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FSR ENERGY

Florence School of Regulation

Understanding renewable gases, hydrogen and power-to-gas: empowering consumers to make informed choices

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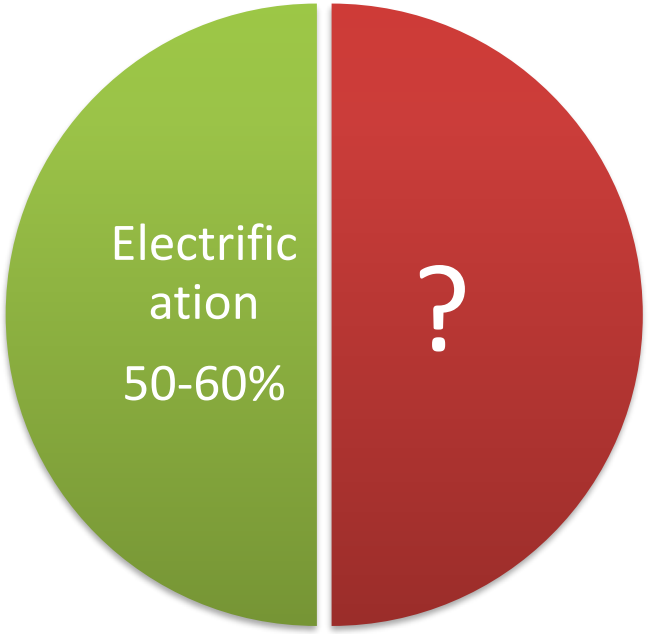
Why do we talk about « renewable gases »?

EU targets for 2030
- 40% CO2 emissions cut*
- 32% gross final RES energy consumption*
- 32,5% energy efficiency

EU Green Deal (Dec 2019): net-zero economy by 2050

EU Commission's strategic LT vision: deep decarbonisation of the economy requires 50% electrification or more, up to 60% by 2050



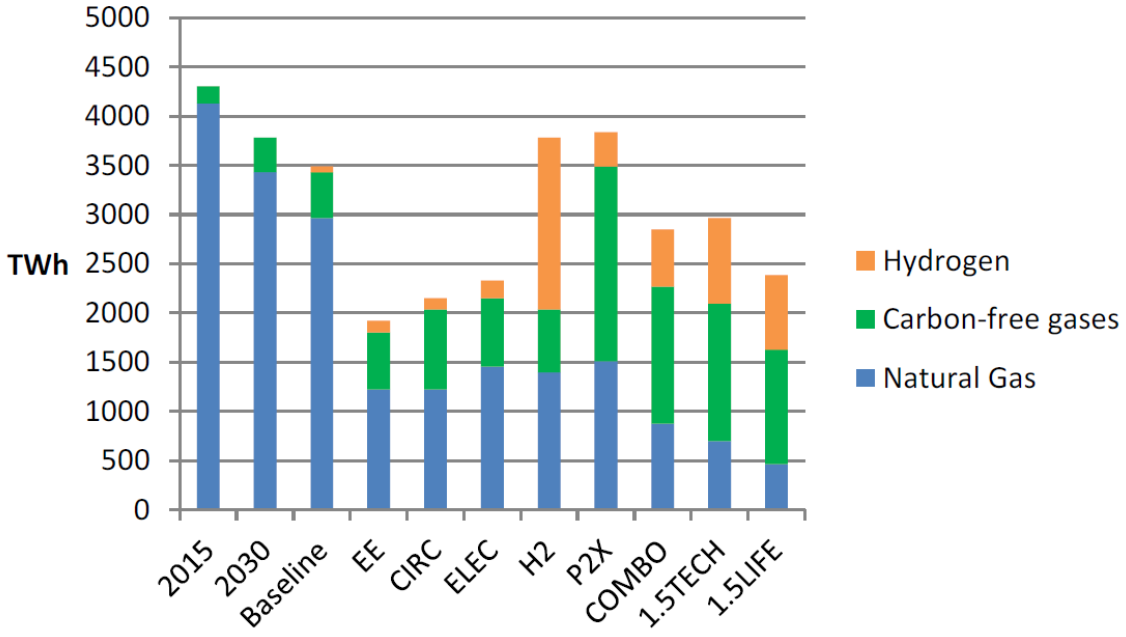
Zero-carbon economy by 2050

Role of gas → support to decarbonisation
- Smaller volumes
- Natural gas as a «back up» (storage, LNG-to-X, etc)
- Clean molecules (Green gas): biogas, biomethane, synthetic methane, Hydrogen
- Sector coupling/integration between gas and electricity is essential to achieve deep decarbonisation by 2050

