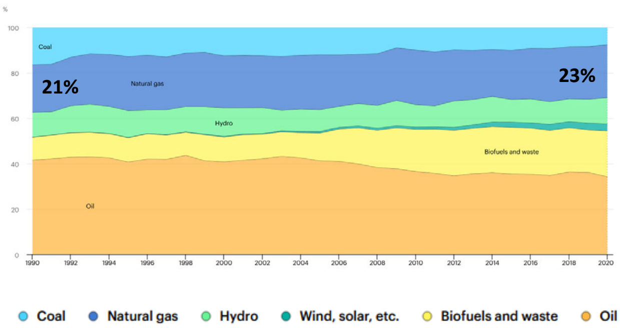
[7] European Commission (2021, December). *Questions and answers on the hydrogen and decarbonised gas package.*

[8] See Cedigaz, *The global gas market edition 2020.*

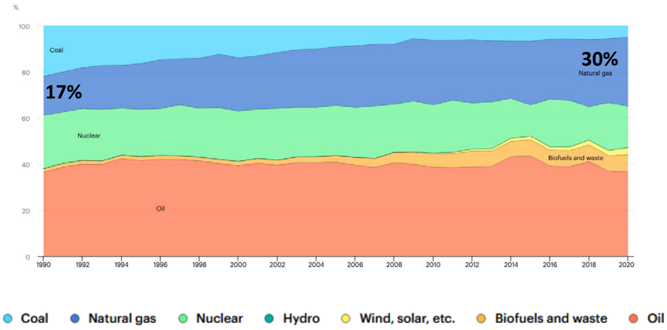
[9] Graphs are extracted from the IEA website and complemented using IEA's data.

European Union

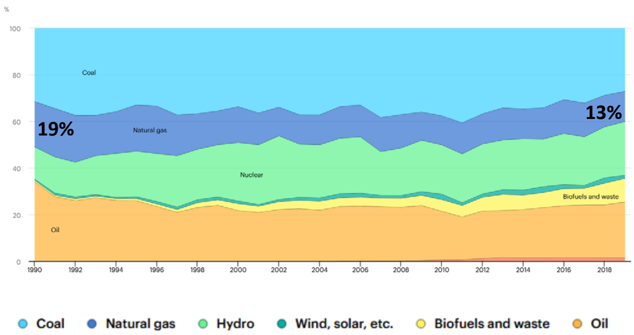
Austria



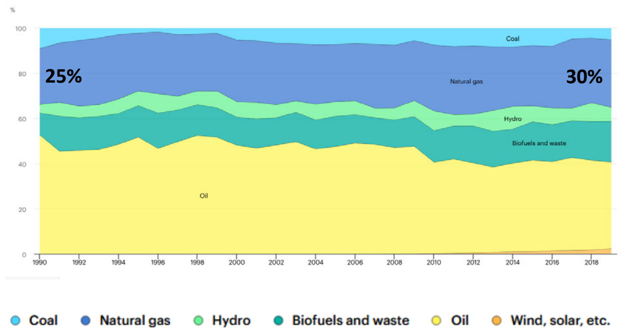
Belgium



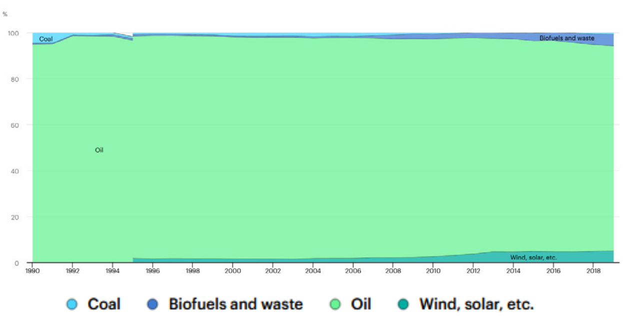
Bulgaria



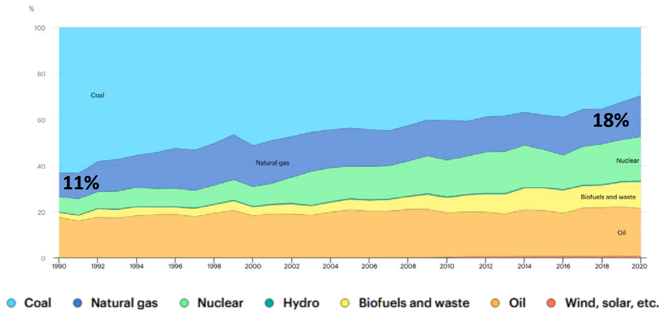
Croatia



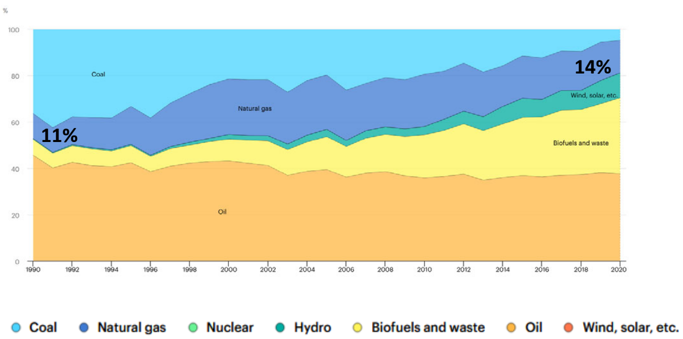
Cyprus – *0% of Natural Gas*



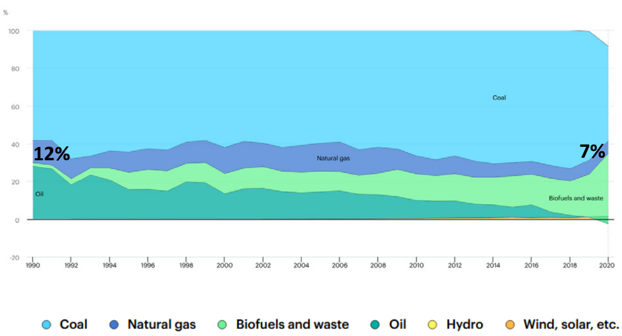
Czech Republic



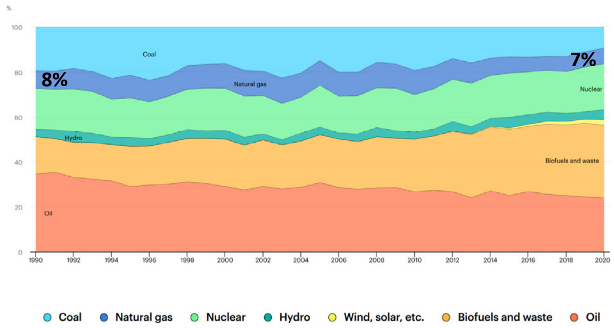
Denmark



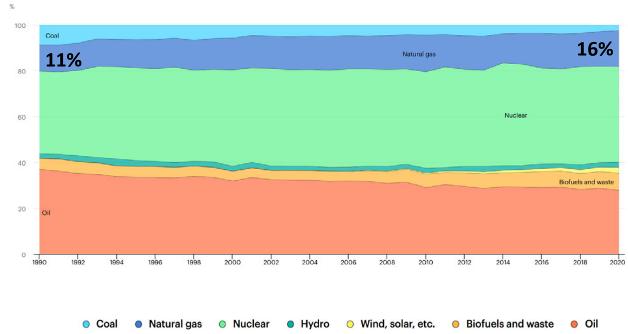
Estonia



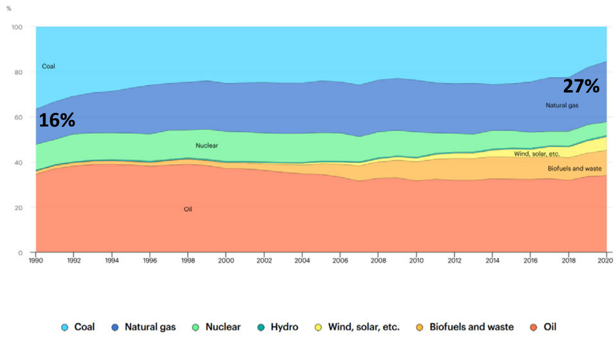
Finland



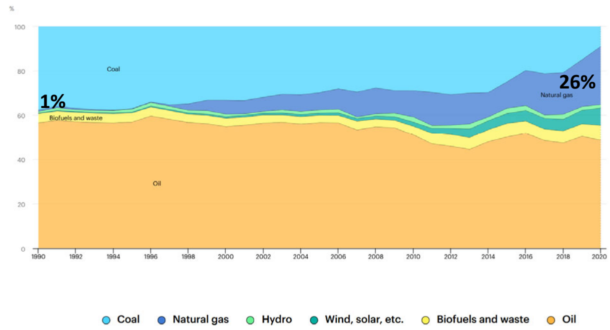
France



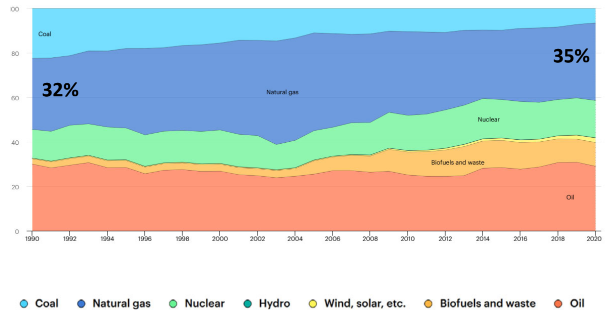
Germany



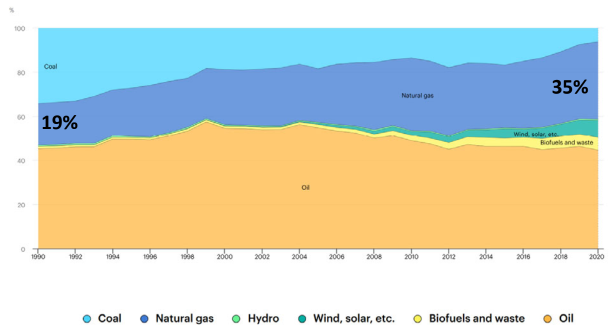
Greece



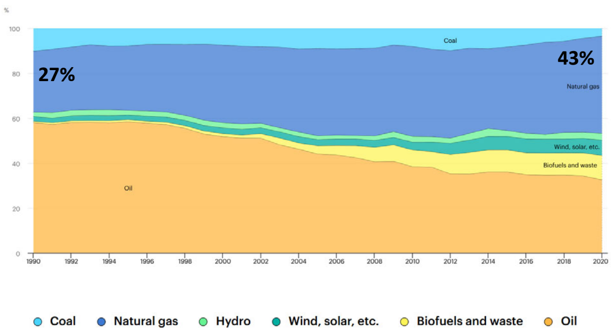
Hungary



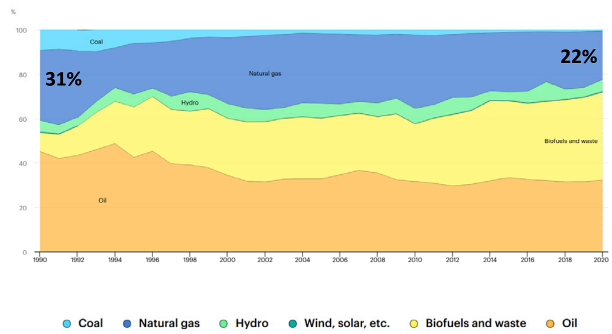
Ireland



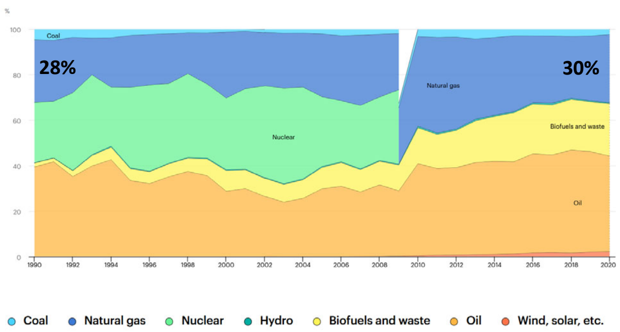
Italy



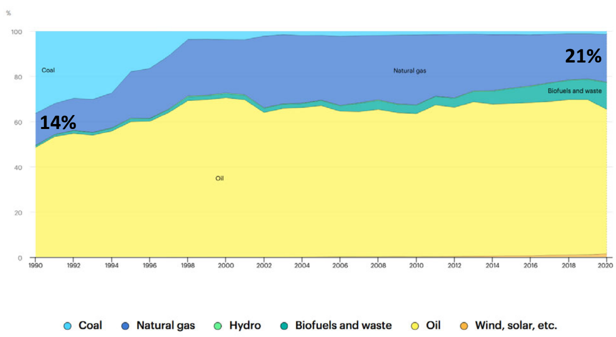
Latvia



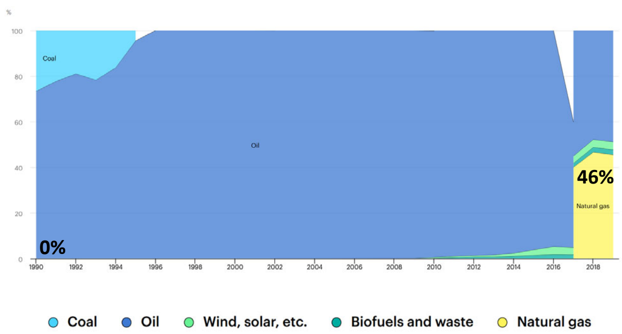
Lithuania



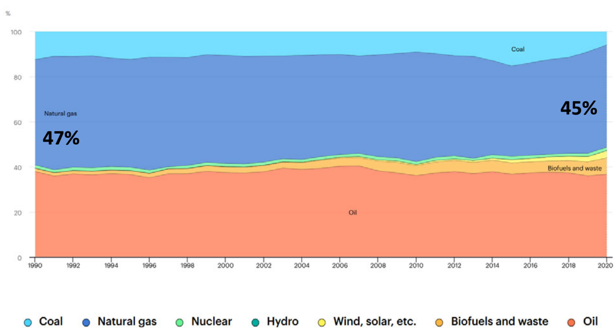
Luxembourg



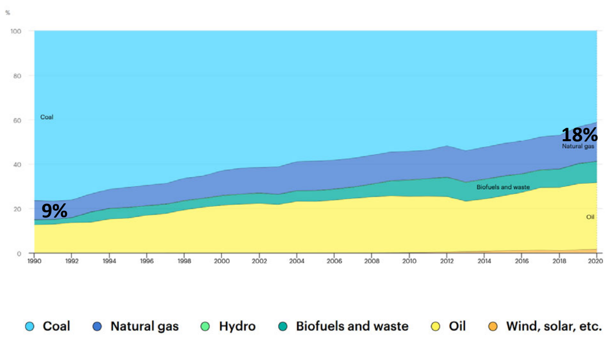
Malta



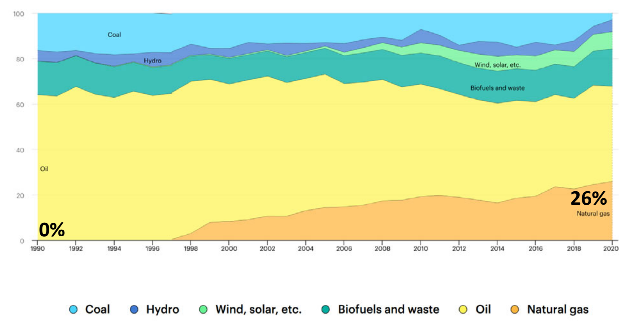
Netherlands



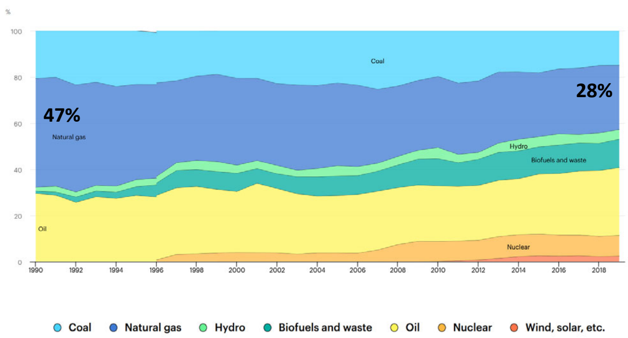
Poland



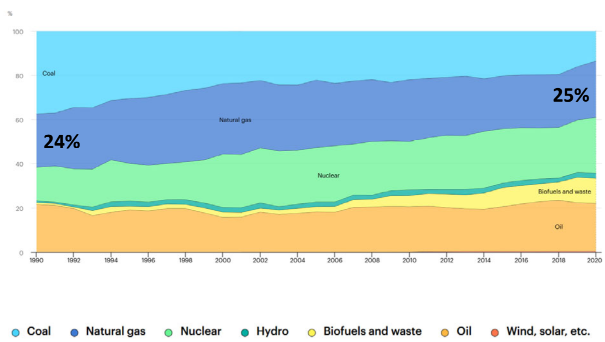
Portugal



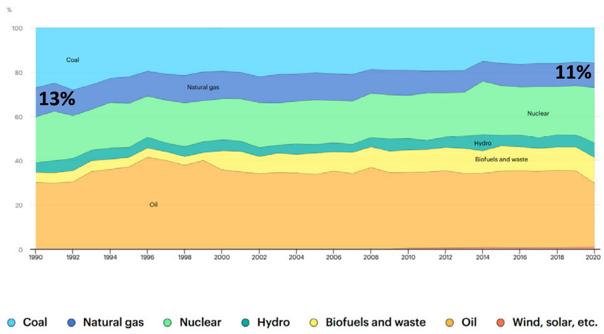
Romania



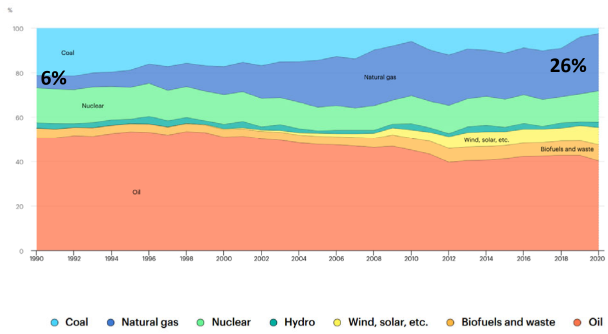
Slovak Republic



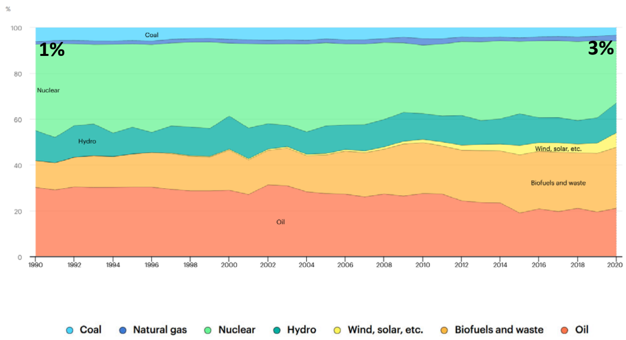
Slovenia



Spain

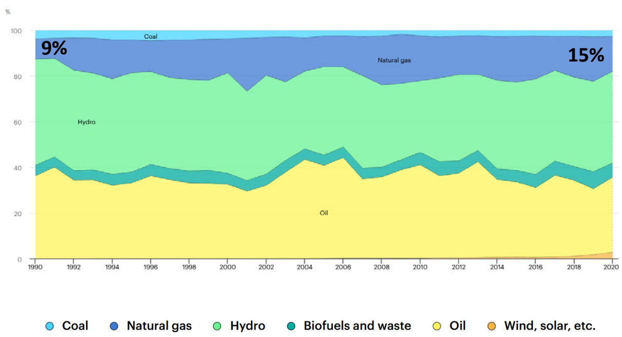


Sweden

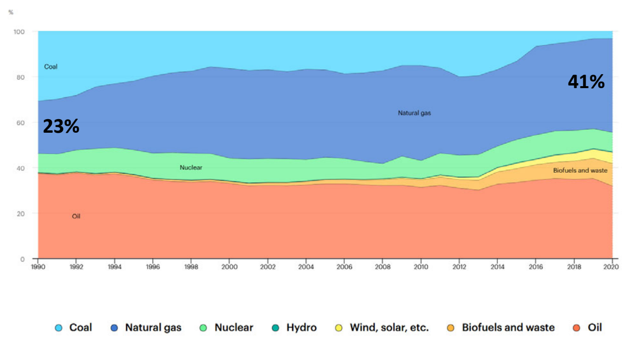


Other European country in the scope of the study

Norway



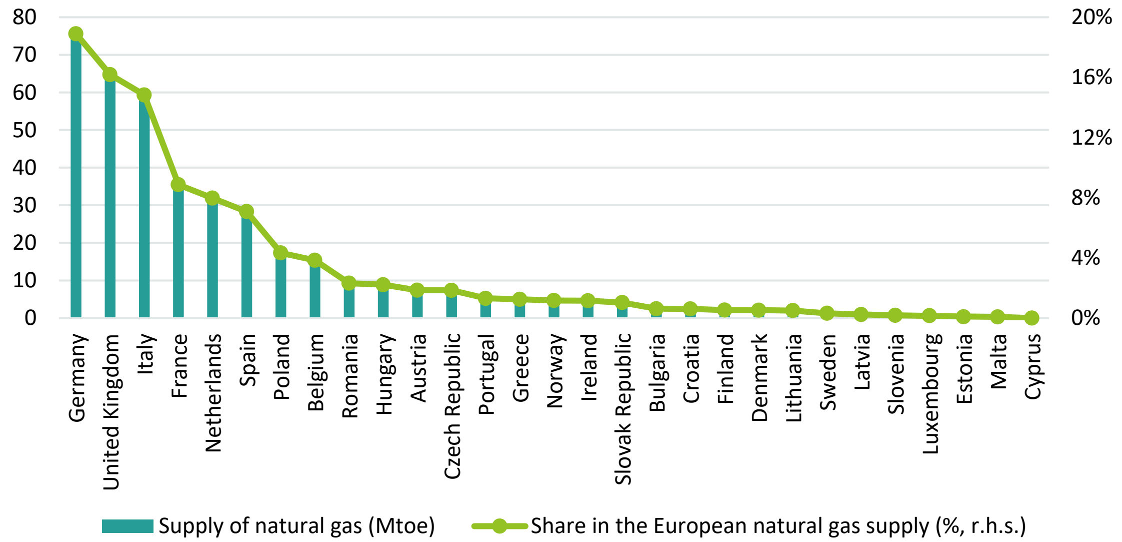
United Kingdom



>>2 GAS SUPPLY ACROSS EUROPEAN COUNTRIES

If gas plays a key role in the energy mix of most European countries, a comparative analysis highlights that only a few countries accounts for most of the gas supplied in Europe. Focusing on natural gas, IEA's data shows that the top three European suppliers - *Germany, United Kingdom and Italy* – represent half of the continent supply[10], the top six – *adding France, the Netherlands, Spain* – about three quarters, and the top nine – *including Poland, Belgium, Romania* – about 85 %. The individual share of the other remaining countries (20 out of the 29) is close to or less than 2 %.

