



**8<sup>th</sup> IAEE Symposium**  
Padua, 27-29 November 2024

# **THE GAS ROLE IN THE TRANSITION: NATURAL GAS, HYDROGEN AND OTHER RENEWABLE GASES**

**Andrea Qualiano**

Head of Green Gas Origination & Gas Supply Portfolio  
Decarbonization

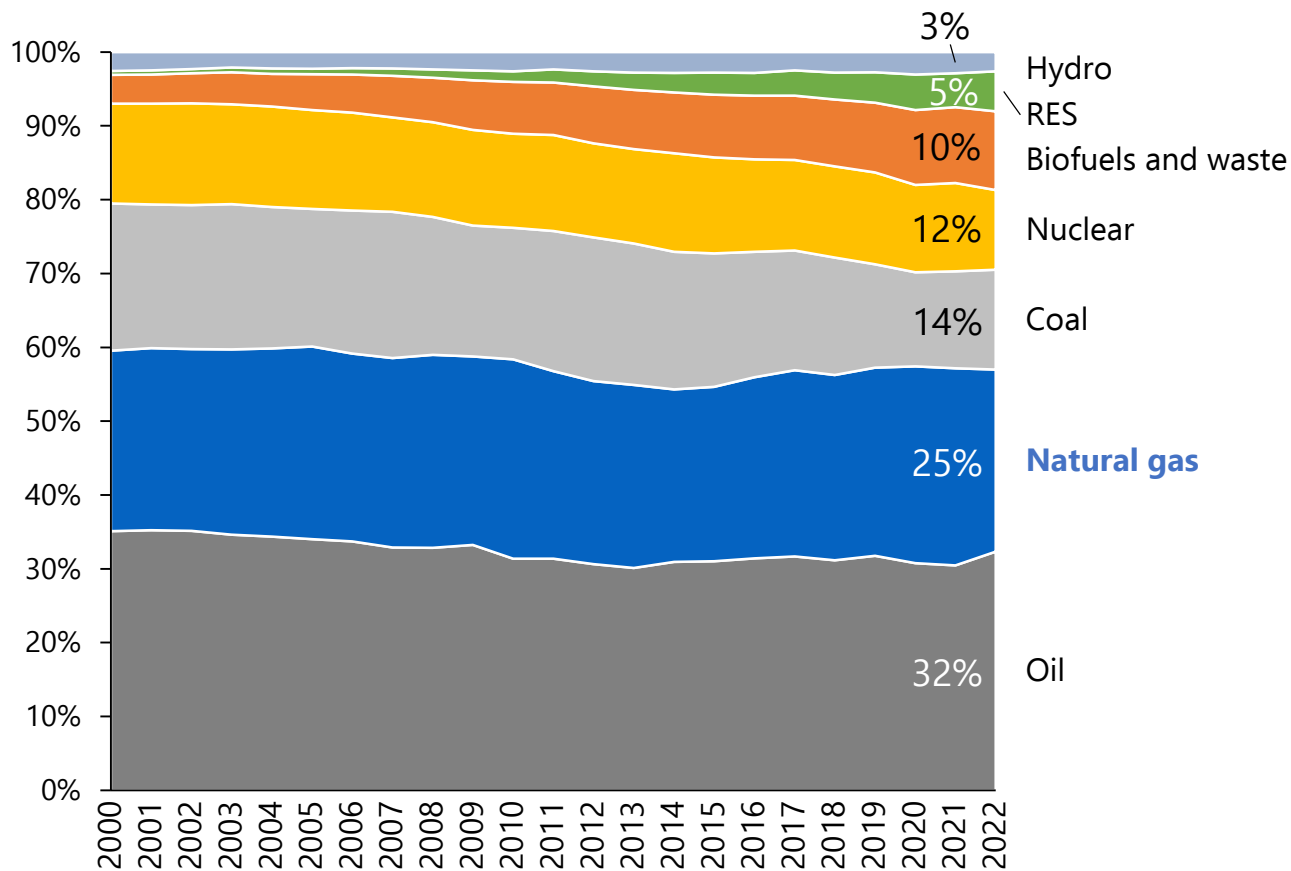




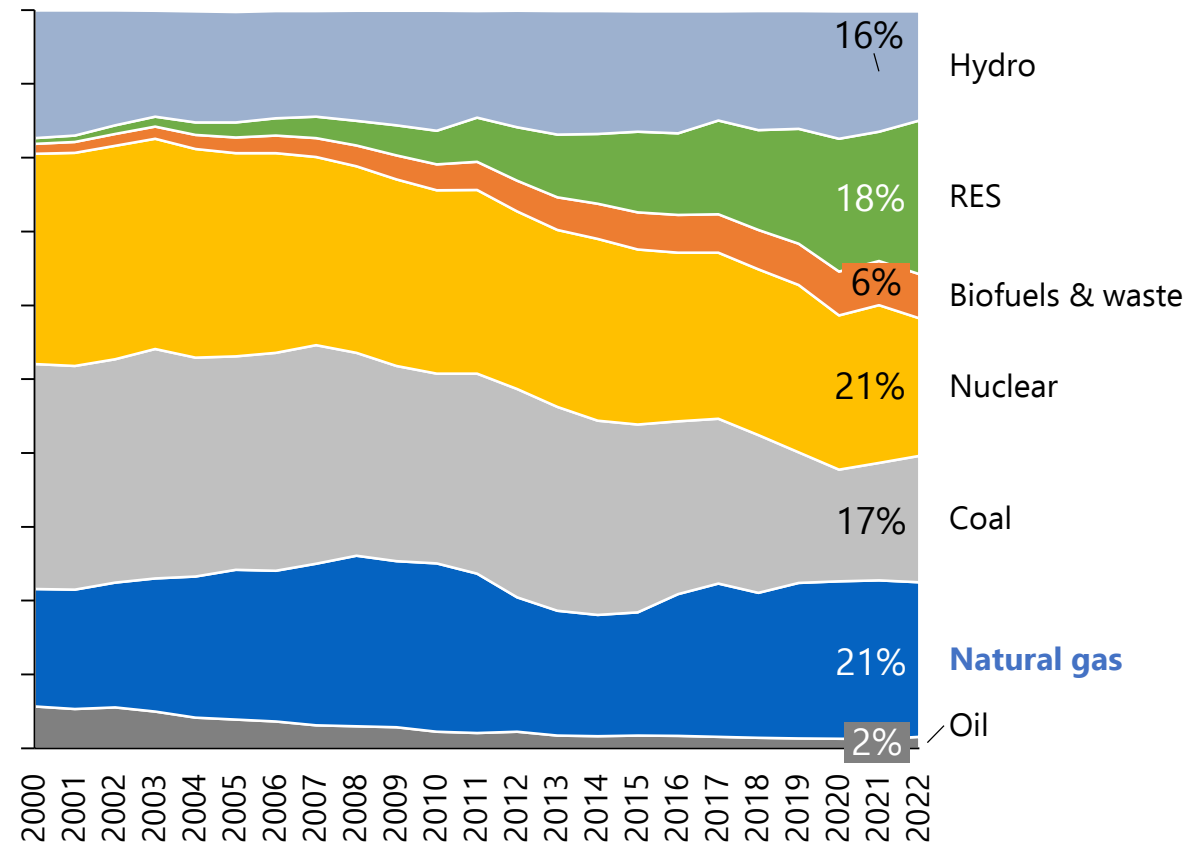
A glimpse to fundamentals

# Natural Gas is still key to EU

### Contributes for 25% of EU's Energy Mix...



### ... and represents a fifth of the electricity production



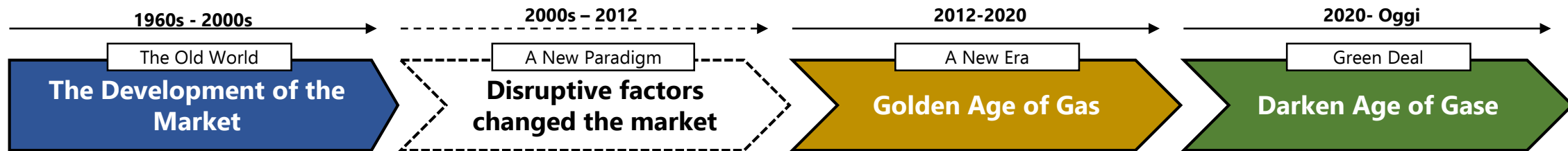
Source: IEA





Where we stand now

# Market cycles of the natural gas industry



Key Word	<b>Infrastructure Driven</b>	<b>Liberalization and Price Decoupling</b>	<b>Commoditization</b>	<b>Sustainability</b>
Market Trends	<ul style="list-style-type: none"> <li>• Huge upstream investments</li> <li>• Downstream markets to be developed</li> <li>• Transport infrastructures needed, but expensive</li> <li>• Increasing demand and security of supply</li> </ul>	<ul style="list-style-type: none"> <li>• Progressive market liberalization</li> <li>• The economic crisis destroyed part of the demand</li> </ul>	<ul style="list-style-type: none"> <li>• Full liberalized market</li> <li>• New players enter the market</li> <li>• Most of the older infrastructures are amortized</li> </ul>	<ul style="list-style-type: none"> <li>• Co2 reduction targets make natural gas no longer suitable</li> <li>• No LT contracts of natural gas beyond post 2049</li> <li>• Huge investments in green vectors</li> <li>• LNG globalized the market</li> </ul>
Commercial aspects	<ul style="list-style-type: none"> <li>• LT Contracts were key to finance E&amp;P and transport facilities</li> <li>• Duration: Long terms prevailing</li> <li>• Price indexation: oil predominantly used as no gas market existed</li> </ul>	<ul style="list-style-type: none"> <li>• Price Decoupling</li> <li>• Hub indexing is emerging</li> </ul>	<ul style="list-style-type: none"> <li>• Price Indexation: Gas-to-gas competition becoming a new benchmark</li> <li>• Gas commoditization</li> <li>• Short term strategies are taking momentum</li> </ul>	<ul style="list-style-type: none"> <li>• Higher price volatility</li> <li>• No clear regulatory framework to support investments</li> </ul>



# The envisaged pathway to drive the transition



## Green Deal

As part of the European post-Covid recovery plan NextGenerationEU, the EU has planned to earmark one third of the €1.8 trillion allocated to adopt a set of proposals (the Green Deal) to transform EU climate, energy, transport and taxation policies so as to reduce net greenhouse gas emissions by at least **55% by 2030** compared to 1990 levels.