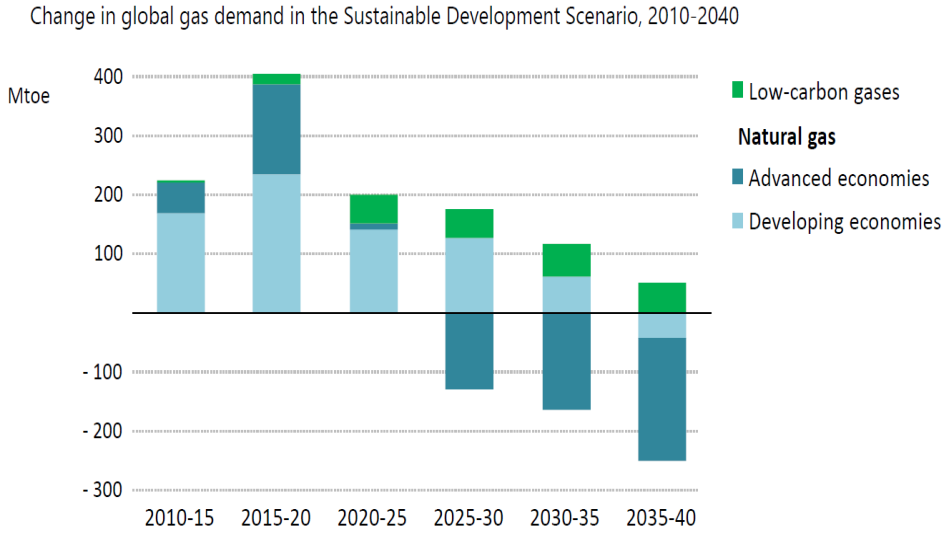
*possible upward revision in 2023

Renewable and low-carbon gases in the path to 2050

Several scenarios and studies see an important scope for renewable gases in the path to 2030 and 2050



Source: EU Commission's Long-Term Strategy and OIES



IEA, Sustainable Development Scenario 2019

Not defined (yet) in regulation

- **REDII (art. 2(1)) defines 'renewable energy' as:**

(1) 'energy from renewable sources' or 'renewable energy' means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas;

- **REDII (art. 2(28)) defines 'biogas' as:**

(28) 'biogas' means gaseous fuels produced from biomass;

- **REDII does not introduce definitions of other renewable gases such as biomethane and hydrogen, although they are both mentioned in the Recitals (Recital 59)**

(59) Guarantees of origin which are currently in place for renewable electricity should be extended to cover renewable gas. Extending the guarantees of origin system to energy from non-renewable sources should be an option for Member States. This would provide a consistent means of proving to final customers the origin of renewable gas such as biomethane and would facilitate greater cross-border trade in such gas. It would also enable the creation of guarantees of origin for other renewable gas such as hydrogen.

Two broad categories of "green gas"

1. Renewable Gases

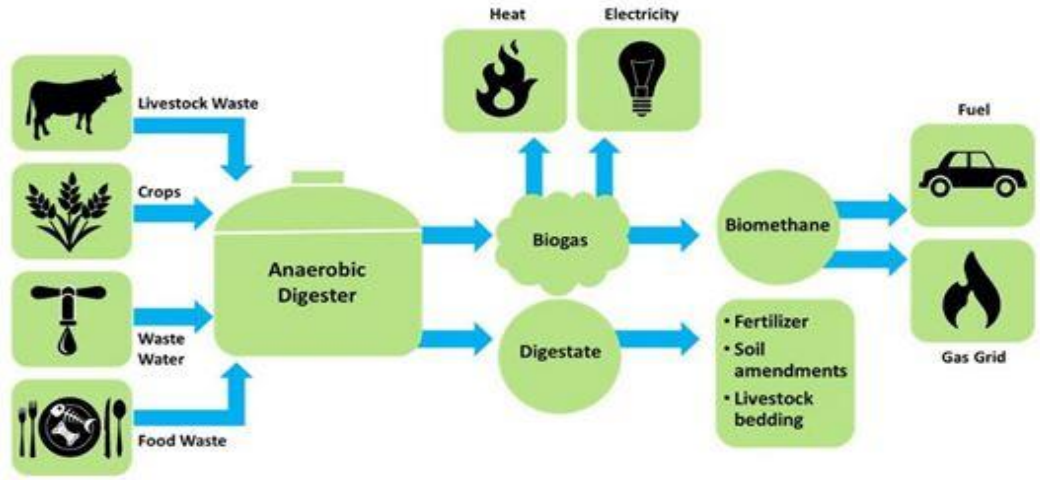
Main processes: anaerobic digestion, gasification, electrolysis (or pyrolysis or photo catalysis), methanation

Renewable gas	Molecule	Type of grid required	Impact on gas infrastructure	Impact on demand side	Decarbonisation potential
Biomethane (anaerobic digestion)	CH_4	Methane	None	None	Small
Bio-Syngas or SNG (biomass gasification)	CH_4	Methane	None	None	Small
Syngas from electrolysis + CO_2	CH_4	Methane	None	None	Large
Hydrogen from electrolysis + NG (blended)	H2NG blend	Methane	Minimal at low concentration	Minimal at low concentration	Small
100% H2 from electrolysis	H_2	Hydrogen	Large	Large	Large