Supply of natural gas in Europe



Source: IEA (data for the year 2020), Syndex

Whether European countries are major gas suppliers or not, almost all of them heavily rely on imports to supply gas (see graph below) :

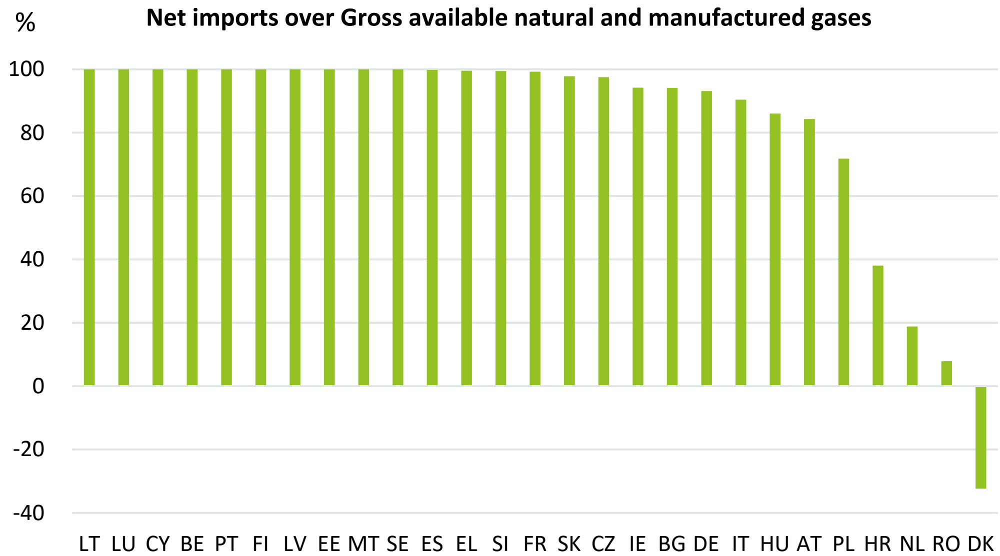
- At the European Union level, net imports account for more than 90% of available natural and manufactured gases for 20 countries out of 27, according to European Commission's data11. Among top suppliers, the Netherlands and Romania are the least dependent countries on imports (producing more than 80% of their domestic available gas energy). Within the EU, Danemark is the only net gas exporter.
- Outside of the European Union, the United Kingdom and Norway have two different profiles. According to Cedigaz's data[12], the United Kingdom imports more than half of its actual consumption, while

[10] Europe refers to the European countries in the scope of the study : EU, United Kingdom and Norway.

[11] These are historical data used by the Commission to assess the impact of the energy transition (see chapter 4).

[12] See Cedigaz, *The global gas market edition 2020.*

Norway is the top European net exports and top three in the world : it exports almost all of its production abroad (98%).



Source: European Commission's historical data used to calculate energy transition scenarios; Syndex calculation

>>3 FROM GAS SUPPLY TO CONSUMPTION: A GLIMPSE OF THE EUROPEAN VALUE CHAIN

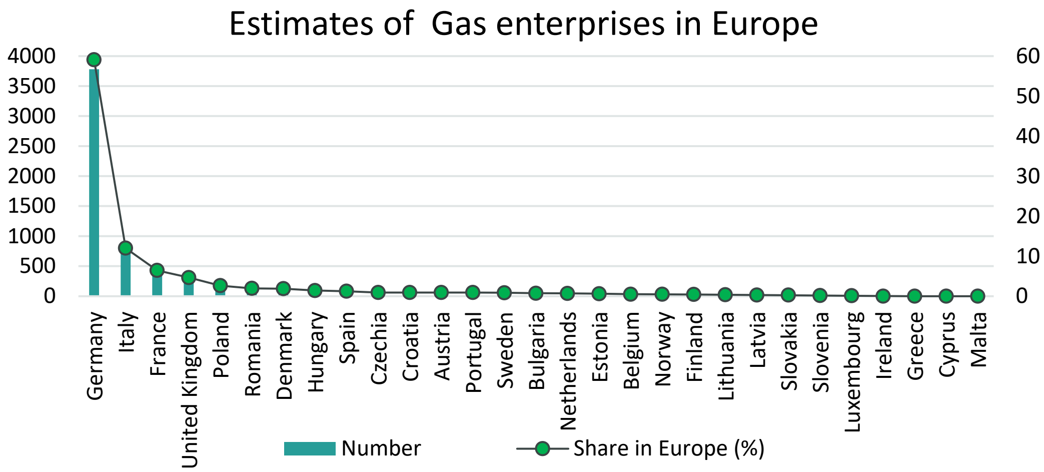
Whether gas is extracted or imported, production, transmission and trading activities are put in place by European gas market playersso as to ensure final consumption. These various economic activities leading from supply to consumption constitutes the gas value chain. Their segmentation and denomination can differ from a study to another and therefore encompass a number of enterprises that can widely vary. At the European level, Eurostat appears to be the only data provider giving estimates of gas enterprises according to the chain value.

According to the European institutes' gas sector data[13], 6000 gas enterprises in the geographical perimeter of this study are currently operating in "extraction of natural gas", "manufacture of gas", "distribution of gaseous fuels through mains", "trade of gas through mains". Half of them operates in the main three countries suppliers of natural gas, 67% in the top six and 77% in the top nine.

However, these estimates should be interpretated with extreme cautiousness as these statistics suffer from major shortcomings related to availability of data as pointed out by Eurostat: confidentiality issues, break in time series, low reliability, definition differs, etc. To provide an example of the uncertainty underlying these data, the total of European gas companies doubled in 2018 to reach 6000 due to an estimate of German gas manufacturers (more than 3000) which became available.

[13] See « Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E) »

On the contrary, data for such activity remain unavailable for some countries such as the Netherlands which is the fifth main natural gas suppliers.". Therefore, it is not possible to exclude that these estimates may not encompass all enterprises from extraction to trading.



Source: Eurostat's estimates - Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E)

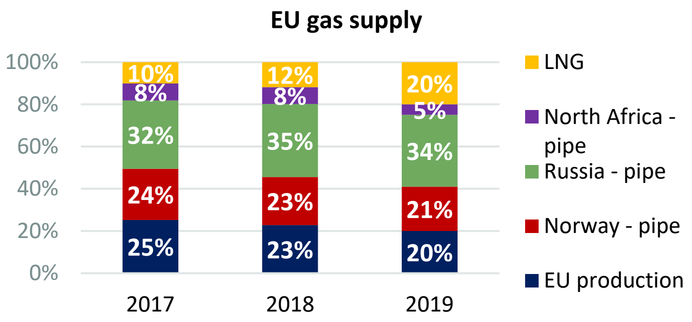
Historically, two types of transportation activities in between gas extraction & production and gas trading have played a key in the gas sector value chain :

- Transmission through pipelines managed by the "transmission system operators". Also known as TSO, these enterprises make sure to connect extraction and production facilities to major customers (private or public companies) or to the distribution network.
- Distribution through mains organized and maintained by the "distribution system operators". Also known as DSO, these enterprises essentially ensure connections from gas pipelines to smaller customers (private or public companies or residential clients).

The rapid development of liquified natural gas (LNG) has brought an alternative to traditional transportation systems and gas providers : from 2017 to 2019, LNG has increased from 10% to 20% of EU gas supply[14], notably compensating for the decrease of EU production (see graph below). However, LNG is largely regasified before use and therefore also rely on current gas infrastructures to reach final customers[15]. Whether gas is liquified or not, various storage facilities enable to smoothen gas supply throughout the transmission and distribution processes.

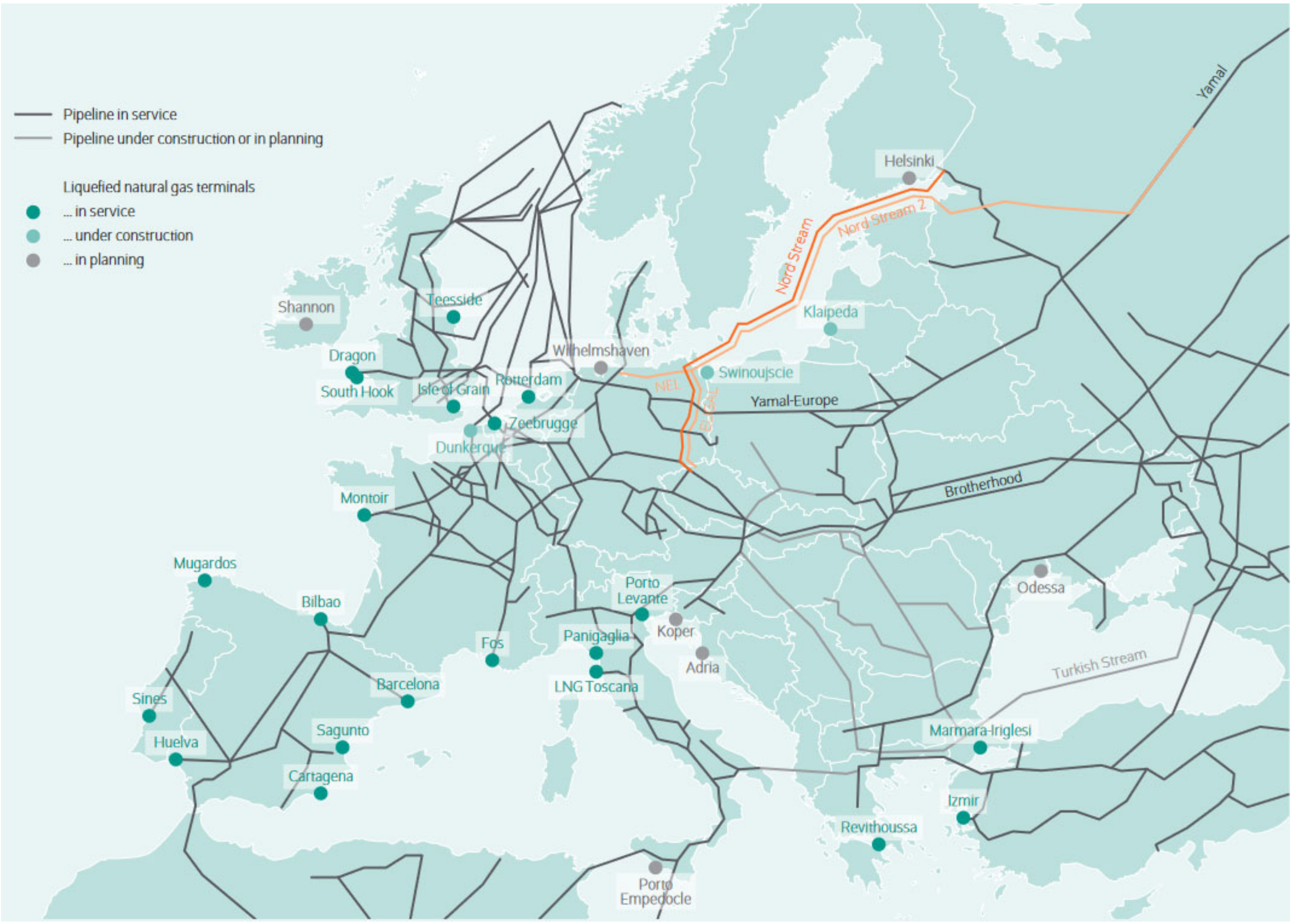
[14] See Cedigaz, *The global gas market edition 2020.*

[15] https://www.naturalgasworld.com/pipeline-gas-versus-lng-increasing-competition-in-europe-and-asia-ggp-73560



Source: CEDIGAZ

The German Institute for Economic Research (DIW)'s map herebelow provide a glimpse of the complexity of the European gas market functioning.



Source : DIW Weekly Report 2018, ENTSOG

#3
EUROPEAN MAJOR COMPANIES ACCORDING TO THE VALUE CHAIN

>>1 IDENTIFICATION PROCESS

European gas companies have extremely various profiles depending on their field(s) of expertise, economic interests, national legislation(s) they have to abide to, etc. As such, they can operate in one or more segments of the value chain, evolve in one or many countries and be confronted with more or less competitive environment. The transmission system operators (TSO) are the most specialized companies as they are usually focus on gas transmission and on a given national, regional or local territory. On the contrary, companies intervening in extraction & production, distribution and trading are more often involved in several countries and facing competition. Extraction & production enterprises usually focus on this segment of the gas chain value while the frontier between distribution and trading appears less pronounced with more companies intervening in these two economic activities.

In order to identify major European gas players in the value chain, we have focused our analysis on the economic activity mentioned in the previous chapter – Extraction & Production, Transmission, Storage, Distribution and Trading – among the major European gas supplying countries – Germany, United Kingdom, Italy, France, the Netherlands, Spain, Poland, Belgium and Romania –. We also included Norway as it is the first gas producer in Europe and third worldwide.

In these countries, the identification process has been more or less challenging depending on data availability, markets' competitiveness, involvement of companies in diverse economic activities (e.g. Oil & gas) and companies' structure (whether a company is a subsidiary or not). Therefore, we have relied on a set of information from main European and national gas representative bodies, regulators, as well as key sectoral publications and companies' websites, such as :

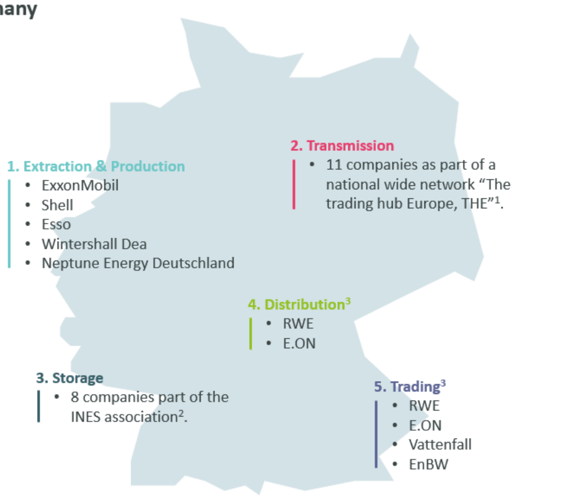
- Cedigaz
- CRE – French Energy Regulatory Commission
- Entsog – European Network of Transmission System Operators
- Eurogas
- GasNaturally
- GD4S – Gas Distributors for Sustainability
- GERG – The European Gas Research Group
- GIE – Gas Infrastructure Europe
- INES – Association of German gas and hydrogen storage system operators
- Marcogaz – Technical Association of the European Gas Industry
- NGVA Europe – The Natural & Bio Gas Vehicle Association
- THE – The trading hub Europe

Collecting these data, we present, thereafter, our mapping of major European gas companies according to the value chain for the ten identified countries, as well as a map of major transmission system operators for all European countries under the scope of this study.

>>2 TABLE OF MAIN EMPLOYERS ACCORDING TO THE VALUE CHAIN

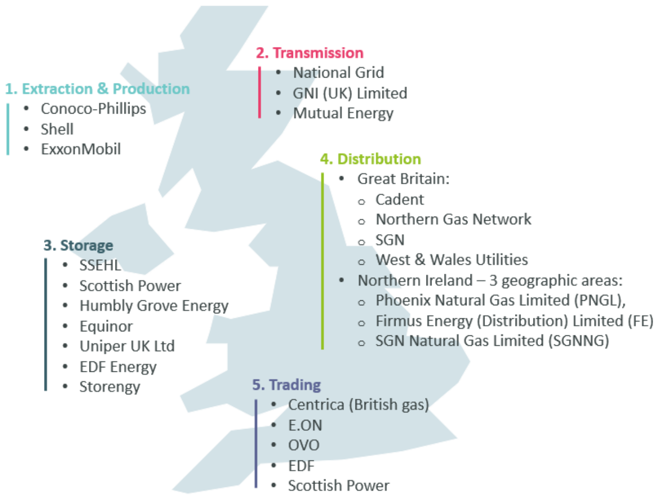
2.1. IDENTIFICATION OF MAJOR EUROPEAN COMPANIES AMONG TOP 3 GAS SUPPLIERS

Germany

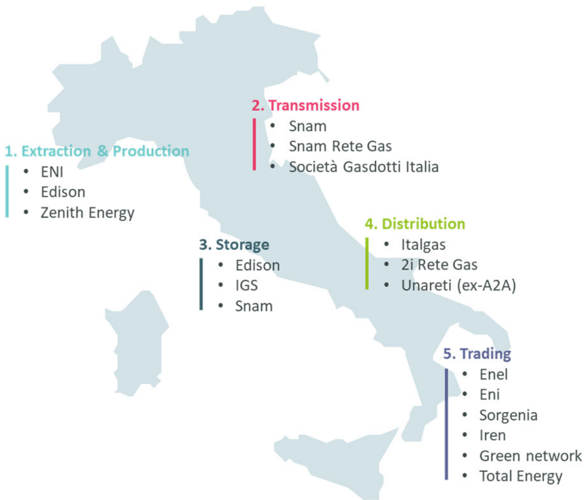


1. bayernets GmbH, Fluxys TENP GmbH, Gascade Gastransport GmbH, Gastransport Nord GmbH (GTG Nord), Gasunie Deutschland Transport Services GmbH, GRTgaz Deutschland GmbH, Nowega GmbH, Ontras Gastransport GmbH, Open Grid Europe GmbH (OGE), terranets bw GmbH, Thyssengas GmbH.
2. INES is the association of German gas and hydrogen storage system operators: Storengy Deutschland GmbH, VNG Gasspeicher, Bayernugs, Astora, Enovos, Nafta Speicher, EKB Storage, Uniper.