The European Green Deal focuses on 3 key principles for the energy transition:

1. ensuring a **secure and affordable** EU energy supply
2. developing a **fully integrated, interconnected and digitalised** energy market
3. prioritizing **energy efficiency**, improving the energy performance of our buildings and developing an energy sector largely based on renewables.



## Fit for 55

- The **Fit for 55 package** fits into this context, whose primary objective is essentially to implement the principles of the Green Deal within the current European legislation.
- The package in fact proposes the **adaptation** of the legislation to the binding climate ambitions, which envisages a 55% reduction in greenhouse gas emissions by 2030 as well as climate neutrality by 2050.
- With regard to the gas sector, the European Commission's objective is to decarbonise the natural gas sector through the promotion and development of supply chains for the production of renewable and decarbonised gases



## The New Gas Package

- Based on these principles, in the context of Fit or 55 the Commission has published a proposal to revise the existing Gas Package by modifying it in order to:
  - › Promote the development of **renewable gases**
  - › Promote the creation of **hydrogen supply chains**
  - › Reduce the weight of «**fossil unabated gas**»
- The Package introduced the revision of 2 existing documents and issued a new Regulation

Existing	Directive 2009/73/UE	General rules of the gas market
	Regulation 715/2009/UE	Access conditions to gas infrastructures
New	Methane Emissions Regulation	Control and management of methane emissions



A new regulation was adopted

# Key Elements of the Methane Emission Regulation

Topic	Key elements
Measure	<ul style="list-style-type: none"><li>• Introduction of rules for the <b>measurement, reporting and verification</b> of methane emissions in the energy sector (covering the entire gas supply chain, including LNG terminals and storage infrastructure);</li><li>• Within specific deadlines from the date of entry into force of the regulation, operators will be required to submit reports to the competent authorities containing the quantification of their methane emissions at source;</li><li>• For regulated entities, investments for the reduction of methane emissions must be considered in the tariffs</li></ul>
Management	<ul style="list-style-type: none"><li>• All measures must be taken to minimize methane emissions, starting with leak detection and repair activities</li><li>• <b>Venting and flaring activities are prohibited</b></li><li>• Report audits by independent entities and periodic inspections by the competent authorities are foreseen;</li></ul>
Imports	<ul style="list-style-type: none"><li>• Importers must provide the competent authorities with <b>information about the commitments of producers/sellers to reduce methane emissions</b> along the upstream supply chain.</li><li>• Based on the annual reporting, a Methane Transparency Database will be created with evidence of the country from which the import is made and the list of companies that import fossil energy</li></ul>



## And then came the RepowerEU A Boost for green gases

### Mission

---

In response to the difficulties and disruptions in the global energy market caused by the Russian invasion of Ukraine, the European Commission has presented the REPowerEU plan.

REPowerEU is a plan to:

- save energy
- produce clean energy
- diversify our energy supply.

The plan includes financial and legislative measures to build the necessary infrastructure and system in Europe.

### Main Targets

---

- Joint procurement of gas, LNG and hydrogen via the EU Energy Platform for all Member States that want to participate and for Ukraine, Moldova, Georgia and the Western Balkans
- New energy partnerships with reliable suppliers, including future cooperation on renewable and low-carbon gases
- Rapid implementation of solar and wind projects combined with the deployment of renewable hydrogen to reduce gas imports by around 50 billion m<sup>3</sup>
- **Increased biomethane production** to reduce gas imports by 17 billion m<sup>3</sup>
- **First EU hydrogen projects** approved by summer
- EU Communication on energy savings with recommendations on how citizens and businesses can reduce gas imports by around 13 billion m<sup>3</sup>
- Increase gas storage capacity to 80% by 1 November 2022
- Coordinated EU-wide demand reduction plans in the event of supply disruptions gas supply



# A glimpse to Renewable Gases

Renewable gas are usually produced via two processes:  
anaerobic digestion and Power-to-Gas.

1

## Power-to-Gas

- Power-to-Gas (P2G) allows renewable electricity to be converted into **storable hydrogen** simply by using water.
- In a first phase, through the chemical process called electrolysis, electricity separates hydrogen (H<sub>2</sub>) molecules from oxygen (O) molecules; in the second phase, hydrogen reacts with carbon dioxide to produce synthetic methane (methanation). Both synthetic methane and hydrogen (although to a limited extent) can be injected into the existing gas network.