2. Low-Carbon or decarbonised Gas from Fossil Fuels: hydrocarbon reformation + CCS

Low-Carbon Gas (e.g. via SMR+CCS)	Molecule	Type of grid required	Impact on gas infrastructure	Impact on demand side	Decarbonisation potential
Hydrogen blended	H2NG blend	Methane	Requires CO_2 infrastructure	Minimal at low concentrations	Small
100% Hydrogen	H_2	Hydrogen	Large	Large	Large

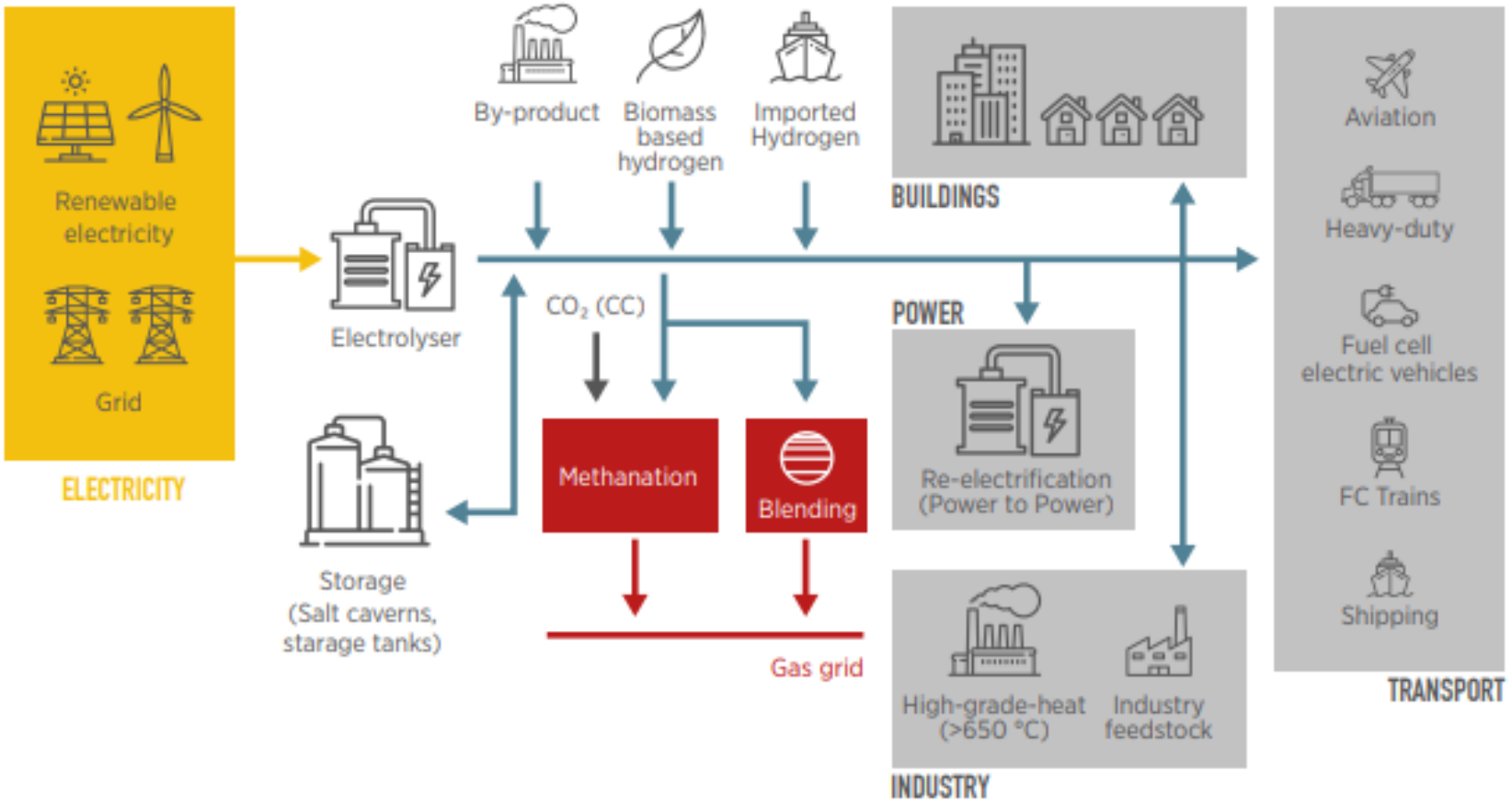
Biomethane can be produced through various processes and starting from different feedstock



Above: Anaerobic digestion process. Source: Environmental and Energy Study Institute, 2017

Below: Thermal gasification process. Source: Navigant, 2019.