United Kingdom



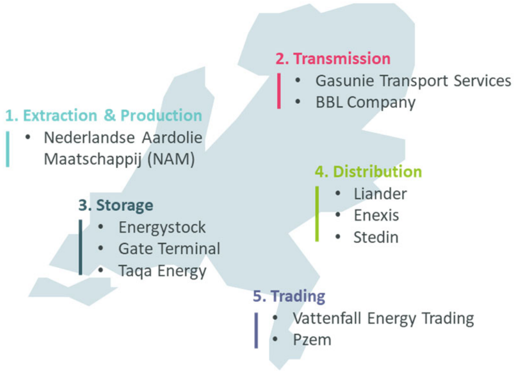
Italy



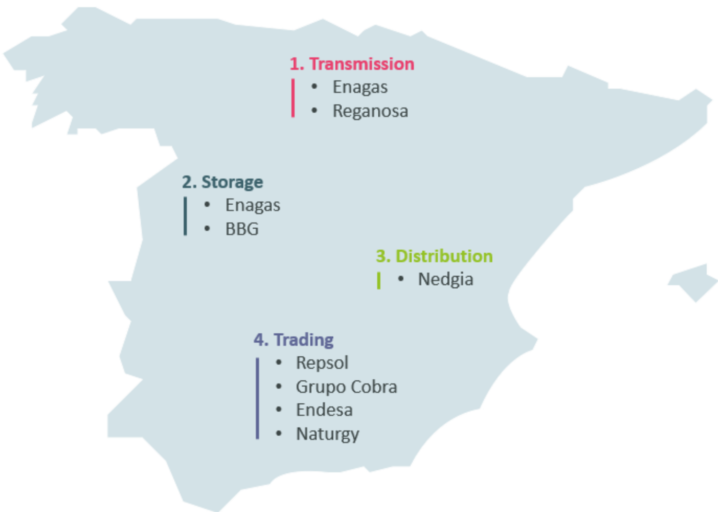
2.2. IDENTIFICATION OF MAJOR EUROPEAN COMPANIES AMONG TOP 6 GAS SUPPLIERS

France

Netherlands

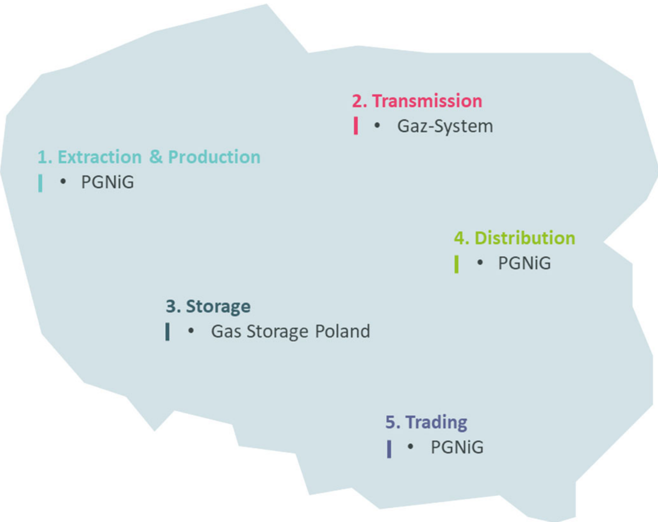


Spain

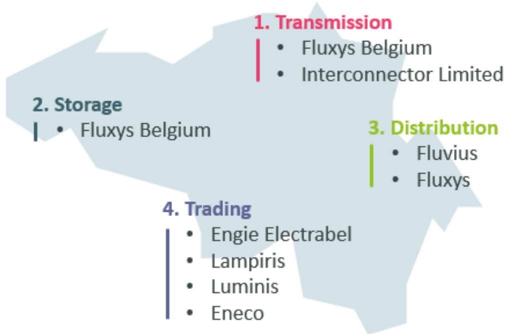


2.3. IDENTIFICATION OF MAJOR EUROPEAN COMPANIES AMONG TOP 9 GAS SUPPLIERS

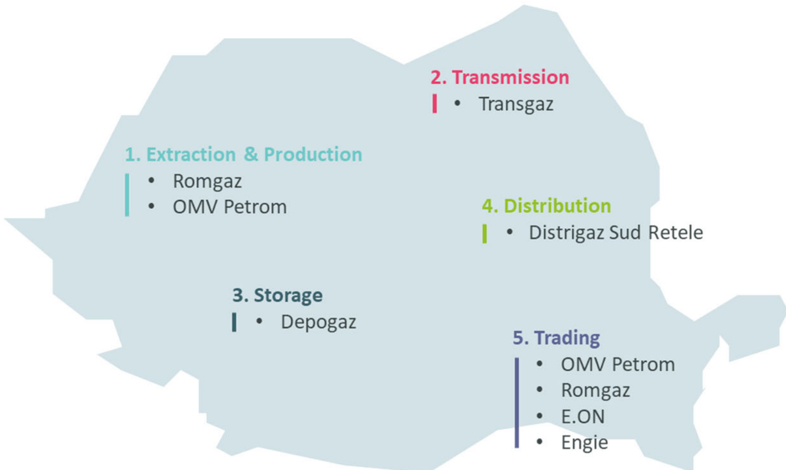
Poland



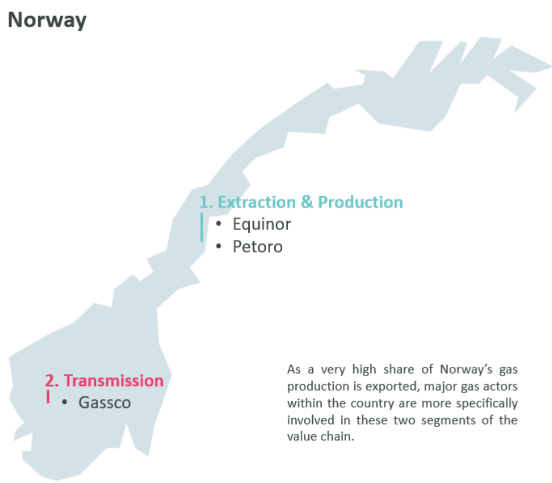
Belgium



Romania



2.4. IDENTIFICATION OF MAJOR EUROPEAN COMPANIES IN NORWAY



2.5. IDENTIFICATION OF MAJOR EUROPEAN TSO

#4
ANALYSIS OF INDUSTRIAL, REGULATORY, ENVIRONMENTAL AND TECHNOLOGICAL DEVELOPMENTS

The European Union set itself the goal of climate neutrality by 2050, which became a legally binding target through the European Climate Act. For the EU to achieve a 55% reduction in greenhouse gas emissions by 2030 and zero net emissions by 2050, a zero-emission energy system is required.

This chapter analyses the decarbonization process in the gas sector as one of the key elements for the European energy transition, from the perspective of how this process will entail a structural change in the sector at industrial, regulatory, environmental, and technological levels. To this end, it presents the most relevant aspects of natural gas, its role as a vector of transition towards decarbonization and, of course, explains the pathways for the decarbonization of the gas sector that are currently being analysed. Then, the regulatory position of the EU regarding the decarbonization of this sector is shown, also providing a critical view, and finally, a summary of how the configuration of the sector may be transformed by according to the elements presented.

>>1 EUROPEAN ENERGY TRANSITION AND NATURAL GAS

1.1. EUROPEAN ENERGY TRANSITION

The energy transition forms one of the basic pillars of the European Union's path towards a climate-neutral future by 2050. To achieve its goal, a number of regional, national, sectoral and corporate strategies and plans have been developed. But when it comes to energy transition, most of them share three key elements:

- Improving energy efficiency and energy savings.
- Reducing greenhouse gas emissions from energy generation.
- Deploying low-emission alternative options in the end-use sectors.

All this without neglecting three fundamental and interdependent values:

- Economic growth: developing countries will not be part of an energy transition that is not in line with their national development goals, including poverty reduction; and similarly, developed countries, while being aware of the investments that will be required, will also use the energy transition, along with decarbonisation and digitalisation, to foster economic and social growth in their economies.
- Energy access: to be in line with the sustainable development goals of the UN's 2030 Agenda, the European economy and energy demand must grow substantially.
- Environmental conservation: the European and global economy is built on a carbon-based energy system that has been the basis for modern industrial development, but for some years now there has been an emphasis on the need to reduce emissions to tackle climate change and other environmental problems.

Against this background, the gas industry will not be just another element in the process but is seen as a key sector in achieving such a transition, both from an economic point of view and as one of the lowest possible emission routes[16].

[16] The Oxford Institute for Energy Studies (2020, March). *Decarbonization pathways for oil and gas.*

1.2. NATURAL GAS IN THE CONTEXT OF THE ENERGY TRANSITION

Currently, around 300 Mtoe of gaseous fuels are consumed annually in the European Union, of which 95% is natural gas. This represents approximately 25% of total EU energy consumption, being used for 20% of EU electricity production and 39% of heat production.[17]

Natural gas is the lowest CO2 producing combustion hydrocarbon compared to coal and oil. Generating electricity with natural gas produces less than half the greenhouse gas emissions of coal, and up to a third less than oil[18]. In this way, relative to coal and oil, natural gas offers industry large emission reductions and can also provide significant savings when manufacturers switch from oil to liquefied natural gas (LNG), due to its cost advantage over oil. For example, in industrial boilers, natural gas provides a 20-25% CO2 advantage over oil or coal, and a combined heat and power application fuelled by natural gas could cut emissions by half. In addition, for road transport, natural gas provides a large GHG advantage (22.5%) relative to petrol for passenger vehicles, and 7% compared to diesel[3].

Another positive aspect of natural gas is its storage and transport capacity. Natural gas can be transported by pipeline or - in the case of LNG - by ship. In addition, natural gas is quite flexible, allowing, for example, gas-fired power plants to be switched on and off, providing an efficient response to fluctuations in demand.

However, it is not all positive. Methane emissions occur during the natural gas value chain (extraction, production, transport, and distribution) and influence the total carbon footprint of natural gas, as methane is the second most important greenhouse gas after CO2. Although methane has a shorter lifetime (12.4 years compared to centuries for CO2)[3], its effect is stronger in the short term.

The COP-21 climate agreement in Paris[19] marked the beginning of the end of coal in Europe and the EU's decarbonisation process is involving clear measures to drive coal out of the energy mix by 2030-2050. Consequently, this raises the question of what will happen to natural gas during this decarbonisation process.

In the long-term scenario of zero net emissions by 2050, gas generation continues to grow in the short term, but is expected to start falling in 2030[20]. Natural gas is more resilient to the decarbonisation process than coal, in fact, its use in the coming years is expected to continue to grow strongly in all 2050 net emissions scenarios, precisely because of its use as a substitute for coal. Increasingly, however, existing gas-fired power plants will need to be retrofitted with CCUS technologies or co-firing with low-carbon fuels such as hydrogen to be consistent with the levels of the 2050 net zero emissions scenario.

Thus, it is estimated that gas will account for 17% of total electricity generation (and not 25% as today), as the share of renewables is expected to increase by more than 60%. And by 2050, the share of unabated natural gas is estimated to fall to 0,4%[4]. This is also because natural gas will be displaced by its decarbonised options (biogas, biomethane, blue hydrogen and green hydrogen, natural gas with CCUS and synthetic fuels).

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[17] European Commission (2021, December)e. *Questions and answers on the hydrogen and decarbonised gas package.*

[18] International Gas Union (2022). *Natural Gas Advantage: Facts & Figures. Sustainability.* https://www.igu.org/facts-figures/#sustainability

[19] United Nations (2015). Paris Agreement.

[20] European Union Agency for the Cooperation of Energy Regulators (2021, 20th December). *ACER and CEER welcome the new gas decarbonisation legislative proposals with some recommendations*. https://www.acer.europa.eu/events-and-engagement/news/acer-and-ceer-welcome-new-gas-decarbonisation-legislative-proposals-some

>>2 THE ROLE OF NATURAL GAS AS A TRANSITION VECTOR TOWARDS FULL DECARBONISATION

Some resources, such as hydrogen, are at the epicentre of discussions on how to revolutionise the energy system to achieve the 2030 and 2050 climate targets. However, adequate facilities for their production, transport, storage, and use are not yet in place; and the share of this gas in Europe's energy mix in the short and medium-term is expected to be negligible. Therefore, the urge to reduce emissions by 2030 makes it necessary to maximise the use of the technologies available for this process, while new technologies are not yet fully developed. Therefore, it is estimated that demand for natural gas will continue to grow until the 2030s, because the short and medium-term benefits that natural gas can bring to the decarbonisation process are recognised.

The role of natural gas as a transition fuel is crucial, especially for coal-intensive regions (such as in Czech Republic, Poland and Germany). Gas could provide a currently affordable and technologically available alternative, which can reduce greenhouse gas emissions while paving the way towards more ambitious targets. One can think that a successful green transition requires effective use of the competitive advantage that natural gas provides as a fully available resource.

One of the most relevant aspects of natural gas as a transition vector is the potential reusability of its infrastructures:

- Pipelines and gas storage infrastructure can blend green gases to reduce the carbon footprint while in the long term the intention is that they can be reused for transporting hydrogen[21] and other renewable gases.
- Gas-fired power plants could be converted to run on hydrogen and other renewable gases, or CCUS technology could be applied in them.
- Liquefaction plants could also be converted to liquefy hydrogen, which would be less expensive than building a hydrogen plant from scratch.
- Industrial and domestic gas-fired boilers could be adapted to hydrogen.
- LNG-fuelled engines for shipping could be converted to run on ammonia at a later date.

In this way, the gas sector could, through this reuse, promote the development of the circular economy, avoiding new infrastructure production, helping to reduce emissions, and also the capital cost of new investments.

In addition, natural gas allows for its combination with renewable energies. From an investment perspective, this minimises risk, maximises and guarantees energy security, and facilitates access and supply confidence for consumers. According to the International Gas Union[22], the risk profiles of renewable energy and natural gas generation technologies are virtually opposite, making these two types of energy sources a combination to consider.

[21] At present, only a 10% hydrogen mixture is possible.

[22] International Gas Union (2022). *Natural Gas Advantage: Facts & Figures. Sustainability.* https://www.igu.org/facts-figures/#sustainability

>>3 DECARBONISATION PATHWAYS FOR THE GAS SECTOR

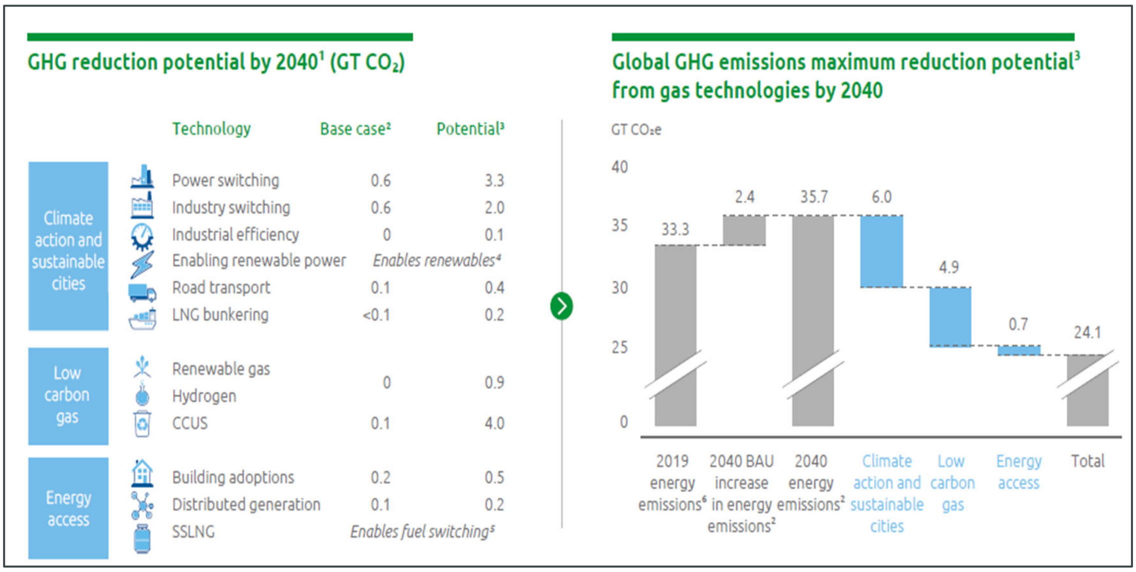
Decarbonisation is inevitable even for the gas sector, given the 2050 climate neutrality targets. And as for all other sectors, decarbonisation poses numerous challenges: ensuring a level playing field for all available technology options and pathways; providing support for innovation through appropriate regulation; monitoring, reporting and verifying emissions throughout the sector's value chain; properly defining "green gases"; ensuring fair competition and market integration; not neglecting just transition for workers, etc.

Decarbonisation of the gas sector can be achieved through different ways and means to avoid, eradicate, or mitigate greenhouse gas emissions associated with the life cycle of natural gas.

Low carbon gas technologies such as renewable gases (biogas and biomethane), hydrogen utilisation and CCUS technology are the pathways currently being explored and developed in the gas sector. However, they do not all offer the same characteristics and do not all have the same technological, economic and/or social value conflict barriers to becoming feasible technologies.

Taken together, technologies and innovation in the gas sector would have the potential to reduce, according to estimates by the International Gas Union[23], up to one third of emissions from the power sector by 2040.

GHG reduction potential from gas technologies by 2040.



Notes: 1. Estimates on the basis of gas demand growth multiplied by the average emissions benefit of switching from coal and or oil to natural gas or low carbon gas; 2. Base case is aligned with IEA 2019 Stated Policies Scenario; 3. Potential is based on the economic potential as defined in Chapter 1; 4. Emissions benefit achieved from the adoption of renewable power were not evaluated, as part of this analysis; 5. Emissions benefit accounted for in other categories; 6. Based on IEA data.
Source: International Gas Union (2020, July).

[23] International Gas Union (2020, July). *Gas technology and innovation for a sustainable future.*

3.1. RENEWABLE GASES (BIOGAS AND BIOMETHANE)

Renewable gases show a significant range of potential net emission reductions relative to natural gas combustion. Best practice could reduce emissions by up to more than 80%, and can even provide a net negative balance, as they capture and use methane that would otherwise have been released into the atmosphere.

These gases have different functions in a decarbonised energy system, providing:

- Storable renewable energy.
- Heat to buildings that already have connections to the gas grid.
- High-temperature heat and feedstock in energy-intensive heavy industry.
- Energy-dense fuel for heavy and long-distance road and maritime transport.
- Feedstock for synthetic paraffin for aviation.
- Cross-sectoral benefits in terms of waste management, promotion of biodiversity and negative emissions.

One of the most positive aspects of renewable gases is that they can be introduced into the existing gas grid, without additional investments or changes to end-use appliances.

Despite all these advantages, the total global production of biogas and biomethane represents only 1% of the world's natural gas production. More than 50% is concentrated in some European countries, and 25% in China[24].

Biogas is a mixture of gases, predominantly methane and carbon dioxide, produced by the anaerobic digestion of biomass[25]. It is mainly produced by anaerobic digestion - the biological decomposition of organic matter. International Gas Union[7] estimates that sustainable biogas could increase to about 20 times its level, i.e., to 20% of global natural gas demand. However, this would require an increase in the momentum of projects that could boost demand.

Biomethane is an upgrading of biogas (by absorption, adsorption, methane filtration or cryogenic separation) that consists of removing CO2 and other impurities, leaving approximately 50% raw biogas, so that they have a quality comparable to that of natural gas[26]. Currently, biogas plants in Europe are mostly used to produce electricity and heat, and only a small part of them are used to produce biomethane for injection into gas grids. Although Europe has been a leader in this field, the total injection of biomethane into the gas grid is less than 1% of the current demand for natural gas in Europe. The most optimistic forecast envisages the possibility of obtaining 98 billion cubic meters of biomethane from biomass sources in 2050[27]. But for this to happen - and despite being the cheapest decarbonised gas option - its production costs must be reduced (€50-100/MWh, compared to €15/MWh for conventional natural gas)[28], which depend on the scale of

[24] International Gas Union (2021). *Global renewable and low-carbon gas report.*

[25] Typically, agricultural waste, manure, sewage and municipal waste.

[26] It can also be made from woody biomass through a gasification process, but this is a less common method.

[27] TIMERA ENERGY (2019, 20th May). *Decarbonising European gas: risks & options.* https://timera-energy.com/decarbonising-european-gas-the-risks-options/

[28] The Oxford Institute for Energy Studies (2020, March). *Decarbonization pathways for oil and gas.*

production and the cost of raw materials. To achieve this, some states have already set support policies, for example: France has set a target of 10% of green gases in gas demand by 2030, which has contributed to increasing the number of biomethane production plants from 17 in 2015 to 172 in 2020, rising from a production volume of 83GWh to 120GWh[29]. Other positive aspects of biomethane are that its production consumes waste and generates useful bioproducts and that it does not require significant additional energy for its production.

3.2. HYDROGEN (BLUE WITH CCUS TECHNOLOGY AND GREEN)

Hydrogen can be used as a feedstock and as a fuel. It is a storable gas and has various applications in industry, transport, energy, and construction. Most importantly, hydrogen does not emit CO2 during use. However, the hydrogen currently consumed in the EU is grey hydrogen, which does generate emissions during its production, as it comes from fossil fuels. In this situation, two alternatives are being considered and developed to reduce or eliminate these emissions: blue hydrogen and green hydrogen.