**Hydrogen, Syngas**

2

## Anaerobic digestion

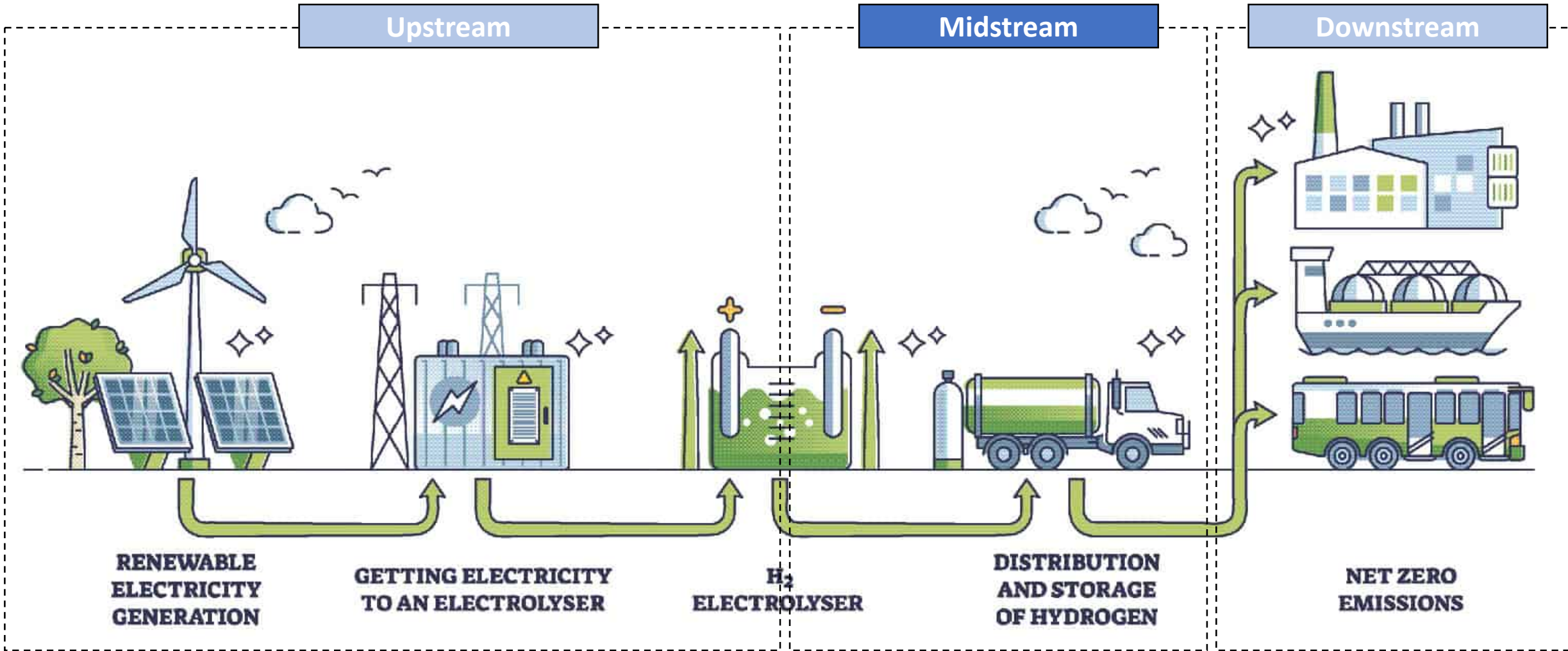
- In the case of anaerobic digestion, organic waste (e.g. from agriculture) is broken down and transformed into **biogas** and **biomethane**.
- Biogas – consisting of methane, carbon dioxide and pollutants such as nitrogen – is in most cases used on site to produce electricity or heat in cogeneration plants. After purification and upgrading to biomethane, it can also be **injected into the gas pipeline** system and transported to end consumers.