Green hydrogen and synthetic methane can be produced via power-to-gas



Source: IRENA, 2018

The need for a Taxonomy of “green gases”

- Taxonomy (*τάξις*, tàxis, order and *νόμος*, nòmos, rule) = the *discipline of classification*

- **Research focus**

Which gases?

Which parameters?

Which methodology?

- **Scope*:***

Ensuring a common language to describe reality

Attribute (environmental, commercial, financial) value

Highlight the essential features of each gas for consumers

Taxonomy: which issues are we trying to solve?

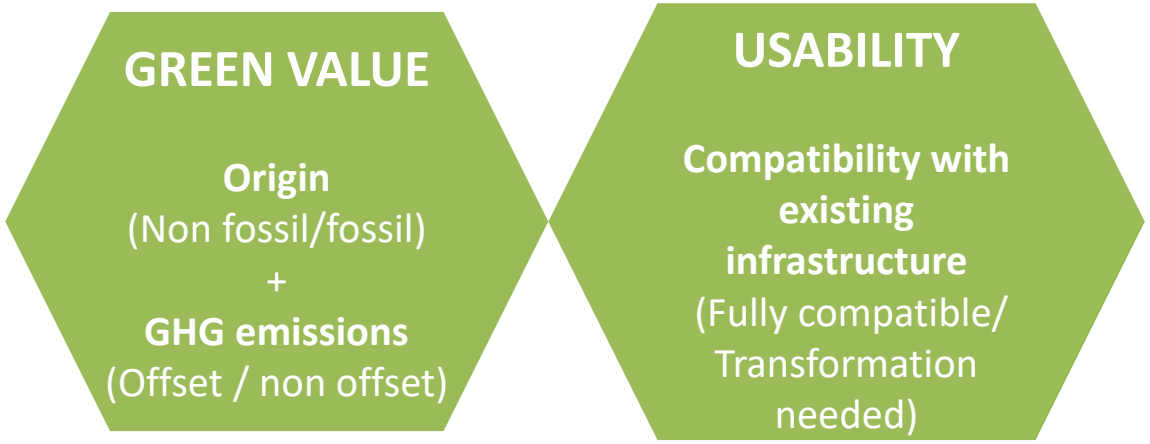
- The same type of gas can be obtained through several processes and starting from different origin
- Gas obtained from non-fossil origin is not always GHG free
- Synthetic gas includes CH4 but it can be made starting from 100% renewable hydrogen and with no GHG emissions
- 3 identical molecules of Hydrogen can be obtained from
  - Biomass (100% non-fossil) with GHG emissions
  - Gas with (almost) no GHG emissions
  - Coal, with GHG emissions

Taxonomy: which issues are we trying to solve?

- **Green H2** – gas produced from renewable resources such as solar PV, wind, hydropower.
- **Blue H2** – low-carbon gas produced by thermochemical conversion of fossil fuels with carbon capture use and storage (CCUS).
- **Grey H2** – gas produced via Steam Methane Reforming (a thermochemical conversion of fossil fuels) without the capture of CO2.
- **Turquoise H2** – gas produced via pyrolysis via renewable electricity and no CO2 emissions.
- **Yellow H2/Pink H2 -** gas produced via pyrolysis or electrolysis using nuclear electricity

FSR Gas Taxonomy proposal: defining and classifying gas(es)

1. **Object:** Biogas, biomethane, synthetic methane, hydrogen
2. Two key **parameters** to define a type of gas**:**



3. Methodology: a binary code to attribute values

	BINARY VALUE	0	1
GREEN VALUE	ORIGIN	NON FOSSIL	FOSSIL
	LIFECYCLE GHG EMISSIONS	OFFSET	NON OFFSET
	USABILITY	FULLY COMPATIBLE	TRANSFORMATION NEEDED

Results

TYPE OF GAS	
ALPHA **(high/very high GV, high U)**	**Biogas, biomethane,** **Synthetic methane** from 'green H2' via ATM CO2, Synthetic methane from 'green H2' via non ATM CO2
BETA **(high GV, low U)**	**«Green H2»** via pyrolysis of biomass, electrolysis or photo catalysis
GAMMA **(low GV, low U)**	**«Blue H2»** via pyrolysis of gas OR via SMR with CCS
DELTA **(very low GV, low U)**	**«Grey H2»**, produced via pyrolysis of coal or via SMR without CCS

The Taxonomy debate is still open

- FSR Taxonomy is not the only one:
  - Gas Industry association proposal
  - Civil society
  - Electricity sector
  - Etc.
- EU Taxonomy for Sustainable Finance
- Clarification in next legislative steps?
  - Hydrogen Strategic Outlook
  - Smart Sector Integration Strategy

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Thank you for your attention!

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