Blue hydrogen can be produced from natural gas, and by adding CCUS technology, the CO2 emitted is captured and stored. In this way, it is a low-carbon gas. The costs of blue hydrogen are between 37 and 41 €/MWh.

The European Union Agency for the Cooperation of Energy Regulators (ACER)[30] projects a generation of 170TWh from gas-fired plants equipped with CCUS technology by 2030. However, of the CCUS gas-fired power plant projects currently under development, most of them exist in the USA and the UK, due to the financial support policies of both countries.

Green hydrogen is receiving special attention in Europe and worldwide in the context of decarbonisation. The European Hydrogen Strategy[31] considers hydrogen essential to the EU's commitment to achieve carbon neutrality by 2030 and defines a target of installing at least 40GW of renewable hydrogen electrolysers by 2030 and producing up to 10 million tonnes[32].

Green hydrogen is produced through the electrolysis of water, using a renewable energy source, and therefore emits no CO2, making it a zero-emission gas. Its costs of producing are between 70-130€/MWh[33].

In relation to infrastructure, as discussed above, the blending of both types of hydrogen with gas is seen as a potential transitional way to utilise existing gas infrastructure. The costs of reusing gas infrastructure to transport hydrogen are estimated at 10-35% of a newly constructed hydrogen infrastructure[16].

European national strategies have in recent years developed a strong interest in green hydrogen and aim to provide support to grow its market. However, the technology has not yet been deployed on a large scale, so while it is in the research and development phase, European strategies recognise the need for blue hydrogen, i.e. natural gas used for hydrogen production together with CCUS technology, which will be instrumental,

[29] Gas for Climate & Guidehouse (2020, April). *Gas decarbonisation pathways 2020-2050.*

[30] European Union Agency for the Cooperation of Energy Regulators (2021, 20th December). *ACER and CEER welcome the new gas decarbonisation legislative proposals with some recommendations.* https://www.acer.europa.eu/events-and-engagement/news/acer-and-ceer-welcome-new-gas-decarbonisation-legislative-proposals-some

[31] European Commission (2021, December)a. A hydrogen strategy for a climate-neutral Europe. COM(2020) 301 final.

[32] This would amount to only about 1% of the total energy consumed in the EU.

[33] Guidehouse & Gas for climate (2021, January). *Setting a binding target for 11% renewable gas.*

also, in helping to increase the overall demand for hydrogen in Europe. This could imply the importance of natural gas as a transition vector, whereby its consumption is expected to increase, at least until 2030.

3.3. OTHER ACTIONS IN FAVOUR OF THE DECARBONISATION PROCESS OF THE GAS SECTOR

Beyond renewable gases, hydrogen and CCUS technology, there are other ways to add value to the decarbonisation process in the gas sector, for example:

- Avoid venting during natural gas exploration and production.
- Prohibit flaring, especially when natural gas is produced as associated gas.
- Avoid fugitive emissions from valves and compressor stations.
- Ensure that combustion is not incomplete.
- Remediation work aimed at eliminating methane emissions from abandoned gas centres.

>>4 THE EUROPEAN UNION'S POSITION ON DECARBONISATION OF THE GAS SECTOR

The European Union has published, especially during the year 2021, a series of very significant regulations for the decarbonisation of the gas sector, with which progress is being made towards compliance with the objectives of the Paris Agreement, the ultimate goal of which is climate neutrality in 2050. However, various organisations relevant to the sector consider that the EU still needs to make a greater effort to achieve these objectives, especially in terms of support and promotion measures, including, of course, the economic and financial support required for an energy transition of this magnitude.

4.1. EUROPEAN LEGISLATION IN RELATION TO THE DECARBONISATION OF THE GAS SECTOR

On 14 October 2020, the European Commissions presented the **EU Strategy to reduce methane emissions**[34], which sets out measures to reduce methane emissions in Europe and internationally. Energy, agriculture and waste, which account for 95% of methane emissions worldwide, are the sectors identified as key sectors in this legislation.

According to EC estimates, in the case of the energy sector, 54% of methane emissions are fugitive from the oil and gas sector[35], and according to its assessments of the plan's impact on climate targets, the EC indicates that the most cost-effective emission savings can be achieved in the energy sector, as oil and gas extraction operations typically have a number of mitigation operations for these methane leaks that have zero or near-

[34] European Commission (2020, October). *EU Stragey to reduce methane emissions*. COM(2020) 663 final.

[35] While 34% are from the coal sector and 11% from the residential and other end sectors.

zero net costs. Therefore, one of the most relevant measures in this regulation is to propose an obligation to improve the detention and repair of methane leaks in gas infrastructure, which can be achieved, for example, by reducing venting and flaring during gas production, transmission, and combustion. Another issue that stands out in this regulation is the importance given to biogas. The EC explains how biogas production effectively contributes to reducing methane emissions from anaerobic decomposition processes in nature and that biogas is a highly sustainable renewable energy source with multiple applications. Broadly speaking, this regulation served as the basis for the subsequent publications concerning the gas sector during 2021.

On 14 July 2021, the **proposal for an amending Directive as regards the promotion of energy from renewable sources and repealing Council Directive (EU) 2015/652**[36] was published with the aim of achieving an increase in the use of energy from renewable sources by 2030, promoting better integration of the energy system and contributing to environmental and climate objectives. This legislation is of relevance for the gas sector, as it establishes accounting rules for greenhouse gas emissions affecting biogas. It also encourages the use of biogas and other renewable gases in sectors such as transport and heating and cooling. For example, one of the rules imposed is that each Member State will impose an obligation on fuel suppliers to ensure, among other things, that the share of advanced biofuels and biogas in the energy supplied to the transport sector is at least 0.2% by 2022, 0.5% by 2025, and 2.2% by 2030.

COP 26 held in November 2021 in Glasgow resulted, among other issued, in the **Global Methane Pledge**[37], which set a target to reduce global methane emissions by at least 30% from 2020 to 2030 levels. Other agreements included, again, the improvement of inventory methodology, promoting greater accuracy, transparency, consistency, comparability, and completeness of national greenhouse gas inventory reports. Again, the great importance of the energy, agriculture and waste sectors was also recognised.

On 15 December 2021, the EC publishes a press release announcing the proposal for a new EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions[38]. The press release states that the EC is adopting on the same day a set of **legislative proposals to decarbonise the EU gas market,** improving access to renewable gases, as well as following up on the international commitment mentioned in the previous paragraph. The proposal is made up of a regulation[39] and a directive[40] which, taken together, set out the following main objectives:

- Establish the necessary conditions to facilitate the rapid and sustained uptake of renewable and low-carbon gases.
- Improve market conditions and increase the participation of gas consumers.
- Better address security of supply concerns.

[36] European Commission (2021, July). *Proposal for an 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 renewable sources, and repealing Council Directive (EU) 2015/652.* COM(2021) 557 final.

[37] Climate & Clean Air Coalition Secretariat (2021). *Global Methane Pledge*. https://www.globalmethanepledge.org/

[38] European Commission (2021, 15th December). *Commission proposes new EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions.* [Press release].

[39] European Commission (2021, December)d. *Proposal for a regulation on the internal markets for renewable and natural gases and for hydrogen (recast).* COM(2021) 804 final.

[40] European Commission (2021, December)c. *Proposal for a directive on common rules for the internal markets in renewable and natural gases and in hydrogen.* COM(2021) 803 final.

- Addressing price and supply concerns within the EU.
- Recalibrate the structure and composition of regulatory bodies.

This publication lays the foundations enabling the market to decarbonise gas consumption and presents a series of policy measures to support the creation of optimal infrastructure and efficient markets. It therefore aims to remove barriers to decarbonisation of the sector and create the conditions for a just and cost-effective transition.

Another long-awaited aspect of this package was incentives for renewable/low carbon gases and/or disincentives for fossil natural gas. Regarding support measures, there is no mandatory off-take for industry and no direct funding mechanism, although renewable and low-carbon hydrogen is granted a 75% discount on entry and exit tariffs. In addition, a Certification Scheme for Low Carbon Gases Will be established. As far as fossil gas is concerned, there are no particular targets or details on its phase-out, but it does set an expiry date for long-term supply contracts: 2049.

In addition, as regards methane, the **first EU legislative proposal on reducing methane emissions in the energy sector**[41] is published, also on 15 December 2021, which will require the oil, gas and coal sectors to monitor, report and verify emissions; and strict rules will be proposed to detect and repair methane leaks and also to limit venting and flaring practices to strictly circumscribed circumstances, as advanced in the EU Strategy to reduce methane emissions of 14 July 2020. Another issue addressed in this legislative proposal is a two-step approach to energy imports: first, fossil fuel importers will be asked to submit information on how their suppliers monitor, report and verify their emissions and how they mitigate them; and second, the EC will engage in a diplomatic dialogue with international partners to revise the Methane Regulation by 2025 to introduce stricter measures on fossil fuel imports.

4.2. A CRITICAL VIEW OFFERED BY GAS FOR CLIMATE: THE BIOMETHANE'S IMPORTANCE

Some industrial players from the gas sector offer a rather critical view of the Commission's approach. Two reports by Gas for Climate[42], a group composed of ten European gas transport companies[43] and two renewable gas industry associations[44] openly state the view that the EU's gas sector measures are not sufficient to achieve the 2030 decarbonisation and 2050 climate neutrality targets. Although both reports were written prior to the publication of the December 2021 measures, they follow the EU Strategy to reduce methane emissions that served as a guide for these measures, so the vision offered by Gas for Climate & Guidehouse is still relevant. In fact, already in December 2021 Gas for Climate published "The future role of biomethane"[45] and signed, together with other companies and associations, a declaration in favour of biomethane development[46].

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[41] European Commission (2021, December)d. *Proposal for a regulation on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942.* COM(2021) 805 final.

[42] Gas for Climate & Guidehouse (2020, April). *Gas decarbonisation pathways 2020-2050.*

Guidehouse & Gas for climate (2021, January). *Setting a binding target for 11% renewable gas.*

[43] DESFA, Enagás, Energinet, Fluxys, Gasunie, GRTgaz, ONTRAS, Open Grid Europe, Snam, Swedegas, and Teréga

[44] Consorzio Italiano Biogas and European Biogas Association

[45] Guidehouse & Gas for climate (2021, December). *The future role of biomethane.*

[46] Gas for Climate et al. (2021, December). *Our vision for biomethane.*

The Gas for Climate & Guidehouse report published in 2020 analysed the decarbonisation pathways for the gas sector and proposed three scenarios:

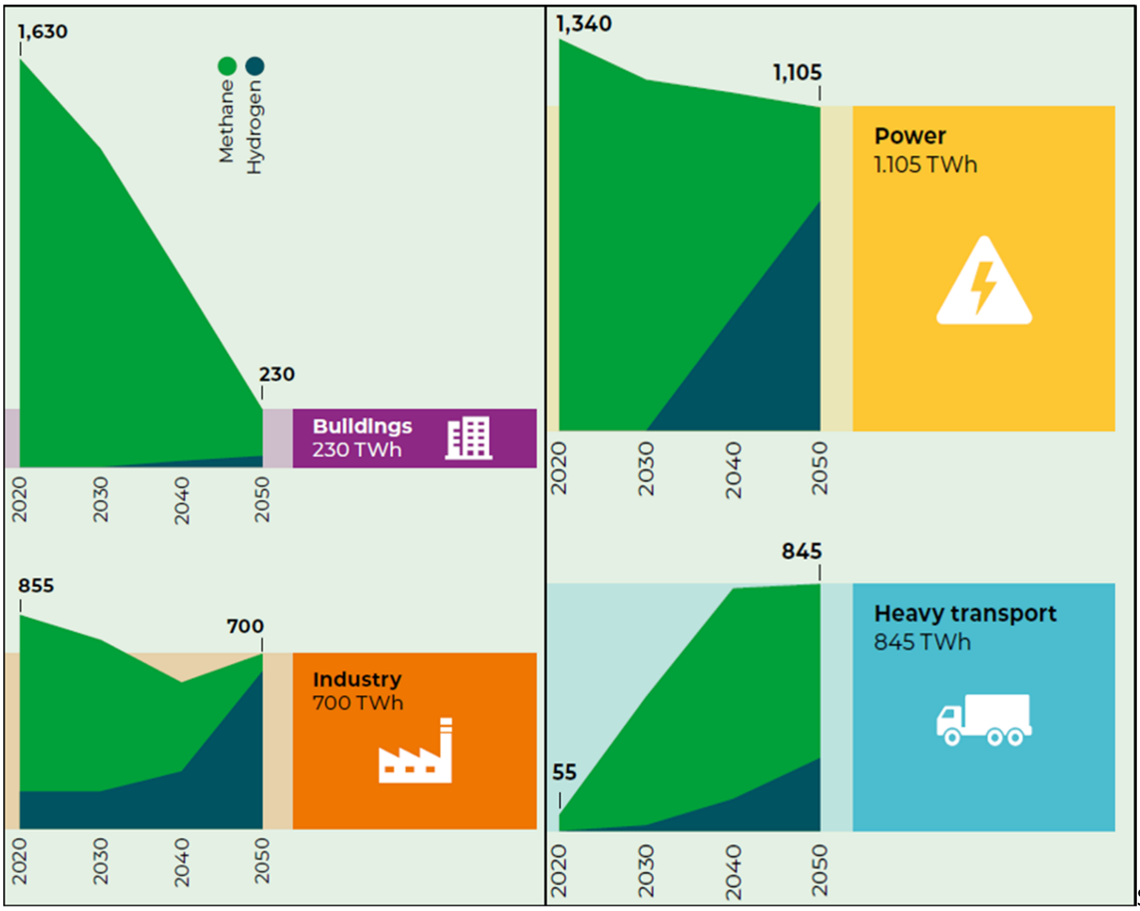
- Current EU Trends Pathways: emissions expected to evolve between 2020 and 2030 under the measures developed so far by the EU.
    - The analysis concludes that current climate and energy policy fell short of achieving decarbonisation.
- Accelerated Decarbonisation Pathway: accelerating supply and demand for renewable electricity, hydrogen and biomethane, taking advantage of innovations and investment opportunities.
- Global Climate Action Pathway: the rest of the world follows Europe's lead in reducing emissions by stimulating innovation in clean technologies globally, enabling even faster decarbonisation.

Accelerated Decarbonisation Pathway is the scenario on which the study focuses. It sets out what it is considered would actually need to be done to achieve the target of a 55% reduction in emissions by 2030, compared to 1990, and thus be on track to achieve climate neutrality by 2050. The scenario includes actions needed to decarbonise the power, industry, buildings, and transport sectors through the gas sector's own decarbonisation; increased private investments driven by a more ambitious policy and regulatory framework; and additional supporting measures. A brief summary of the main policy recommendations offered to develop such a scenario are:

- Adapt the EU regulatory framework to make gas infrastructure future proof in an integrated energy system.
- Stimulate the production of biomethane and hydrogen by binding mandate for 10% gas from renewable sources by 2030.
- Foster cross-border trade of hydrogen and biomethane, by among others a well-functioning Guarantee of Origin system.
- Incentivise demand for hydrogen and biomethane by strengthening and broadening the EU ETS combined with targeted and time-bound Contract ford difference.

One of the most relevant aspects of this report's analysis - and also of the one explained below - is the greater importance given to the development of biomethane, as opposed to hydrogen. Gas for Climate & Guidehouse explain that EU decarbonisation measures do lay the foundations for hydrogen development, however, this is not the case for renewable gases such as biogas or biomethane. Re-prioritising, the study presents an estimate of biomethane, and hydrogen use in the energy, industry, buildings, and transport sectors from 2020 to 2050 in the potential scenario of accelerated decarbonisation. This estimate shows the high importance given to biomethane.

Estimating renewable hydrogen and biomethane use in Accelerated Decarbonisation Pathway of Gas for Climate & Guidehouse.



Source: Gas for Climate and Guidehouse (2020, April).

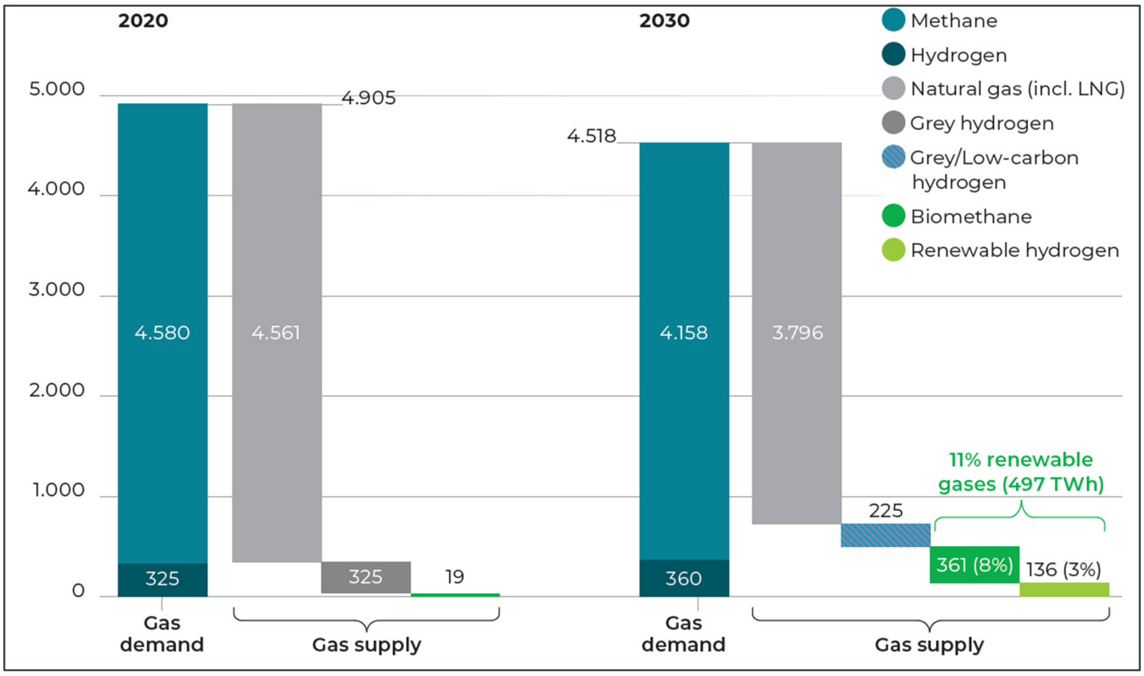
Continuing with the relevance given to biomethane as an energy carrier in the decarbonisation process, **Gas for Climate & Guidehouse presented in January 2021 a policy paper** in which they propose to the EC to include a target for the consumption of renewable gases by 2030: at least 11% of all gas consumed in the EU should be biomethane or renewable hydrogen, namely 3% hydrogen and 8% biomethane.

This target would be translated into differentiated obligations at Member State level and could even be considered as national sectoral targets. In this way, it would be possible to:

- Create a pan-European liquid market with relatively low transaction costs, which would reduce the costs of renewable gases.
- Reach at least 40 GW of renewable hydrogen production capacity within the EU by 2030, which is about 140 TWh of renewable hydrogen produced from renewable electricity.
- Reach about 360 TWh of biomethane produced from biowaste and sustainable, low indirect land use change risk intermediate crops.
- Providing certainty to producers and end-use sectors on the long-term (2030-2050) prospects from renewable hydrogen and biomethane.

To substantiate their proposal, Gas for Climate & Guidehouse assess its potential impact. Gas for Climate & Guidehouse forecasts a decrease in gas demand from 4,905 TWh in 2020 to 4,518 TWh in 2030, induced by increased energy efficiency through building retrofits and partial electrification in all sectors. The introduction of the proposed target would result in 497 TWh[47] by 2030.

Gas supply and demand in 2020 and forecast for 2030 for EU 27 + UK (TWh) with the proposed target of 11%.



Source: Guidehouse & Gas for Climate (2021, January).

One of Gas for Climate's latest actions to further demonstrate the importance of biomethane development was **the signing, in December 2021, together with other companies and associations[48], of a declaration in support of biomethane development**. The companies and associations explain that their intention is to mobilise the biomethane supply chain to highlight its benefits and opportunities, and to be able to partner with public bodies to ensure support for its development and use across Europe. The quantitative estimates they put forward are 350 TWh, or 33 billion cubic metres by 2030, thus avoiding some 110 Mt of CO2eq emissions.

[47] 361 TWh of biomethane and 136 TWh of renewable hydrogen.

[48] Such a Nature Energy, Volvo, Iveco, European Biogas Association, Heppner, Scania or Revis Bioenergy.