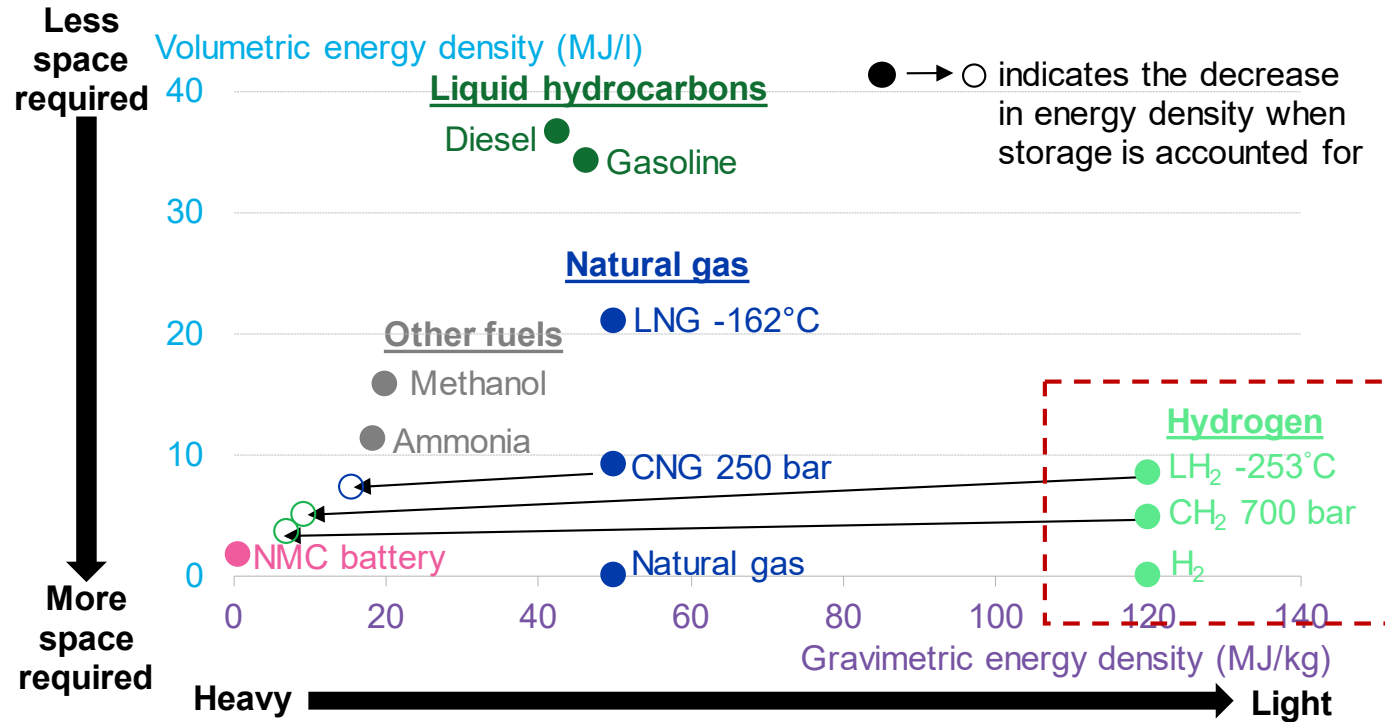
**Biogas, Biomethane**



# The H<sub>2</sub> chain replicates the natgas chain, but transport is an issue...

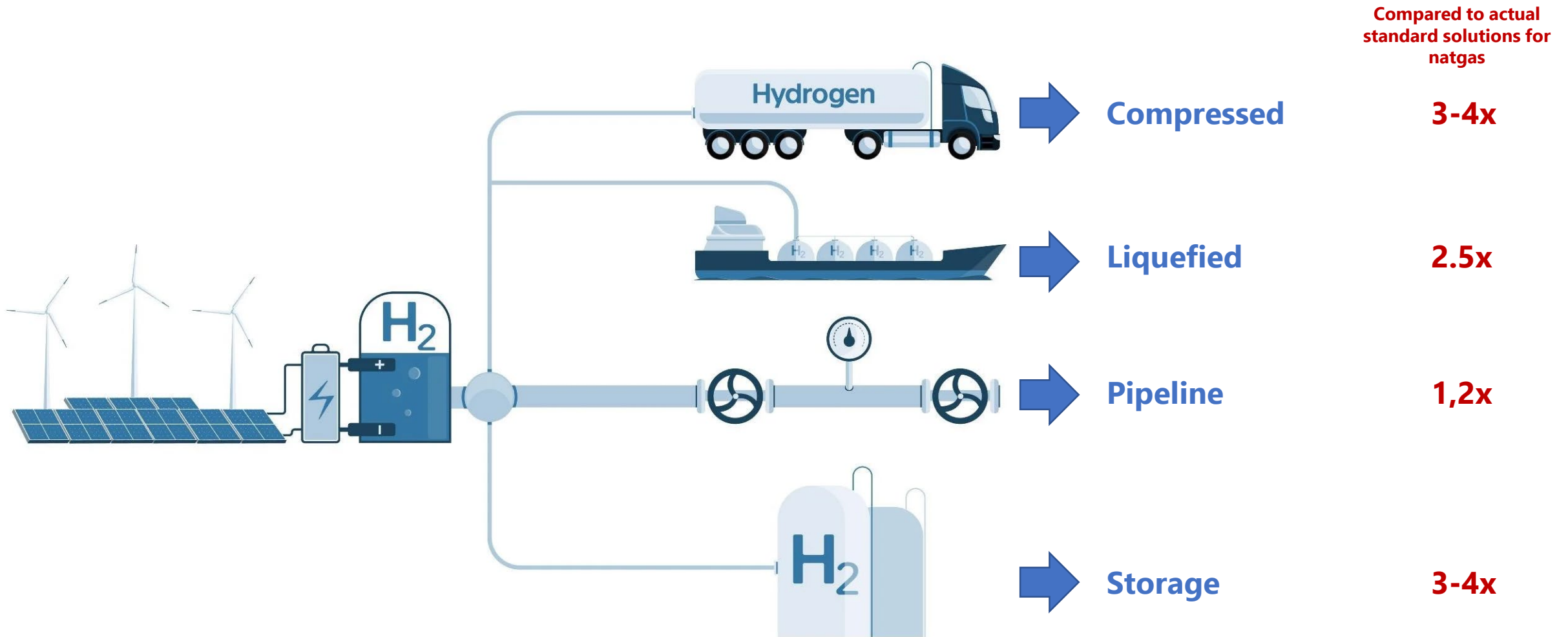


### Energy and volumetric density of H2



- Hydrogen contains a lot of energy per kilogram because of its high gravimetric energy density.
- One kilogram of hydrogen contains 3.1 times more energy than one kilogram of gasoline and 2.6 times the energy of one kilogram of natural gas.
- However, **hydrogen takes up a lot of space because of its low volumetric density.**
- Compression, liquefaction, or conversion into compounds such as **ammonia** reduces its volume.

### Distance may undermine the economic viability of H<sub>2</sub> projects



It is a regional ecosystem that connects hydrogen production, transportation and end-users as mobility or industrial feedstock, covering various aspects of the hydrogen value chain.