>>5 THE IMPACT OF DECARBONISATION ON SOME ASPECTS OF THE CONFIGURATION OF THE GAS SECTOR: CONSUMPTION, EUROPEAN ENERGY SYSTEM, THE GAS GRID AND THE DIGITALISATION

Gas sector technologies could play a key role in facilitating the sustainable energy transition, as awareness and increased investment in the sector for innovation can significantly improve its performance, with the potential to reach three-time horizons:

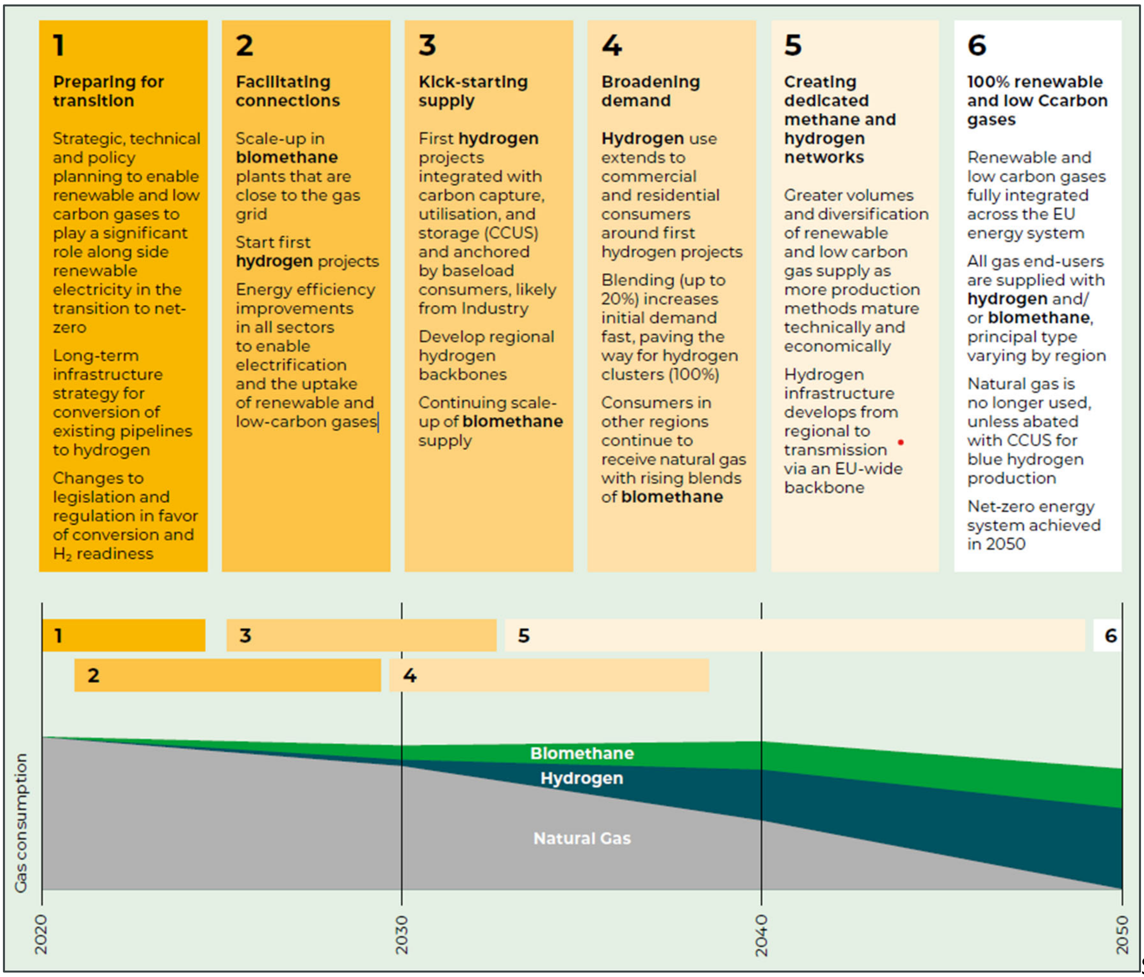
- In the short term, gas can have a significant impact on the decarbonisation process if used as a substitute for coal and other oil products with higher greenhouse gas emissions, allowing for reduced emissions and increased access to clean energy.
- In the medium term, the development of gas technologies can enable the promotion of structural transitions in the method of energy supply, as through the development of low-cost technologies and their potential integration with renewables they could enable the development of a distributed energy system and increase the efficiency of energy consumption. In addition, the potential reuse and adaptation of existing gas infrastructures would provide a faster and less costly transition to decarbonisation.
- In the longer term, the full development of low or zero carbon gas technologies (renewable gas, hydrogen and CCUS) could provide an efficient and cost-effective pathway to reduce greenhouse gas emissions.

Although it is not possible to estimate exactly how the energy transition will actually take place and how the gas sector will be transformed, industry benchmarks - such as Gas for Climate[49] - do make their estimates.

In the case of consumption, as discussed throughout this chapter, natural gas will initially be resilient to the decarbonisation process thanks to its characteristics as a substitute for fossil fuels, and to the development of CCUS technologies that will make it part of the blue hydrogen production process. However, as the development of renewable gases such as biomethane and hydrogen increases, and the various regulations in favour of their increased production and consumption are applied, natural gas will gradually begin to be replaced, especially from 2030 onwards, so that the gas sector can move towards the goal of climate neutrality by 2050. The following graphs show, respectively, the breakdown of a potential transition process, and trends -developed and to be developed- that are considered possible to develop, both on the supply side, demand and infrastructure.

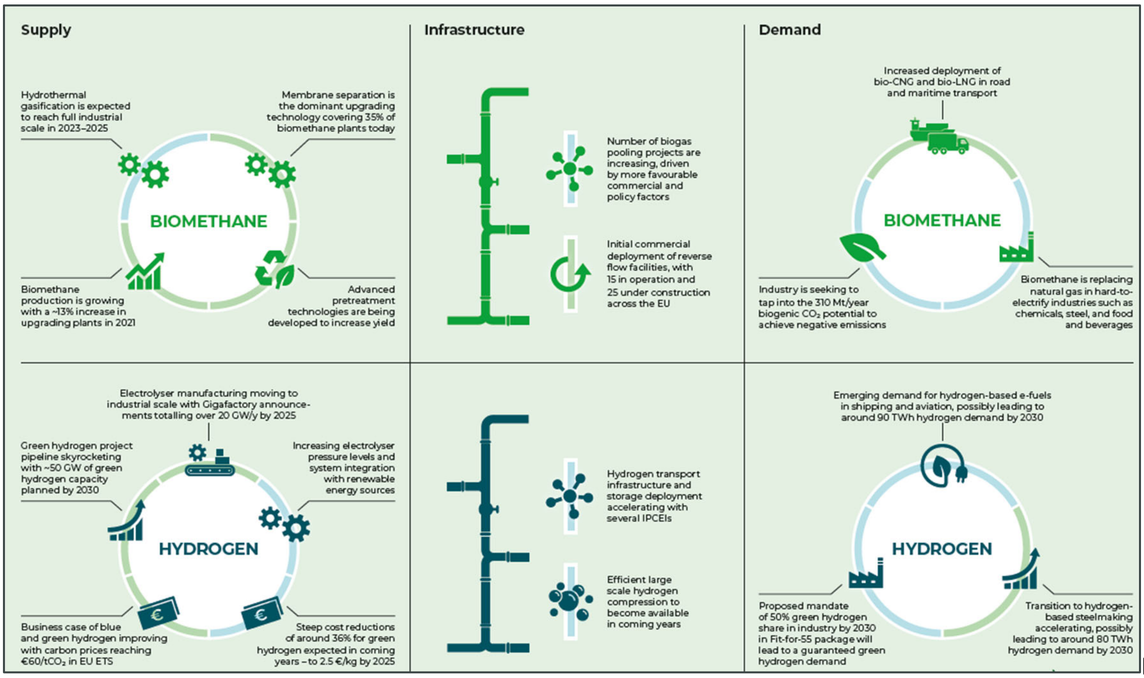
[49] Gas for Climate & Guidehouse (2020, April). *Gas decarbonisation pathways 2020-2050.*

The gas sector potential transition process towards a net zero emissions scenario in 2050.



Source: Gas for Climate & Guidehouse (2020, April).

Key-trend in biomethane and hydrogen in Europe.

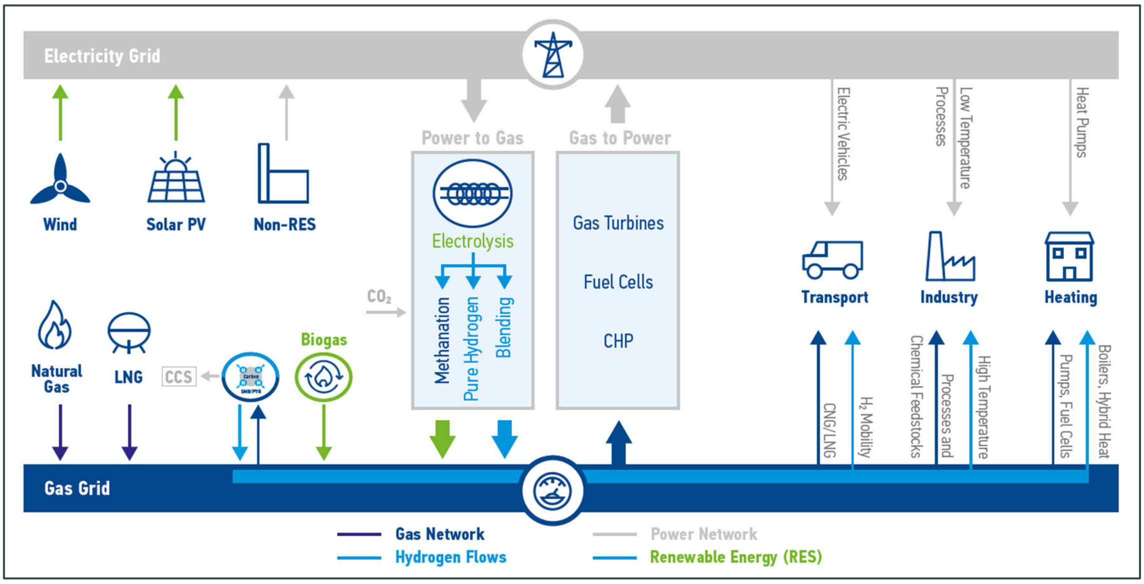


Notes:
Green: confirmed trend; Blue: emerging trend is developing.
Source: Gas for Climate & Guidehouse (2021, December).

Another relevant look into the future of the European gas sector is ENTSOG's[50] view that the EU's future energy system should be a hybrid energy system: a connection between the gas and electricity systems, based on the synergies between these two energy carriers. In its roadmap to 2050, the European Network of Transmission System Operator for Gas -ENTSOG-, explains that this hybrid energy system would allow the EU economy to meet decarbonisation targets, as well as gaining greater flexibility, storage options, cross-border transmission capacities and security of supply, thanks to the use of existing infrastructure, new technologies and the advantages of both energy carriers -gas and electricity-. This hybrid system would imply a significant increase in the importance of the gas sector in the energy transition process, and a reordering of the functioning of the sector, as it would have to be coupled with the power sector.

[50] ENTSOG (2019). *ENTSOG 2050 roadmap for gas grids.*

Diagram of the Hybrid Energy System proposed by ENTSOG for the EU.



Source: ENTSOG (2019).

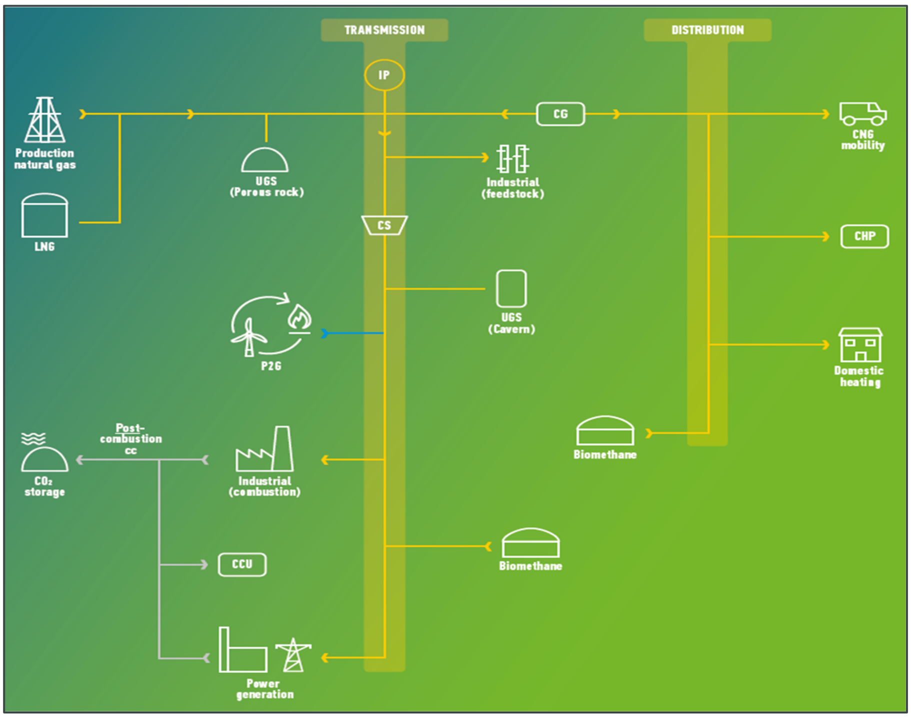
As regards the configuration of the gas network, it will be modified according to the choices made by Member States. The future EU energy system will have to be able to combine the specificities and potential of each state or region to achieve the decarbonisation objectives in the most cost-effective way possible. ENTSOG identified three possible gas grid configurations, although there may be others, as the most likely to evolve and, over time, have to coexist, interoperate and complement each other: (i) methane (with CCUS, biomethane, synthetic methane), (ii) mixed hydrogen and methane, and (iii) hydrogen.

Legend for all three schemes.

CH_4	H_2	CHP = Combined Heat and Power	LNG = Liquified natural gas
CH_4H_2	CO_2	CNG = Compressed Natural Gas	MET = Methanation
		CS = Compressor station	P2G = Power to Gas
CC = Carbon Capture		DAC = Direct Air Capture	PYR = Pyrolysis
CCU = Carbon Capture Utilisation		FC: Fuel Cell	SMR = Steam Methane Reforming
CG = City Gate		IP = Interconnection Point	UGS = Underground Gas Storage

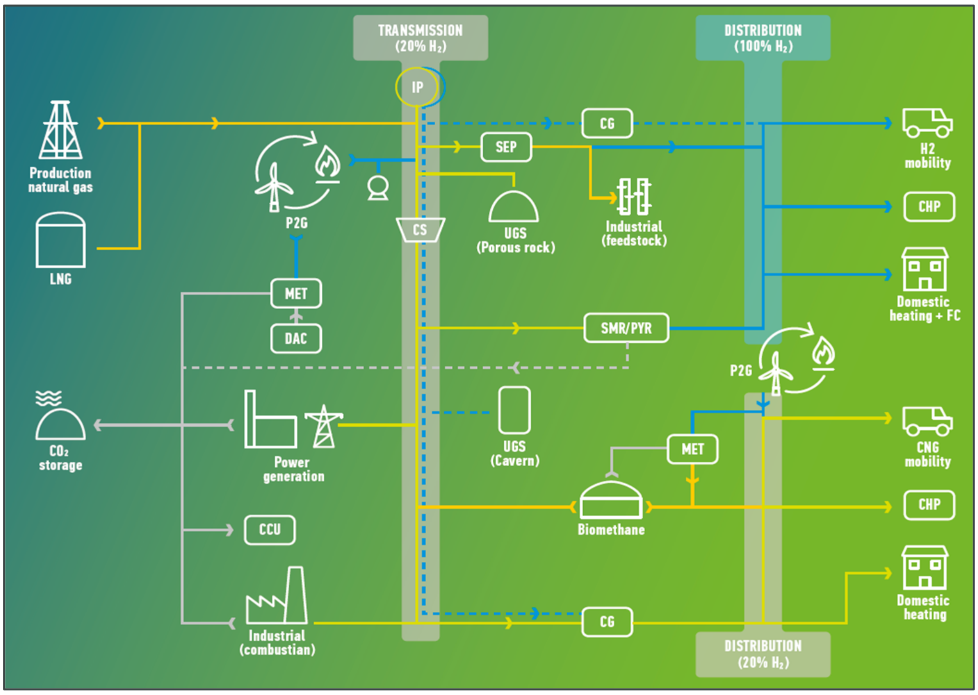
Source: ENTSOG (2019).

Schematic configuration of the gas gris for methane.



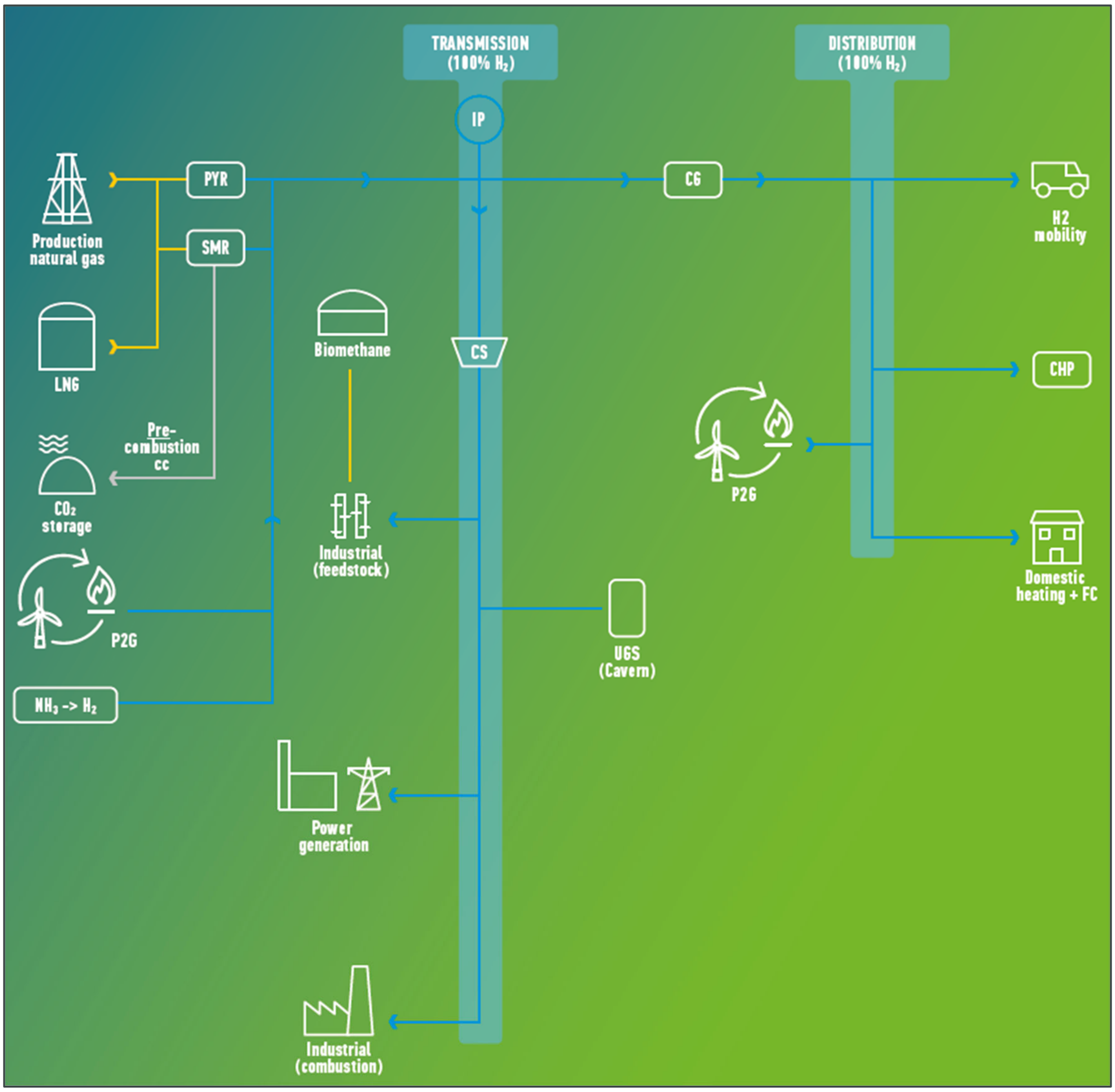
Source: ENTSOG (2019)

Schematic configuration of the gas gris for blending hydrogen and methane.



Source: ENTSOG (2019).

Schematic configuration of the gas grid for hydrogen.



Source: ENTSOG (2019).

These three pathways have different market design characteristics and many of them still need to be developed or redesigned.

- For the development of the methane pathway:
  - Incentives for biomethane production and grid injection.
  - European biomethane certificates to be recognised by all Member States.
  - Conditions for a safe, reliable and permanent storage of CO2, such as clear responsibilities and rules of the EU-ETS system.

- For the development of the methane and hydrogen blending pathway:
  - European gas quality services, ensuring cross-border trade of hydrogen certificates between Member States.
  - European sectoral coupling principles so that the value of the gas and electricity system for capturing renewable energy can be assessed.
- For the development of the hydrogen pathway:
  - A dedicated hydrogen network to transport and store hydrogen.
  - Guarantee of non-discriminatory third party access to the infrastructure.

All the technological developments outlined throughout this chapter will, of course, pose challenges for the gas sector that must be overcome in order to best adapt to the EU's decarbonisation process and along the entire value chain. The energy transition process will involve investments in research, development, and implementation. The digitisation of the sector will also be one of the areas where such investments will be required to develop, for example:

- Smart metering, along the entire value chain.
- Gas quality detection.
- Certification and data exchange, including technologies to capture and exchange data in real time.
- Implementation of climate certificates and guarantees of origin.
- Simulations of industrial production and distribution facilities that make it possible to recreate operations in order to train, in a more preventive and safer environment, the personnel involved in maintenance, safety and risk prevention tasks at the facilities.
- Smart gas meters for households.

#5
EXPECTED IMPACT OF THE ENERGY TRANSITION ON THE GAS SECTOR

>>1 OVERVIEW AT THE EUROPEAN SCALE

1.1. EUROPEAN COMMISSION'S FORECASTS

European governments' energy commitments are setting the path to the energy transition. At the European Union level, the 2030 climate and energy framework adopted in 2014 had set key climate targets for 2030[51], notably regarding carbon emissions and renewables. Following this framework, the Clean energy for all Europeans package in 2019 led to the request for countries to submit national energy and climate plans (NECPs) so as to undertake necessary measures. Details of these plans are gathered on the European Commission's website[52].

Following the NECP submissions, the Commission assessed and forecast the overall impact of governments' pledged measures on all types of energy sources including gas. The European institution estimated that their combined effect should only reduce green house gas emissions by 40% emissions in 2030 compared to 1990 and were not sufficient to respect the Paris agreement's climate goals (only 60% decrease in 2050[53]). Henceforth, the Commission has proposed new measures in July and December 2021 as part of the « Fit for 55 » package. It is expected that they should enable a 55% emissions reduction by 2030 and lead the path to carbon neutrality in 2050. As the Fit for 55 measures are currently debated at the European parliament and the Council of Ministers[54], the precise perimeter of the energy transition is yet to be defined.

Evolution of EU climate targets			
Agreements	2020 package	2030 framework (2014)	2030 framework (Fit for 55)
Emissions reduction target (compared to 1990)	20%	40%	At least 55%
Renewable energy target (in total energy consumption)	20%	At least 32%	40% [proposed]
Energy efficiency target (compared to baseline scenario)	20%	At least 32.5%	36% [proposed]

Source: Bruegel based on European Commission

At this stage, the European Commission has identified and evaluated the impact of 4 scenarios on energy sources :

- **The reference scenario 2020** (« REF2020 »), where countries have implemented all measures from their submitted NECP.

[51] https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2030-climate-energy-framework_fr
[52] https://ec.europa.eu/info/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en#the-processe
[53] https://www.bruegel.org/2021/07/fit-for-55-marks-europes-climate-moment-of-truth/
[54] https://www.energymonitor.ai/policy/green-deals/get-ready-to-get-fit-first-votes-on-new-eu-climate-laws-loom

- **Three core scenario with different options to reach the fit for 55's goals**, which are[55] :

  > « REG » scenario : relying on very strong intensification of energy and transport policies in absence of carbon pricing in road transport and buildings. In REG, maritime transport sector is included in the EU Emissions Trading System (ETS).

  > « MIX » scenario : relying on both carbon price signal extension to road transport and buildings and strong intensification of energy and transport policies. With its uniform carbon price, it reflects either an extended and fully integrated EU ETS or an existing EU ETS and a new ETS established for road transport and buildings with emission caps set in line with cost-effective contributions of the respective sectors. Maritime transport sector is assumed to be included in the existing EU ETS in MIX.

  > « MIX-CP » scenario : representing a more carbon price driven policy mix that illustrates a revision of the EED and RED but limited to a lower intensification of current policies in addition to the carbon price signal applied to new sectors. Unlike MIX, this scenario allows to separate carbon price signals of "current" and "new" ETS. The relative split of ambition in GHG reductions between "current" ETS and "new ETS" remains, however, close in MIX-CP to the MIX scenario. Consequently, considering the different assumptions on policies, this leads to differentiated carbon prices between "current" ETS and "new" ETS. Maritime transport sector is assumed to be included in the "current" ETS in MIX-CP.

The impact of these scenarios on the gas sector are detailed in the table herebelow. In every scenario, natural and manufactured gas capacity, consumption, production and imports should significantly reduce by 2030. The Fit for 55 scenarios entail the strongest reduction and, in particular, the Reg scenario.

European Union's Energy & Natural gas forecasts	EU:Reference Scenario 2020			EU: "Fit for 55" scenarios			
	Historical*		REF 2020	Historical*	REG	MIX	MIX-CP
	2010	2020	2030	2020	2030	2030	2030
Gross Available Energy (Mtoe)	1606	1305	1289	1302	1194	1198	1205
Natural and manufactured gases	363	296	272	294	234	243	255
Variation compared to 2020 (%)	*22*	*0*	*-8*	*-1*	*-21*	*-18*	*-14*
Share of Gross available energy (%)	*23*	*23*	*21*	*23*	*20*	*20*	*21*
Final Energy Consumption (Mtoe)	970	843	840	841	770	782	793
Natural and manufactured gases	221	189	171	188	142	146	155
Variation compared to 2020 (%)	**17**	**0**	**-9**	**-1**	**-25**	**-23**	**-18**
Share of final energy consumption (%)	23	22	20	22	18	19	20
Primary Production (Mtoe)	697	587	597	586	590	586	582
Natural gas	110	53	42	53	38	40	41
Variation compared to 2020 (%)	105	0	-21	-1	-29	-26	-24
Share of primary production (%)	16	9	7	9	6	7	7
Net Imports (Mtoe)	895	718	692	716	603	611	622
Natural gas	246	243	230	241	196	203	214
Variation compared to 2020 (%)	1	0	-5	-1	-19	-16	-12
Gross Electricity generation by source (TWh)	2954	2638	2996	2625	3152	3154	3151
Natural and manufactured gases	622	495	433	486	419	441	452
Variation compared to 2020 (%)	26	0	-13	-2	-15	-11	-9
Share of Gross electricity generation (%)	21	19	14	19	13	14	14

Source: European Commission using the PRIMES model
* 2020 data used for calculations are different in the reference scenario and the fit for 55 scenarii. 2010 data are similar.

[55] All these information are extracted from the European Commission website : https://energy.ec.europa.eu/data-and-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en

In the European Commission scenarios, hydrogen is the only other gas energy source for which forecasts are provided. However, **for all scenarios, hydrogen forecasts show that, at the 2030 horizon, this source of energy will keep playing a very modest role in the European Union energy mix** as, even in the case where it is the most developed (reg scenario), hydrogen should only represent **0.1% of the EU's final energy consumption by 2030** (less than 1 Mtoe).

1.2. IEA'S FORECASTS

At the international level, the International Energy Agency (IEA), which play a key role in the sector of energy by providing analysis and recommending policies to worldwide governements and firms, has also presented a global scenario to reach net zero emission by 2050 (NZE). Specially established for the COP26 in 2021, the NZE scenario is the first energy scenario established by the IEA which should enable to reach carbon neutrality by 2050.

Under this scenario, no new exploration gas and oil project should be explored after 2021 across the World and technologies that are still little mature today (hydrogen, CO2 capture and storage in particular) should be massively developed under the condition of large infrastructure investment : the total of low-carbon hydrogen production should therefore reach 48 Mtoe[56] in 2030, which remains around 3% of total energy supply. The level of Energy consumption should reduce along with a decrease of gas, especially in advanced economies such as Europe. On the contrary, the use of electricity will increase sharply supported by a strong increase of renewables sources such as wind and solar.

The IEA also explored three other scenarios in its 2021 Energy outlook for which it detailed the impact on Europe :

- Stated Policies Scenario (SPS) : reference scenario for the IEA based on the policies undertaken ; it implies a warming of +2.6°C, which does not make it possible to reach the targets set in the Paris Agreement (<2°C)
- Annouced Pledges Scenario (APS) : based on the national objectives of States and political intentions, in particular via the energy components of post-Covid recovery plans. Warming would be +2.1°C in 2100.
- Sustainable Development Scenario (SDS), close to the NZE scenario for advanced economies as it assumes that they reach net zero emissions by 2050. Without assuming extensive net negative emissions, this scenario is consistent with limiting the global temperature rise to 1.65 °C (with a 50% probability).

The impacts on the gas sector is detailed in the table herebelow. As for the European Commission's scenarios, it shows a decrease in natural gas production, demand and generation especially when announced pledges are being implemented for the EU members. The APS and SDS scenarios appear to have similar effects overall : natural gas demands reduced by more than 20% which is comparable to the decrease implied by the Fit for 55 scenarios. However, natural gas production reduce a lot (more than 40% compared to less than 30%).

[56] This equals 17 EJ.

For non-EU members which includes the United Kingdom and Norway, the impacts on gas production, demand and generation appears overall less substantial with the decrease of production being around half of what is expected in the EU. However, the United Kingdom, which is one of the main gas producers in Europe, should play a key role in that regard. In 2020, the UK Climate Change Committee has indicated that natural gas production could drop by up to 80% in 2050[57]. The UK intends to compensate part of it by developing low carbon hydrogen production capacity, with a 5 GWh generation target by 2030[58].

Natural gas forecasts			Historical		Stated Policies	Announced Pledges	Sustainable Development**
			2010	2020	2030	2030	2030
Production (bcm)	Europe		341	241	200	179	172
		Variation compared to 2020 (%)	*41*		*-17*	*-26*	*-29*
	European Union (EU)		148	55	41	32	32
		Variation compared to 2020 (%)	*169*		*-25*	*-42*	*-42*
	Non-EU members*		193	186	159	147	140
		Variation compared to 2020 (%)	*4*		*-15*	*-21*	*-25*
Demand (bcm)	Europe		696	596	587	504	483
		Variation compared to 2020 (%)	*17*		*-1*	*-15*	*-19*
	European Union		446	401	392	315	314
		Variation compared to 2020 (%)	*11*		*-2*	*-21*	*-22*
	Non-EU members		250	195	195	189	170
		Variation compared to 2020 (%)	*28*		*0*	*-3*	*-13*
Generation (TWh)	Europe		947	846	802	742	734
		Variation compared to 2020 (%)	*12*		*-5*	*-12*	*-13*
	European Union		590	556	535	459	459
		Variation compared to 2020 (%)	*6*		*-4*	*-17*	*-17*
	Non-EU members		357	291	268	283	275
		Variation compared to 2020 (%)	*23*		*-8*	*-2*	*-5*

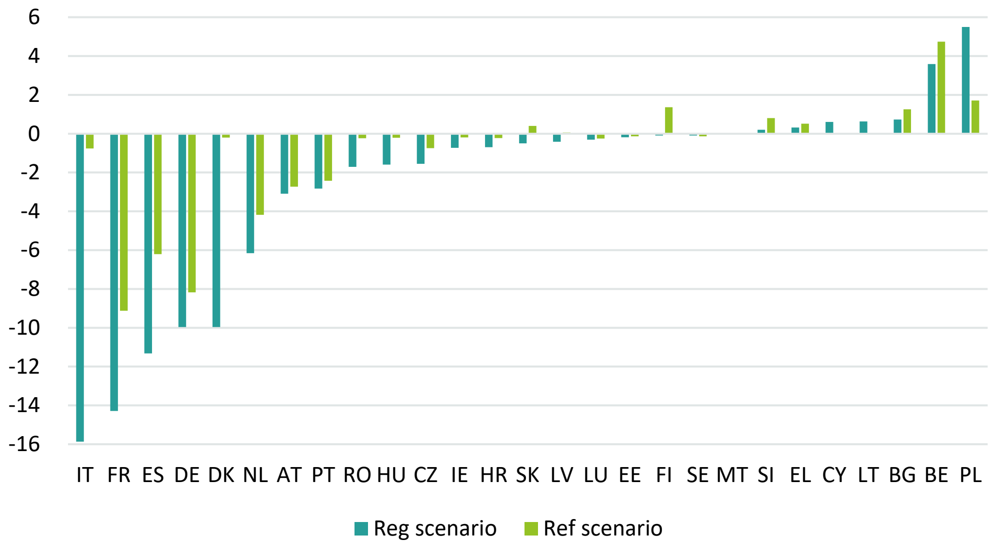
Source: IEA's 2021 Energy Outlook
*IEA does not provide specific estimates for the United Kingdom and Norway, which are part of the Non-EU members
**IEA's does not provide Europe forecasts regarding the NZE scenario.

>>2 OVERVIEW FOR THE EUROPEAN UNION COUNTRIES

- The European Commission provides the details of the estimated impacts of the pledged and proposed measures for the EU members according to its scenarios. We thereafter indicate these impacts for the reference scenario – *when all countries implement their submitted NECP* – and for the reg scenario of the Fit for 55 package as it entails the strongest decline of gross available natural and manufactured gases. A few key conclusions can be drawn for the gas sector with regards to these forecast:
- Most countries should see their level of gross available natural and manufactured gases decrease, in particular the main gas suppliers : Italy, France, Spain, the Netherlands and Germany.
- In most cases, this decreases is more important in the Fit for 55 scenario, especially in Italy.

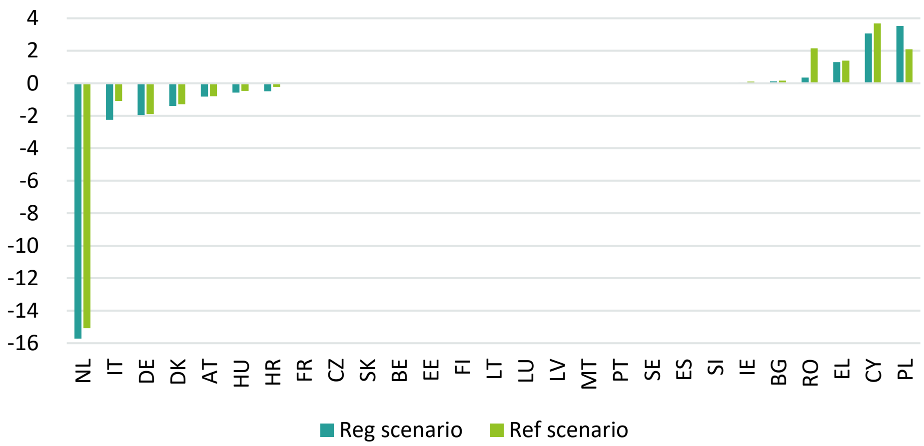
[57] See « Energy white paper : Powering our Net Zero Future » published in December 2020.
[58] See « the ten point plan for a Green industrial revolution » published in November 2020.

Variation of Gross available natural and manufactured gases 2030 compared to 2020 (Mtoe)



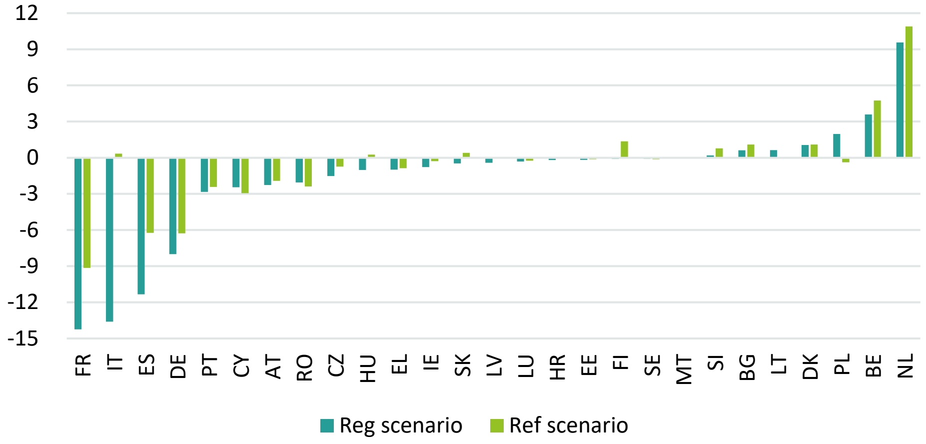
- Regarding primary production, many European countries produce little or no natural and manufactured gases. Therefore, impacts of the energy transition regarding this economic activity will have no or little effect on them.
- Regarding producers, a majority should see their production decrease with the Netherlands being by far the most impacted country. However, a few countries should still increase their primary production, in particular in Eastern Europe.
- The impacts of the Reg and Ref scenarios appears relatively similar.

Variation of natural and manufactured gases production 2030 compared to 2020 (Mtoe)



- The variation of net imports by country reflects the impacts of scenarios on gas availability and primary production. Consequently, most countries should see their net imports diminish.
- This decrease is the strongest for the top natural gas suppliers, except for the Netherlands as the sharp reduction of its primary production should be compensated by more imports.

Variation of natural and manufactured gases net imports 2030 compared to 2020 (Mtoe)



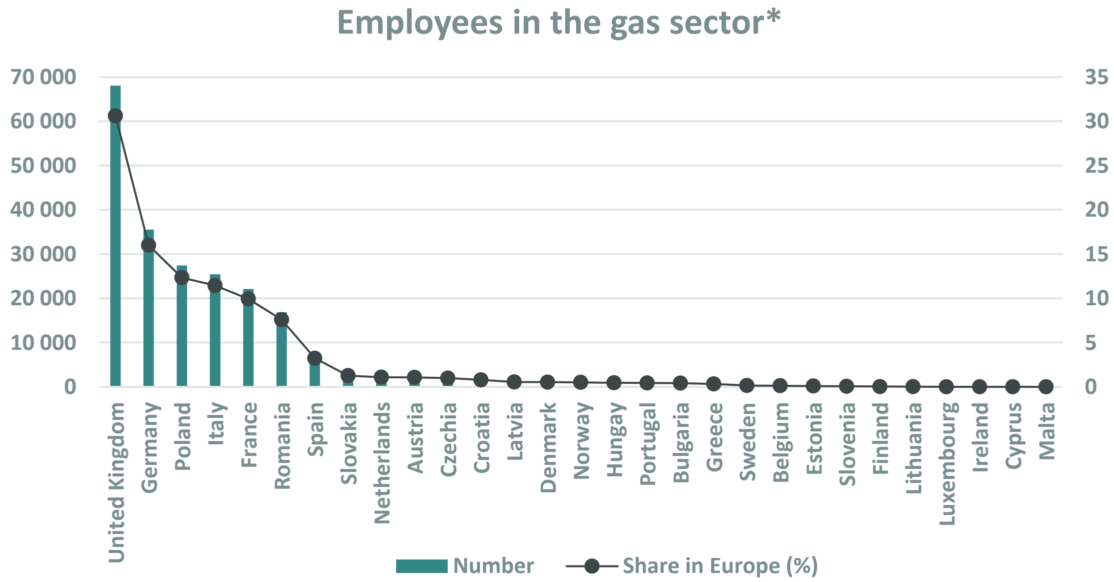
#7
FIRST ANALYSIS OF THE CURRENT EUROPEAN EMPLOYMENT STRUCTURE

>>1 QUANTITATIVE ANALYSIS

Estimating gas-related employment is a complicated task. Available public data produced[59] often include gas into a broader sector: “oil and gas”, “gas and electricity”, “gas, electricity, water, air conditioning and steam supply”, etc. Furthermore, they may refer to “direct” employment or “indirect” employment which can encompass a large array of services and therefore drastically increase the number of employed people.

At the European level, Eurostat appears to be the only data provider giving employment estimates specific to gas according to the chain value. In particular, employment is estimated for four types of economic activity: “extraction of natural gas”, “manufacture of gas”, “distribution of gaseous fuels through mains” and “trade of gas through mains”. As for the statistics regarding gas enterprises, data series should be taken cautiously as they suffer from similar issue regarding data availability.

According to these estimates, more than 220 000 employees are currently working in the gas sector. According to the value chain, the vast majority of them (66%) are part of manufacture and distribution industries (66%) while the rest is divided among trading (27%) and extraction (7%) activities. The top three natural gas suppliers account for close to 60% of total gas employment in Europe, the top six for 80% and the top eight for 84%. The individual share of other countries is slightly above or less than 1%.