Characteristics of the Hydrogen Valley (HV) ecosystem:

- **Large scale:** The scope and scale of the project goes beyond demonstration activities and involves at least a multi-million dollar investment. It may also include several sub-projects that form the Valley's "portfolio".
- **Well-defined geographic scope:** HVs represent a hydrogen ecosystem that covers a specific geographic area. The footprint may vary from a local or regional focus, to a specific national or international region.
- **Broad value chain coverage:** HVs cover different stages of the hydrogen value chain, from hydrogen production to subsequent storage and distribution to consumers through various modes of transport.
- **Supply for use in various sectors:** The HV, among other things, aims to demonstrate and apply the versatility of hydrogen in various sectors in the targeted geographic area. These include, for example, mobility, industry and energy end-uses. HVs are ecosystems in which various end-use applications share a common hydrogen-powered infrastructure.







### Biomethane in a nutshell

- Biomethane is a gas derived from biogas, which has undergone a refining and purification process, called upgrading, whose concentration of methane CH<sub>4</sub> exceeds 98%.
- It has characteristics and conditions of use corresponding to those of methane gas and is suitable for injection into the natural gas network.



### Carbon footprint

- The greenhouse gas emission reduction potential of biomethane is large.
- Typically, biomethane achieves emissions reductions of **over 80%** when replacing fossil fuels, and in some cases up to 200% emission reductions.
- This is because, in addition to the emissions avoided by replacing a fossil fuel, a similar amount of greenhouse gases **are actually removed from the atmosphere or are avoided in the production of fertilizers.**



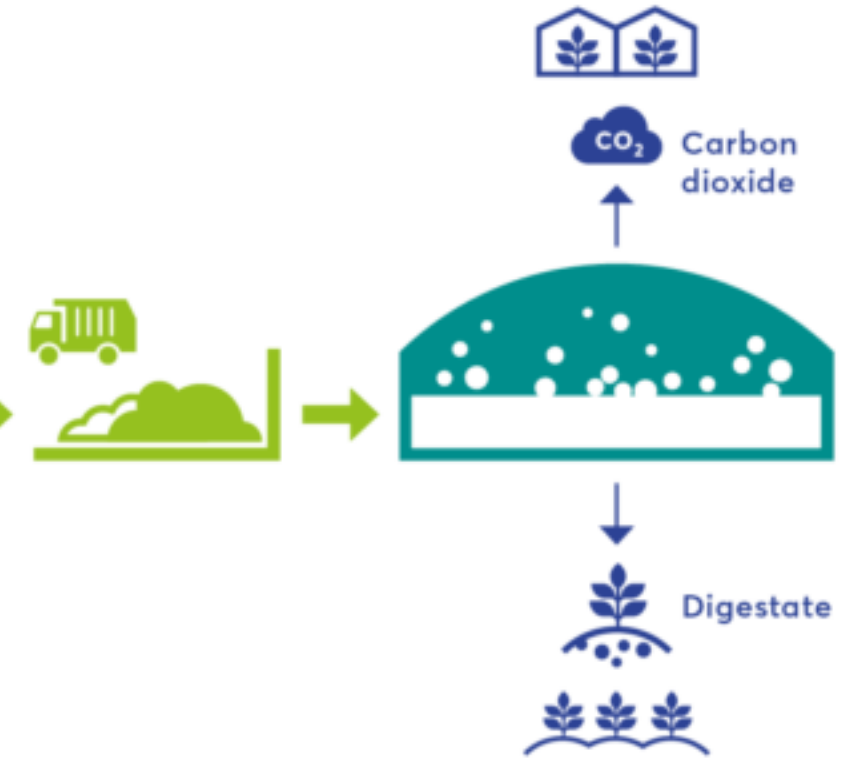
### Advantages

- **Programmable** renewable source
- Reduction of **import dependency**
- Development of **local economy**
- Environmental **sustainability**
- Enables the **circular economy**
- **Reduction** of emissions and greenhouse effect
- **Operational flexibility**





# The production process in a nutshell

## INPUTS (FEEDSTOCK)

- Energy Crops 
- Plant by-products 
- Animal by-products 
- Biowaste from households 
- Industrial & commercial organic waste 