Source: Eurostat, Syndex calculation

**Data are confidential for some countries : for instance, gas employment in the Netherlands is only available for extraction industry.*

[59] For instance : OECD’s labor force statistics https://stats.oecd.org/Index.aspx?DataSetCode=ALFS_EMP

#8
OVERVIEW OF THE EXPECTED IMPACT OF THE TRANSITION ON THE GAS SECTOR ON EMPLOYMENT, TASKS, SKILLS AND JOB PROFILES

As with other economic, social, technological or environmental changes, the energy transition affects all aspects of society. Its impact is uneven across workers, sectors, communities, regions and countries. Moreover, the COVID-19 pandemic has further heightened its risks and inequalities, since the recovery efforts needed in the short term to cope with it will have to be in line with the objectives of the transition, which was already underway.

Employment is one of the concerns about the effect that the energy transition and decarbonization will have, as elsewhere, on the gas sector. Where will jobs be created and where will they be lost? How will it affect the economies and communities that most sustain these jobs? Moving from fossil fuels to a sustainable energy system brings benefits (such as the creation of new jobs and livelihoods or the dramatic improvement it can bring in energy access) but also major challenges (such as the disruption to jobs and workers, especially in those countries most dependent on fossil fuels).

The evolution of employment is conditioned by several factors, including:

- The pace of manufacturing, installation and commissioning of renewable energy equipment (which largely depend on costs and investment).
- The rate at which investments are disbursed (which in turn depend on the long-term security provided).
- Policy guidance: through roadmaps, driving ambition and encouraging the adoption of transparent and consistent rules for all types of regulations (and, of course, the adjustment of such supportive policy instruments as the industry transforms).
- The dynamism of national and regional markets, technological leadership, industrial policy, and the resulting depth and strength of the supply chain in each country (which affect the geographic footprint of employment).
- The balance between supply and demand for the required workforce (and, again, the adjustment of workforce needs and skills as industry transforms) for which government, industry, and educational and training institutions should coordinate closely.

The energy transition will involve frictions and misalignments, in several dimensions:

- Temporal: if job losses precede large-scale job gains.
- Spatial: if new jobs emerge in other communities or regions and challenge people who lost their jobs because they have financial, family or property ties to the region in which they live, even though they may have the qualifications and skills needed for such a job.
- Educational: if the levels of education or occupation required in the transition have not been necessary in the previous system.
- Sectoral: if the changes in the value chain occur in the same country, there may be a shift from one industry to another, and if the new value chain depends heavily on imports, the impact on employment will be transferred out of the country.

>>1 SOME QUANTITATIVE ESTIMATES

According to a report by IRENA & ILO the EU-27 countries welcomed a combined total of 1.3 million renewable energy jobs. Among them, the biogas sector ranked third, with 76,000 jobs created in the EU-27 from 2012 to 2020.

Taking a look into the future, the IEA estimates that the net job creation brought about by the energy transition will be positive, as the increase in the number of jobs in the energy sector globally will be 14 million by 2030. For their part, IRENA & ILO estimate that 25 million new jobs could be created worldwide as a result of the energy transition by 2030.

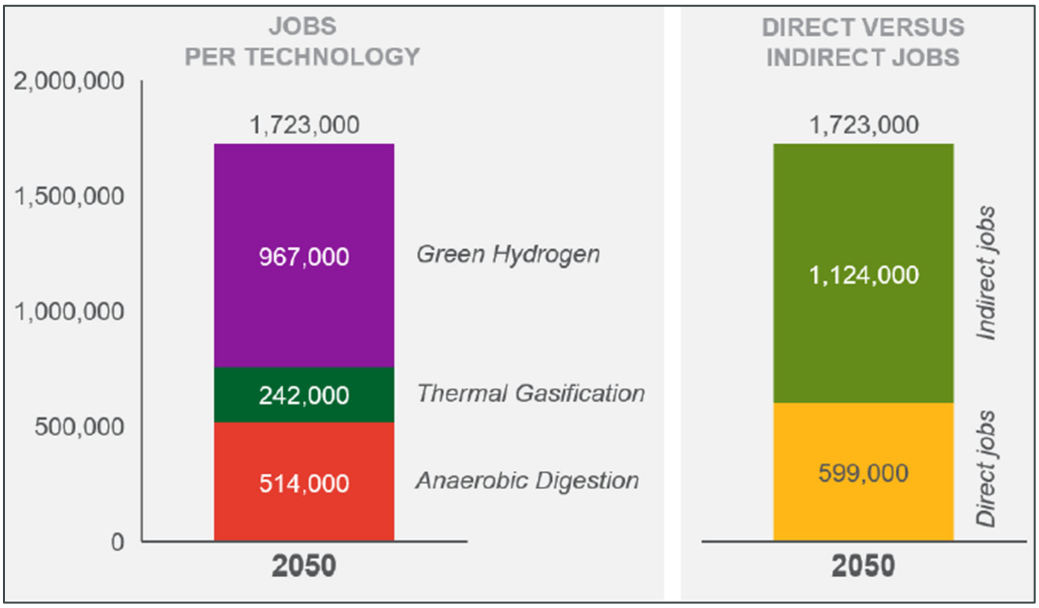
Specifically for the EU and the gas sector, Gas for Climate & Guidehouse estimates that an increase in renewable gases could create between 600,000 and 850,000 additional direct jobs, and between 1.1 and 1.5 million indirect jobs, from 2021 to 2050.

Gas for Climate & Guidehouse, in the same report, explore, from the supply side, the employment effects of an EU-wide renewable gas expansion. They focus on the employment effect of supplying biomethane through anaerobic digestion and thermal gasification, and hydrogen through electrolysis using renewable electricity (green hydrogen).

The results of the analysis suggest the following potential direct employment opportunities:

- 150,000-225,000 in renewable electricity generation for hydrogen production and another 50,000-75,000 in the energy sector.
- 100,000-150,000 in agriculture and forestry (among others) to provide feedstock for biomethane production facilities.
- 200,000-300,000 in industry related to the development and operation of digesters, thermal gasification plants and electrolysers.

In addition, it would lead to new indirect jobs in the construction, technical and non-technical services, and operations and maintenance sectors. Thus, the following graph presents the total estimate in a scenario of a potential increase in the use of renewable gases:



Source: Gas for Climate & Guidehouse (2021, December).

However, the estimates also take into account the job losses involved in the decarbonization process.

The same IEA article estimates that 5 million jobs will be lost in fossil fuel production worldwide, which reduces the estimate of 14 million job creation to a net creation, in any case, of 9 million jobs.

And the same IRENA & ILO report explains that almost 7 million jobs will be lost. Around 5 million could be relocated to other industries and within the same country, however, regardless of relocation efforts, between 1 and 2 million jobs worldwide will become obsolete with no vacancies opening in the same occupation in another industry or another country. Furthermore, another relevant aspect mentioned in this report is that, despite the great importance being given to hydrogen development, its impact on employment in relative terms represents only a small part of the total number of jobs in the renewable energy sector -the IRENA & ILO estimate is that it will remain at about 2 million additional jobs between 2030 and 2050-.

>>2 POSITIVE AND NEGATIVE QUALITATIVE ASPECTS

We could assume that, with proper long-term planning, many displaced workers can find work in related sectors, which would minimize the short-term effects of displacement. This is because many workers in traditional industries have relevant experience for the jobs that the transition may generate: for example, gas workers have skills needed for offshore wind, CCUS technology, and low-carbon gas production and transportation. According to a 2020 survey of UK oil and gas workers, 81.7% of them stated that they would consider moving to a job outside the sector, and around half said they had a preference for offshore wind; furthermore, 70% of the UK workforce in these sectors have a medium transferability to other energy industries, mainly offshore wind, and a further 20% have high transferability. Putting the two factors together, it may seem straightforward to transition jobs from the oil and gas sectors, affected by decarbonization, to, for example, the offshore wind sector; however, this is not so straightforward.

Although displaced workers may end up finding another similar job by mastering certain skills that can serve them in the new developing sectors, if this transfer process is not managed in an efficient and safe manner, individuals may suffer the effect of job loss for a significant period of time. In addition, the transition of workers to renewable energy jobs requires, among other aspects: a clear identification of such transferable skills, the standardization of skills certifications, the establishment of a well-funded retraining program aligned with the transition plans, and the guarantee of a living wage for workers during such retraining process.

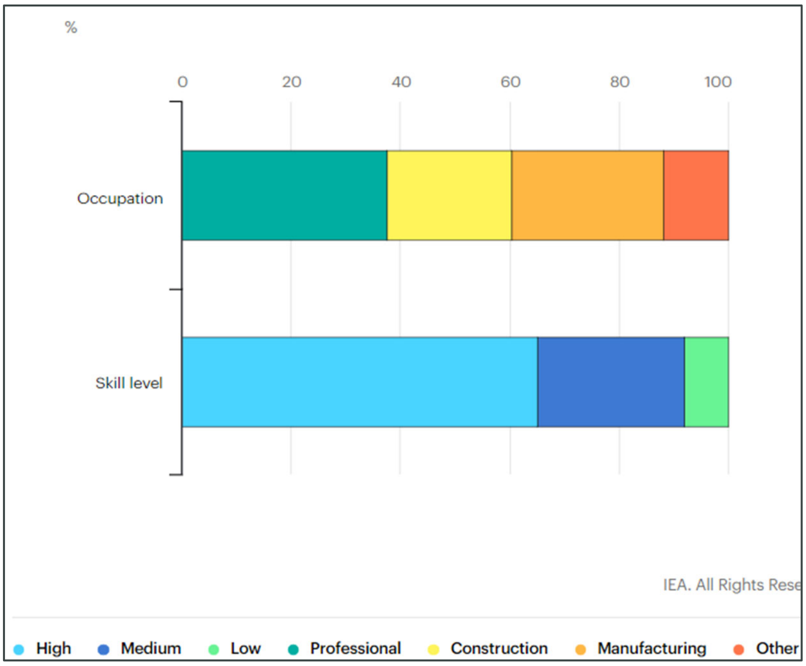
Another aspect mentioned as positive is the job creation in the gas sector from the environmental restoration of closed mines or wells, stating that it can help maintain vital jobs within communities for several years after closure. However, newly created jobs won't necessarily match the qualifications of displaced workers by the transition. This may be positive for those people who take up those jobs, but it will certainly be negative for those who lose their jobs.

Job creation will be uneven from a worker skill perspective. IEA explains that the energy sector is already struggling to find skilled workers to keep pace with the clean energy rebound. For example, if solar and wind installations were to reach four times the current level by 2030, as estimated necessary to achieve the goal of climate neutrality by 2050, labour constraints on skilled workers could even impede the ability to achieve a net-zero emissions future. Most of the jobs that IEA estimates will be created in connection with the energy transition are expected to be high-skilled.

According to Transitions report, the development prospects of the biogas sector foresee an increased need for certain categories of employment in the coming years:

- Project managers with a good command of technical, financial and administrative issues.
- Design and process engineers (who represent 70% of the profiles currently recruited by the recruitment agency Borea, specialized in renewable energies).
- Operations managers with previous experience.
- Technicians (electromechanical, biological control): they should represent 40% of the sector's recruitment in the coming years.

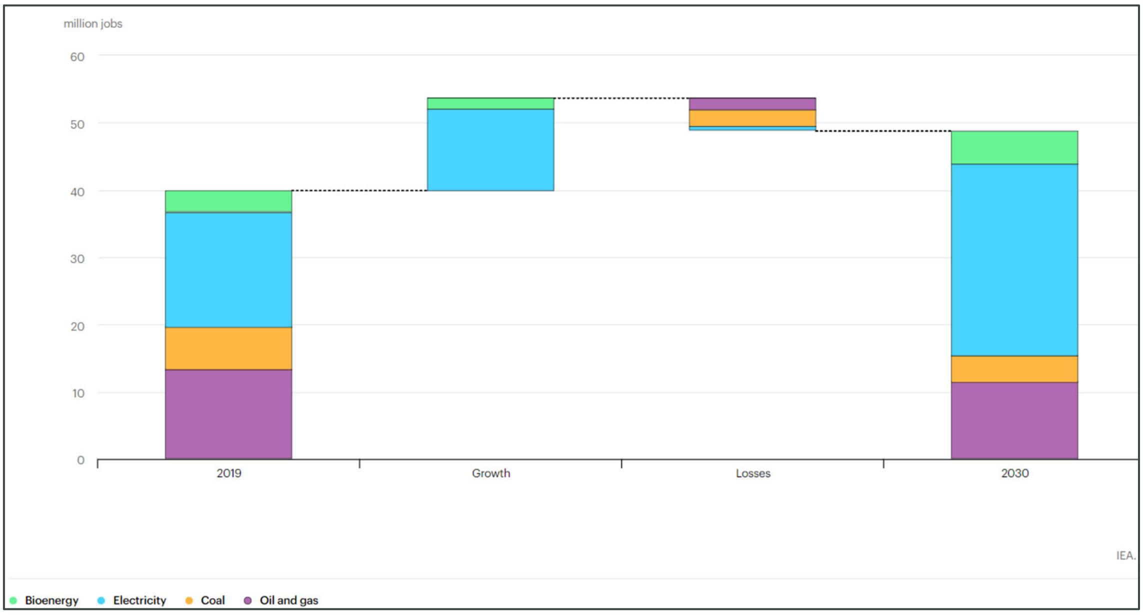
Additional workers in the Net-Zero Emissions Scenario by occupation and skill level, 2020-2030.



Source: IEA (2021, 6th July).

In addition, the gas sector is one of the adversely affected sectors in IEA's estimates, representing job losses by 2030 compared to 2019:

Global employment in energy supply in the Net-Zero Emissions Scenario 2019-2030.



Source: IEA (2021, 6th July).

Finally, it is also important to note that, just as the skills and profiles sought will change with the decarbonization process, so will the recruitment difficulties for companies: while large companies will suffer relatively little from the lack of access to training, on the other hand, smaller and often less recognized players will encounter more difficulties due to more difficult access to training, both for the implementation and management of projects and for the operation of installations.

#9 FIRST RESEACH ON GOOD PRACTICES OF COMPANIES REGARDING THE MITIGATION OF THE IMPACT OF THE JUST TRANSITION ON EMPLOYMENT, TRASKS, SKILLS AND JOB PROFILES

Just Transition is a key requirement of the Paris Agreement and one of the most important for the successful development of the decarbonization process, as the proposed objectives will only be achieved if qualified personnel are available for the tasks. The basis for a just transition is social dialogue between employers, employees and trade unions. For companies, a just transition is a process in which the company plans and implements emission reduction efforts and increases resource productivity in a way that maintains and improves employment, maximizes positive effects for workers and local communities, and allows the company to take advantage of business opportunities. From a business perspective, implementing a just transition enables companies to plan, manage and optimize the operational and reputational effects of climate and business changes. From an employee perspective, the implementation of a just transition allows, in this case the energy transition and decarbonization, to have as little or no negative impact on jobs as possible.

The forecasts of a positive impact on employment of the energy transition and decarbonization will not be achieved without the corresponding accompaniment of just transition plans, and the forecasts of a negative impact on employment can be mitigated or minimized if all actors are involved in the development of a just transition at the corporate, local, national and European levels.

Decarbonization of the gas sector requires a profound change in the culture of the industry, with implications for access to information, social awareness, basic education and technical and professional training. A competitive industry depends on the recruitment of skilled labor and the ability to retain it. Therefore, it is key to work on the Just Transition Strategy.

According to Just Transition Centre & The B Team[60] a good development of just transition has three phases:

- Engage: ensure social dialogue with workers and their unions, and potentially government; consult broadly with key stakeholders such as communities.
- Plan: collaborate to produce concrete, time-bound, enterprise and sectoral plan for just transition, including emissions reductions.
- Enact: deliver plans and advocate for broader action to promote just transition.

The following is a breakdown of different good practices that should be developed by companies in the decarbonization process in order to carry out a just transition:

AREA	MEASURES
Adaptation of workers' skills and abilities to the new demands of the labour market.	Elaborate a diagnostic study of the training needs of the energy transition and decarbonization.
	Develop programs for young people for the realization of a promotional offer of degrees and certificates of professionalism, promoting quality dual vocational training between companies and young people in training.
	Predict qualification needs and employment opportunities at different levels and design appropriate training services.

[60] Just Transition Centre & The B Team (2018, May). *Just transition: a business guide.*

	At the local level, design and implement policies and actions that help create new industries, jobs and social service benefits for workers and communities.
	Consider the risk that workers and communities may face over time and include in transition plans options and resources to manage this risk and build resilience.
	Align with government and other stakeholders on employment resilience.
	Create decent jobs within companies and their supply chains, jobs with fair incomes, job security, social protection, right to unionize and bargain, etc.
	Provide for retention, re-skilling and redeployment of workers as part of company transformation, rather than layoffs.
	Eliminate or relax the requirement for industry-specific experience in job advertisements and actively welcome people with transferable skills.
	Consult with employees who have moved into roles related to new low-carbon technologies to understand what training they have received has had the greatest impact and where there are gaps in order to provide enhanced development plans for future employees.
	Promote a culture of continuous learning and development.
	Include equal training and employment opportunities for women, youth, people with disabilities and marginalized groups in general.
Sectoral issues	Promote intersectoral communication to facilitate the employability and mobility of workers from sectors undergoing reconversion to sectors driving change.
	Promote the development of a Sectoral Transition Plan for Industry that identifies challenges and opportunities, job creation and worker training.
	Promote the inclusion of training clauses for green jobs in sectoral agreements, and the inclusion of the contents in the institutions responsible for their offer.
Improve knowledge on the impact of the energy transition and decarbonization on employment.	Present a periodic analysis of the energy transition and decarbonization of the company and the sector, in order to know the situation, the trend, the evolution, its employment generation possibilities, etc.
	Present an analysis of vulnerabilities in specific aspects or areas in order to be able to implement anticipation policies.
	Develop quantitative and qualitative indicators to identify vulnerabilities in order to implement anticipation policies.

	Report on the progress or new obstacles of the Just Transition Strategy in the Annual Report and also periodically.
	Improve the information available to society as a whole on techniques and best practices.
	Elaboration of energy transition and decarbonization plans with clear timetables, agreed and respected by the parties so that all actors can anticipate adaptation and transformation measures.
Adapt the company to the Just Transition process.	Work on diversification to incorporate new production lines and technological solutions to maintain quality employment in the same areas.
	Anticipate and find ways to maximize the positive impacts of the company's climate action on workers and communities, as well as minimize its negative impacts.
	Integrate "just transition" into business strategy.

>>1 NATURGY & ENDESA: TWO EXAMPLES OF GOOD PRACTICE IN USE

Naturgy develops in its Just Transition report 2021[61] some of its actions:

- Agreement for a fair energy transition for the closure of thermal power plants:
  - Signed by the Spanish government, Naturgy and the unions, to guarantee employment and economic reactivation in the areas affected by the closure of thermal power plants.
  - With an accompanying plan for each of the plants, which establishes the commitments to be made through new investments in the same territories:
    - Plans for the relocation of personnel.
    - Prioritization for workers of auxiliary companies.
    - Search for investments and collaboration in support plans to improve employability in new activities.
  - With a monitoring framework for the workers involved, as well as specific training plans aimed at their outplacement.
  - In addition, the pacts include a participatory process of mobilization and consultation for their elaboration.
- Professional Training Program for Employability:

[61] Naturgy (2021). *Just transition report 2021.*

- > The Naturgy Foundation provides training to teachers and students on training cycles, both for employed and unemployed people in the sector.
- > The training deals with sustainable and efficient construction and refurbishment, natural gas vehicles, energy assessment of vulnerable environments and digitalization of electricity grids. In this way, it transmits updated technical knowledge on energy efficiency, thus contributing to the development of the sector and promoting training in emerging trades, recycling and job placement.