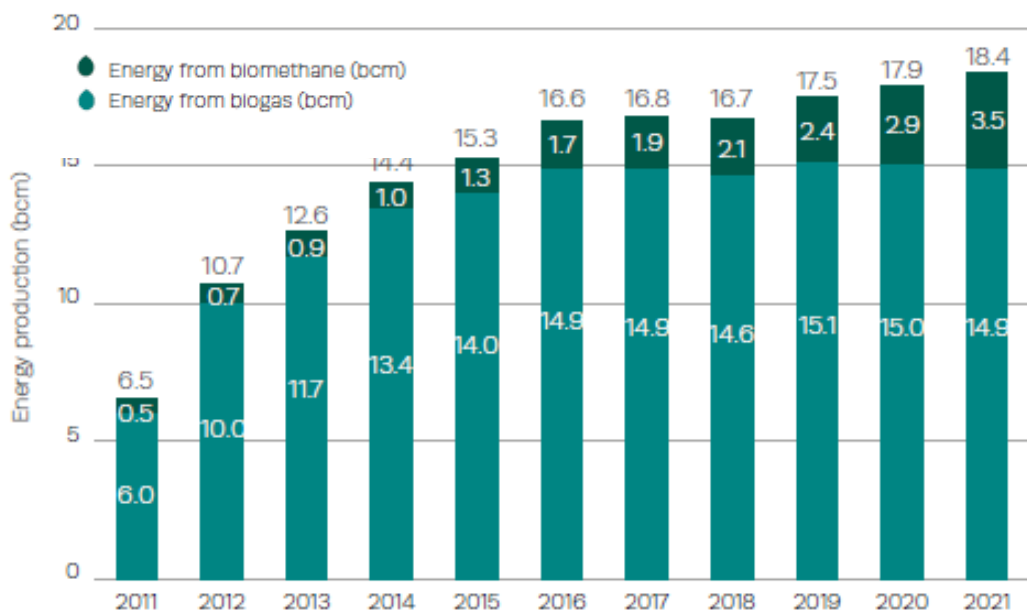


## OUTPUTS

-  Biofuel for transport
-  Biomethane injected in natural gas grid
-  Electricity
-  Heat

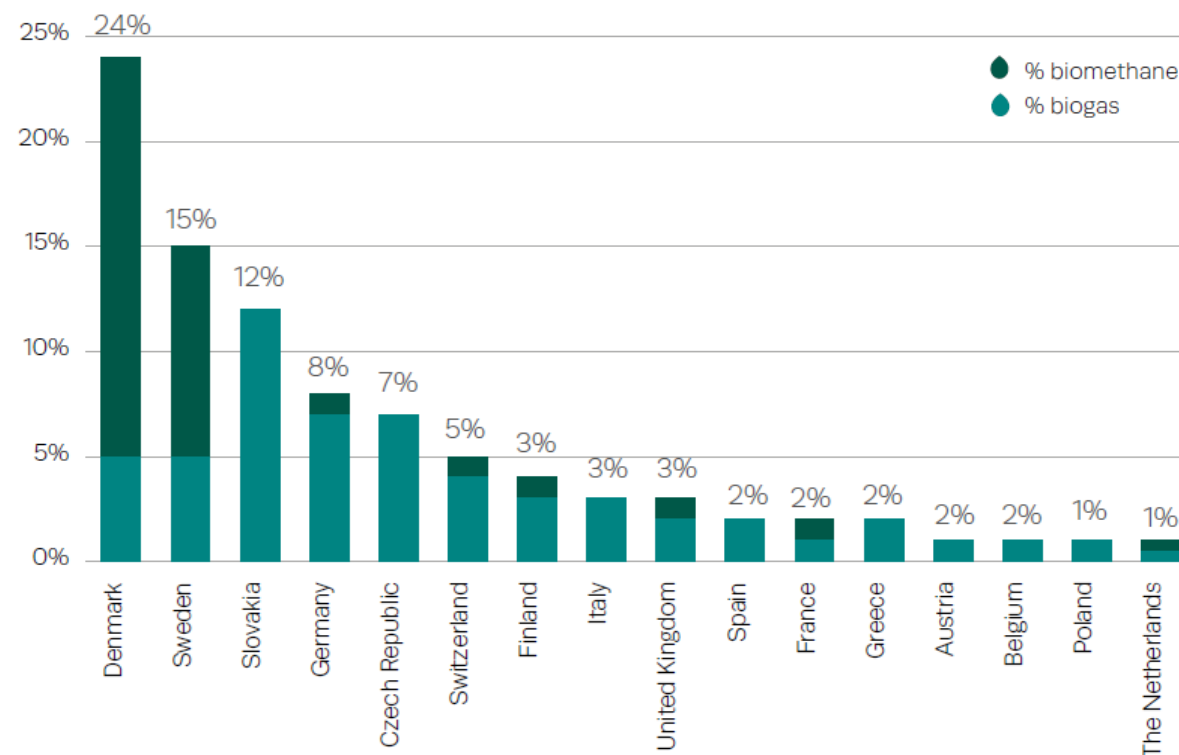


### Renewable gas production in EU



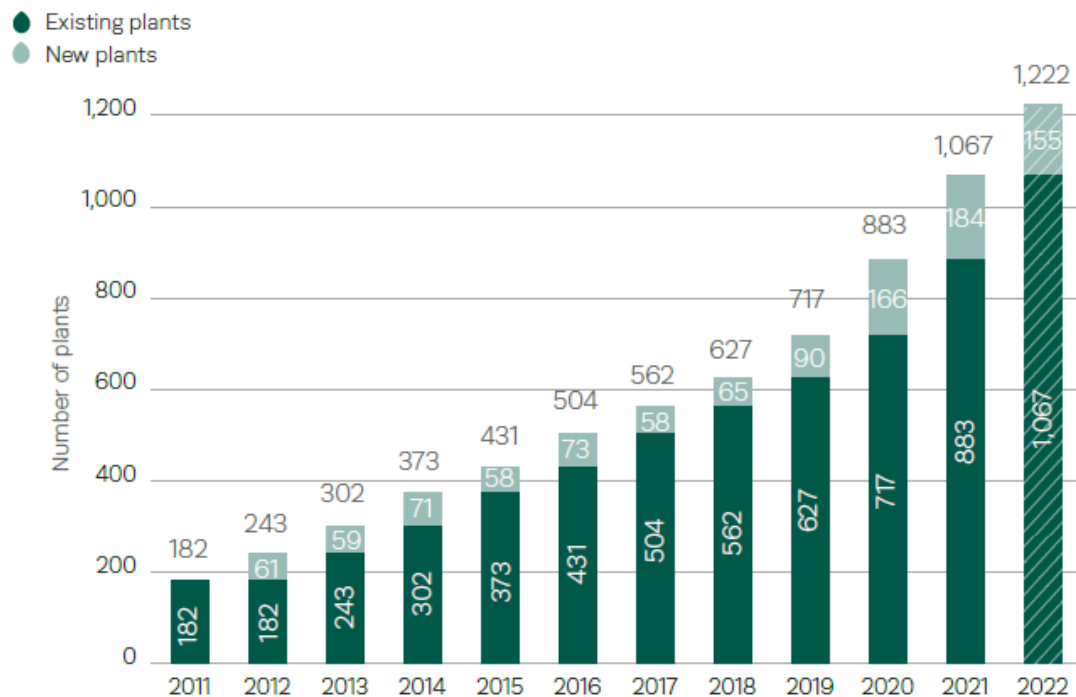
- In Europe, the main production of renewable gas is linked to biogas for cogeneration use (CHP) thanks to the incentive policies of the last decade
- The production of biomethane is still limited but progressively growing