Endesa has de Futur-e Plans for a Just Transition:[62]

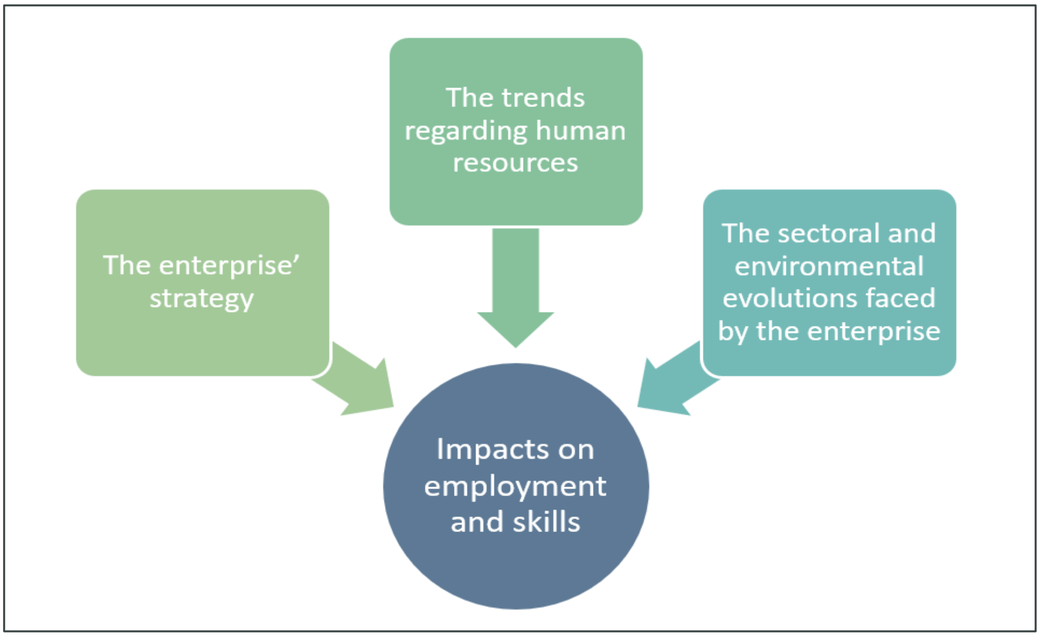
- Initiatives around the plants of those that have requested their closure, with the aim of mitigating the impact on the local population. The plans are structured along four axes:
  - > Proactive job search for directly affected personnel.
  - > Promotion of economic activity and employment in the area, with renewable energy projects, decommissioning work, etc.
  - > Education and training, to achieve the professional recycling of the people directly affected and maximize the percentage of local employment in the projects developed in the area.

>>2 MUNICIPAL SUSTAINABILITY: INITIATIVES TO MITIGATE THE FISCAL IMPACT THAT THE CLOSURES GENERATE IN THE MUNICIPALITIES WHERE THE PLANTS THAT ARE BEING CLOSED ARE LOCATED.GPEC: A FRENCH MODEL AIMING AT ANTICIPATING CHANGES AT COMPANY LEVEL

The decarbonisation transformation will require a profound reorganisation of the gas sector and an in-depth reflection on the needs in terms of the workforce as well as the skills required to carry out the future activities.

[62] ENDESA (2022). *Planes Futur-e para la transición justa*. https://www.endesa.com/es/proyectos/todos-los-proyectos/transicion-energetica/futur-e/futur-e-modelo-economia-circular

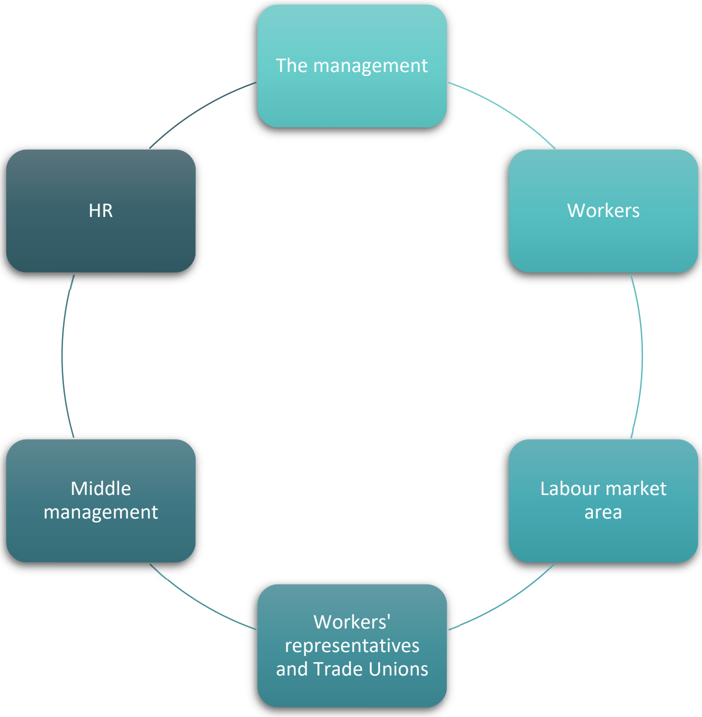
As shown below, the impact on employment and skills will depend on several factors that should be considered as a whole.



The mechanisms to be implemented by each company in order to mitigate the potential negative impacts of the decarbonisation transition could be identified by the following methodology:

- Identification of the actual jobs and of the actual skills
- Identification of tomorrow's jobs and the related required skills
- Building career paths between today's and tomorrow's jobs
- Identifying pathways that will lead to defining the needs for successful transition/mobility/up-skilling/re-skilling

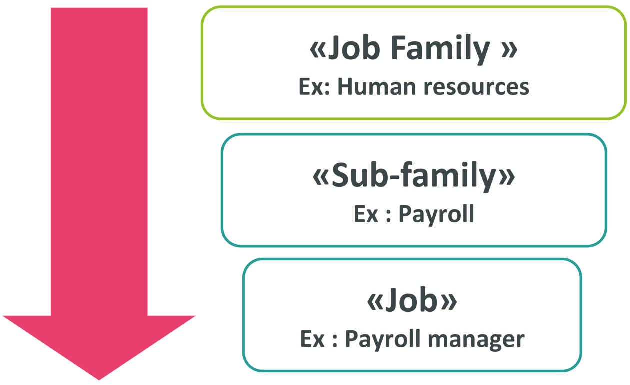
This work should be done collectively by all the potential stakeholders as shown below.



>>3 IDENTIFY EXISTING JOBS AND SKILLS

The first stage of the work is to detail all the existing jobs in the company or sector.

The process must be carried out company by company but the sectors can set common rules and define the boundaries of this listing. These rules may allow jobs with different titles to be grouped into broader families containing several jobs. The jobs thus positioned in these families, can then be broken down into sub-families. The level of granularity remains to be defined but each job must be attached to a family.



With these groupings it will be possible to identify the trends to which the jobs are exposed:

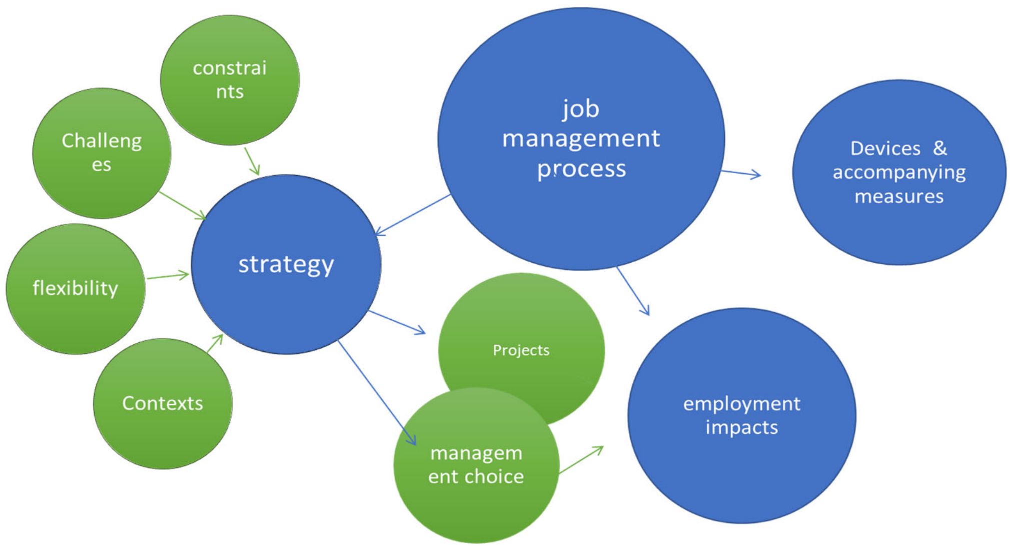
- **In tension**: requiring strategic and rare skills. Need to recruit very specific profiles.
- **Undergoing transformation**: the work content or methods require new skills (digitalisation of work content, changes in the way the activity is carried out).
- **Emerging or growing**: requiring the creation of new jobs in the short or medium term.
- **In decline**: exposed to a reduction in the number of employees or to disappearance.
- **Stable**: no particular changes expected.

This step should make it possible to define the volume of existing jobs, particularly with a view to strengthening efforts to up-skill/re-skill jobs that are in decline.

Once this task is completed, the next step will be the identification of the skills required for each family and each job. **The challenge is to map all existing skills and then identify bridges between today's and tomorrow's jobs.**

>>4 IDENTIFY TOMORROW'S JOBS AND THE RELATED SKILLS REQUIRED

The second step involves an analysis of the company's strategy in the mid-long term to determine the volumes of jobs required and the needs in terms of skills, knowledge or know-how. This step requires a deep and thorough understanding of the industrial strategy of the company with regard to the sector and the environment.



At the end of the this step the future organisation of the company in terms of employment, competences and job profiles should be available.

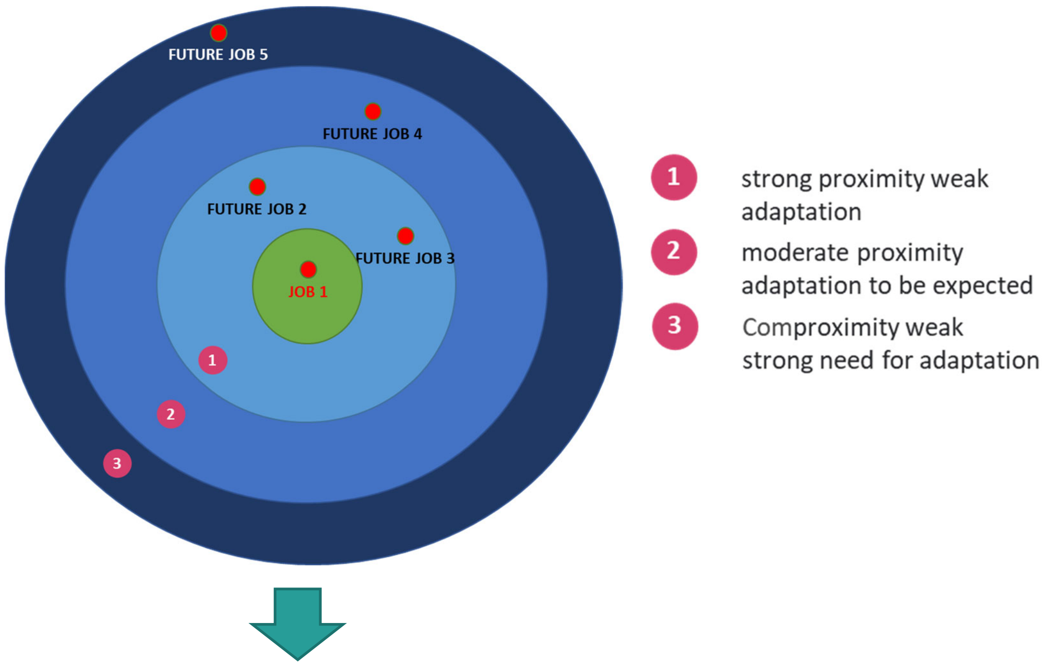
>>5 BUILDING CAREER PATHS BETWEEN TODAY'S AND TOMORROW'S JOBS

Step one of the methodologies defines the starting point; step two determines the future organisation to be achieved.

Step three aims to identify the bridges between today's jobs and those of tomorrow, i.e. to build pathways enabling employees holding today's jobs to envisage up-skilling and re-skilling for the already identified jobs of tomorrow.

To do this, the most traditional method is to identify jobs that are professionally close (i.e. that share activities or skill bases) and to define the feasibility of functional mobility between these two jobs.

Illustration of a mobility area for a given job (job 1). The four future jobs are positioned according to the degree of difficulty of the transition.



A transition from job 1 to job 2 or 3 does not require the same efforts and therefore the same needs in terms of training and time to adapt to the new job as the more distant job 5.

This work must be done for all the jobs in each element of the value chain but it must be transverse at the same time so as to offer the possibility of moving from a company in one element of the value chain to a company in another element of the same chain.

Based on these mobility zones or areas, companies and employees can start thinking about the range of measures that need to be implemented to make this transition feasible.

>>6 IDENTIFYING PATHWAYS LEADS TO DEFINING THE NEEDS FOR SUCCESSFUL TRANSITION/MOBILITY/UP-SKILLING/RE-SKILLING

Vocational training: the main lever for transition.

Identifying skills needs will therefore make it possible to define the action plans to be drawn up so that employees will have the skills required for future jobs. Each job or professional field, and the training to be implemented at company level according to the defined strategic axes, must therefore be successfully defined.

This will require a sufficient number of trained HR teams to build and implement these training programmes.

Public aid for upskilling/re-skilling and geographical mobility.

The transition of the EII sector will potentially lead to the delocalisation or relocation of jobs. The relevant employment volumes will have to be defined and above all, for regions or employment areas with a shortage of manpower or skills, measures to support geographical mobility will have to be put in place. This involves arrangements for relocation, but also for family and personal life, to ensure schooling, support for the mobility of the partner, financial aid, etc.

If inter-company staff movements are envisaged in the sectoral branch, these measures could be pooled at same-sector branch or company grouping level in order to promote employee transfers under the best conditions.

Securing career paths: key to a successful transition.

Changing jobs remains a process full of uncertainty for employees because the success of a re-skilling must not be taken for granted, even if the paths are well identified, the support is commensurate with the challenge and employee training is guaranteed.

On the one hand, employees may be dissatisfied with their new situation and on the other hand there may be a "misdirection" that leads to the failure of the mobility.

The chosen process should therefore guarantee the implementation of significant resources for each individual, but also the possibility of returning to the situation that existed before the upskilling/re-skilling in order to reassure employees about accepting these professional mobilities.

Regular monitoring and follow-up of upskilling/re-skilling programs to ensure their success and to develop efficient mechanisms.

Companies, or any other organisation in charge of these mechanisms, must think in terms of systems that are capable of evolving. On the one hand, the sector will continue its transformation in the short, medium, and long term, and on the other hand, difficulties may emerge after the job starts. There must be regular monitoring of the actions carried out and the possibility of establishing corrective actions to optimise the transition processes and to adjust the offers in terms of volume or skills requirements.

#10 CONCLUSION

The prospect of a decline in the share of gas in the European energy mix as background of the future situation of employment and skills of the gas sector in Europe.

The climate challenges, and in particular the objective of carbon neutrality by 2050, are leading and will lead to profound transformations in the European energy sector.

The ambition to reduce greenhouse gas emissions will have a particular impact on fossil fuels, including gas, and possibly more than is currently forecasted.

Against this background the share of gas in the energy mix of European countries must decrease considerably due to its high level of GHG emissions (CO2 and methane) (see below)

Natural gas forecasts		Historical		Stated Policies	Announced Pledges	Sustainable Development**
		2010	2020	2030	2030	2030
Production (bcm)	**Europe**	**341**	**241**	**200**	**179**	**172**
	Variation compared to 2020 (%)	*41*		*-17*	*-26*	*-29*
	European Union (EU)	**148**	**55**	**41**	**32**	**32**
	Variation compared to 2020 (%)	*169*		*-25*	*-42*	*-42*
	Non-EU members*	**193**	**186**	**159**	**147**	**140**
	Variation compared to 2020 (%)	*4*		*-15*	*-21*	*-25*
Demand (bcm)	**Europe**	**696**	**596**	**587**	**504**	**483**
	Variation compared to 2020 (%)	*17*		*-1*	*-15*	*-19*
	European Union	**446**	**401**	**392**	**315**	**314**
	Variation compared to 2020 (%)	*11*		*-2*	*-21*	*-22*
	Non-EU members	**250**	**195**	**195**	**189**	**170**
	Variation compared to 2020 (%)	*28*		*0*	*-3*	*-13*
Generation (TWh)	**Europe**	**947**	**846**	**802**	**742**	**734**
	Variation compared to 2020 (%)	*12*		*-5*	*-12*	*-13*
	European Union	**590**	**556**	**535**	**459**	**459**
	Variation compared to 2020 (%)	*6*		*-4*	*-17*	*-17*
	Non-EU members	**357**	**291**	**268**	**283**	**275**
	Variation compared to 2020 (%)	*23*		*-8*	*-2*	*-5*

Source: IEA's 2021 Energy Outlook
*IEA does not provide specific estimates for the United Kingdom and Norway, which are part of the Non-EU members
**IEA's does not provide Europe forecasts regarding the NZE scenario.

This decrease concerns all industrial players in the gas sector, a capital-intensive industry whose business models are likely to be strongly challenged and that is why the gas sector is therefore currently studying different pathways to adapt its activities to new challenges.

The adaptation pathways are mainly based on the use of current networks with alternative technologies but apart from feasibility issues, both main technologies raise cumulative problems and/or dilemma:

- **Replacing natural gas by biomethane (issued from agricultural methanization or household waste or organic waste)** : as long as biomethane is a « biogas » its CO2 and methane emissions are inferior to the ones of gas from fossil fuels. On the contrary, its development potential suffers from two handicaps:
  - Its potential development is not in line with (current) needs,
  - The high costs would require public support for a long time to remain "competitive

  Moreover, the use of biogas may involve technical or moral conflicts:
  - Which use must be given to land? Production of gas? Agriculture use?
  - From a technical point of view, the multiplication of gas injection points in the network can lead to a network fragility
- **Injecting a share of hydrogen in the network**: while this is currently feasible, it is only possible up to 10% of the injected gas.

  However, the use of hydrogen raises two questions:
  - Main issue is the production of decarbonated hydrogen which involves electrolysis, provided that decarbonated electricity is used, mainly from renewable energy (electrolysers are placed close to the production sources and convert the electricity into storable hydrogen)
  - The economic model from hydrogen (especially green hydrogen) is still at stake

The future of the gas industry, considering its know-how regarding infrastructure, may also involve other and more distant alternatives but on which it has great hopes:

- **Setting up hydrogen networks in extenso**, with materials allowing 100% H2, probably within the framework of local loops, possibly linked together (for example: green electricity produced via offshore wind turbines is gasified in the form of H2 and then transported to energy-intensive industries (cement factory, steel industry...) converted to hydrogen)
- and/or **the creation of infrastructure for large-scale carbon capture and storage (CCUS)** as envisaged by the IEA in the middle of a bouquet of solutions for the transition to zero net CO2 emissions in 2050.

  However, concerns over the safe transport and storage of captured carbon make CCUS options less attractive. The effective management of large volumes of CO2 from industrial production will in fact require the planning and development of CO2 transport and storage infrastructure in the near term. These investments can have lead times of several years, particularly for pipelines and for greenfield CO2 storage sites and for the time being they are a factor limiting CCUS uptake.

In addition to technological issues, the key question of financing arises:

- who is ready to invest billions in adapting and/or developing the current networks? a fortiori, who will finance new gas transport infrastructures, in a context where geopolitics also plays a major role? (the recent development of the NordStream2 pipeline can be seen as a good exemple)
- maintaining gas transport networks generates very high fixed costs. How far will this cost be sustainable in a context of a sharp decline in the share of gas in the mix and therefore in a context of a small number of consumers?
  - The question of the total cessation of natural gas use in the medium term in some EU countries (and the subsequent massive employment impact) is a realistic one?

In any case and from an industrial point of view, the current models are being challenged and the major companies are changing their strategic plans... Some are choosing to move up the value chain, for example by developing means of producing "green" electricity that can be converted into hydrogen. And this is happening in a context of disengagement of public partners/shareholders, and therefore the rise of private financiers, whose expectations are more short-term and stronger in terms of dividends.

The aforementioned context if the one that shapes the future of jobs and skills in the gas industry. On the specific issue of employment and skills on the gas sectors there is still a lot to be done and even at corporate level the strategic plans do not yet take the employment issue into consideration; for the time being, priority is given to industrial and technical investment projects without taking the social issue into account.

In fact, given the uncertainties surrounding the future of the gas sector there is no clear idea of the impact of decarbonisation on the number of workers needed to match the new technologies and the foreseen evolutions. On the contrary and with regards to the impact of decarbonization on employment, tasks, skills, and job profiles there is a widespread consensus on several facts:

- The transition will require a major and sustained reallocation of labour across sectors, occupations and regions as well as significant investment in re- and up-skilling, retention of existing workers and attracting new workers.
- Skills development will be a particularly important challenge as new capacities will be necessary.
  - Mainly in digitalisation, decarbonisation, innovation, internationalisation, and resilience but an important role is also to be played by the "key competences" or "21st century skills" or even "soft skills": basic and digital skills as well as a mix of cognitive and socio-emotional skills (problem solving, creativity, communication, and collaboration).
- High demand is forecast for engineers, specialists and business professionals who have emerging technology expertise.
- New job opportunities can be expected in design, innovation and product development, disassembling, remanufacturing, repair, administrative handling of new service contracts, resource scouting and information management.

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syndex

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