### Production over total demand per country



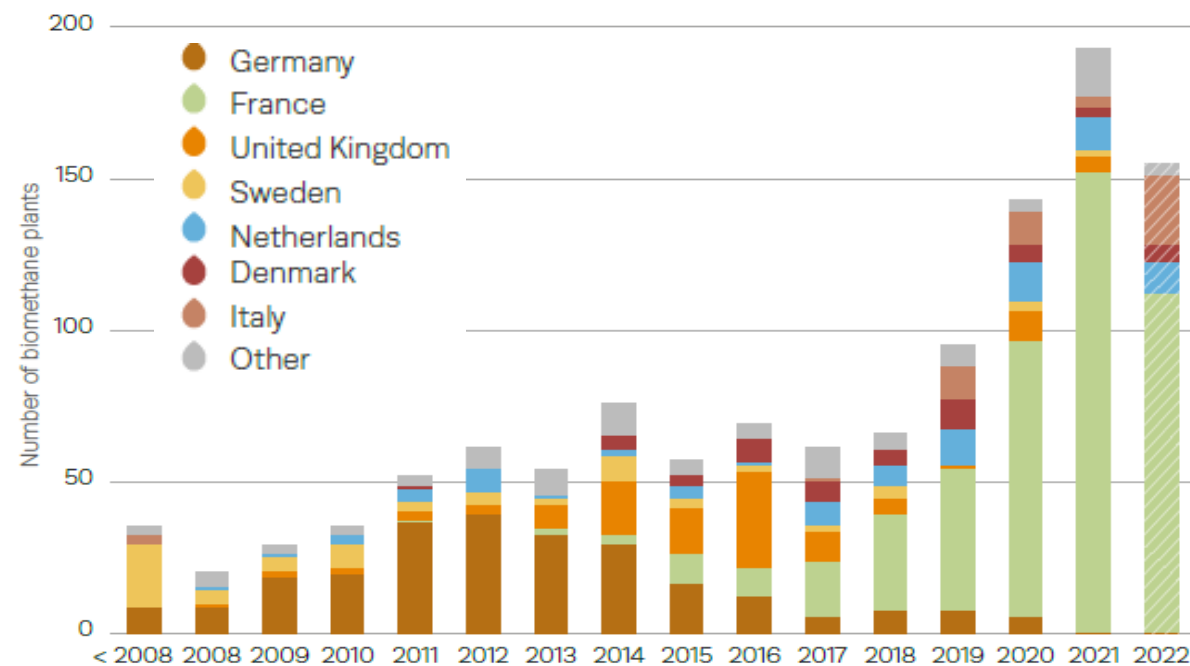
- The weight of biomethane on the overall gas demand is greater in countries with lower population density and lower consumption (Denmark and Sweden)
- In **Italy**, however, biomethane represents approximately **0.3% of Italian gas demand**

### Existing and new production units per annum



- In 2021, the total number of biomethane plants in Europe totaled approximately 1,067 units, with a forecast of growth to over 1,200 in 2022.
- The most significant increase is seen between 2018 and 2020 when some national policies began to incentivize the production of biomethane

### New plants per country



- France is the country that has seen the largest increase in the installation of biomethane plants in Europe over the last 6 years
- Italy has started to progressively see the construction of the first infrastructures since 2018



# Conclusions

- **Renewable gases** can hardly replace natural gas with green gases
- Thus, there is the need to **refocus on the important role of natural gas** a clean solution to drive the energy transition
- A more pragmatic approach is required as:
  - › Gas is needed for **flexibility** and to **manage the fluctuations** inherent to the intermittency of renewables.
  - › It then remains **key for hard-to-abate** industries to produce final goods.
  - › Ultimately, natural gas is also an essential resource needed to **compensate the potential delays** that may arise in deploying the new technologies envisaged by the energy transition
- We should work along the value chain to
  - › **reduce the carbon intensity** of these molecules across their entire lifecycle
  - › Mitigate the **methane leakage** of the O&G industry
  - › promote an international framework for **“abated gas”**.
- Such cooperation should be put in place not only at the European level, but also on an **international level**, so that the gas that is produced in the US or another supplying country can be certified in Europe as well.