GAS FOR CLIMATE

THE OPTIMAL ROLE FOR GAS IN A NET ZERO EMISSIONS EU ENERGY SYSTEM

MADRID FORUM

5 JUNE 2019

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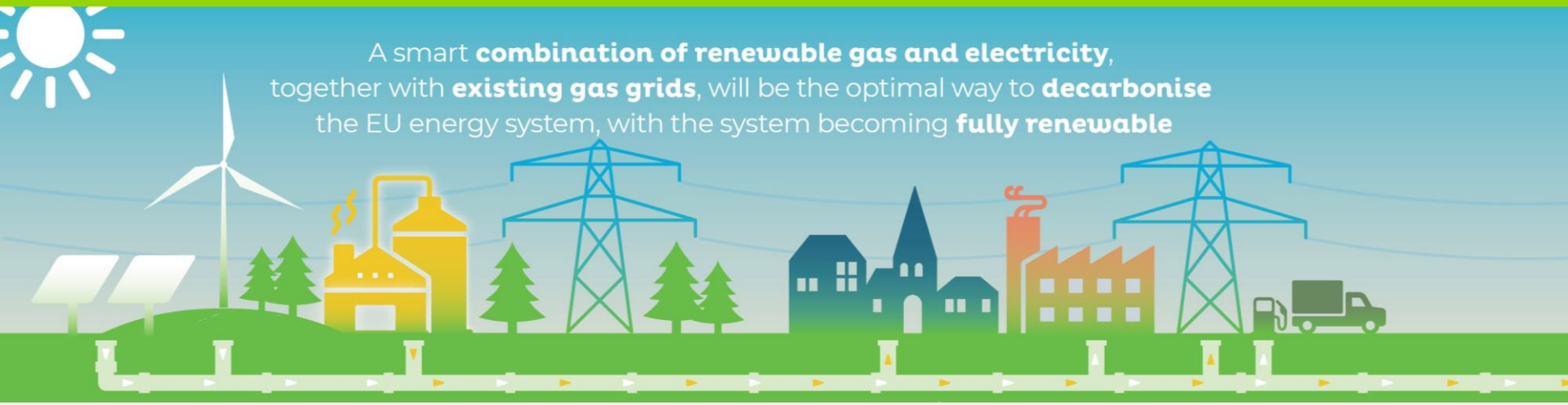
GAS FOR CLIMATE - VISION AND SCOPE



- Gas for Climate: a consortium of seven European gas transport companies and two renewable gas industry associations.
- Navigant's 2019 Gas for Climate study analyses the entire energy system:
  - **Supply**: biomethane, power-to-methane, green hydrogen (from additional wind and solar), blue hydrogen (from natural gas with CCS) and renewable electricity
  - **Demand**: buildings, industry, transport, power; range of decarbonisation options
  - Gas and electricity **infrastructure**
- In our analysis, we aim for **lowest overall societal cost**

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NEW GAS FOR CLIMATE STUDY ANALYSES ALMOST THE FULL ENERGY SYSTEM

Vision	**Achieving a net zero emissions EU energy system by 2050 based predominantly on renewables**	
Scenarios	**Minimal gas scenario**	**Optimised gas scenario**
Future energy categories	Variable renewable electricity Hydropower Biomass power Green hydrogen	Variable renewable electricity Hydropower Biomethane Power to methane Green hydrogen Blue Hydrogen
Infrastructure		
Demand sectors	BUILDINGS TRANSPORT INDUSTRY POWER	

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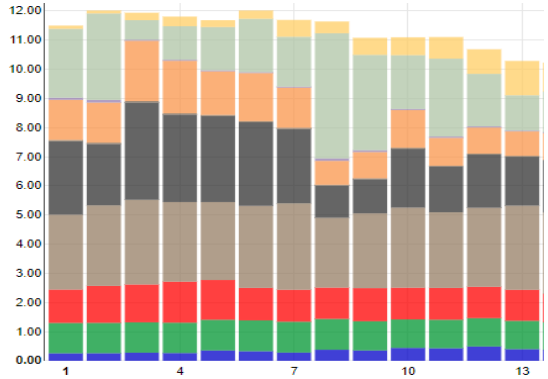
RENEWABLE GAS CAN SIGNIFICANTLY REDUCE SYSTEM COSTS, WITH FOUR SWEET SPOTS

POWER

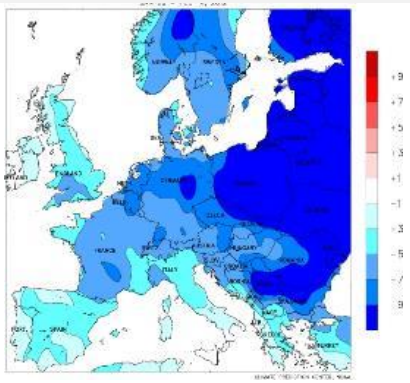
DISPATCHABLE POWER



Source: Energy-Charts.de

BUILDINGS

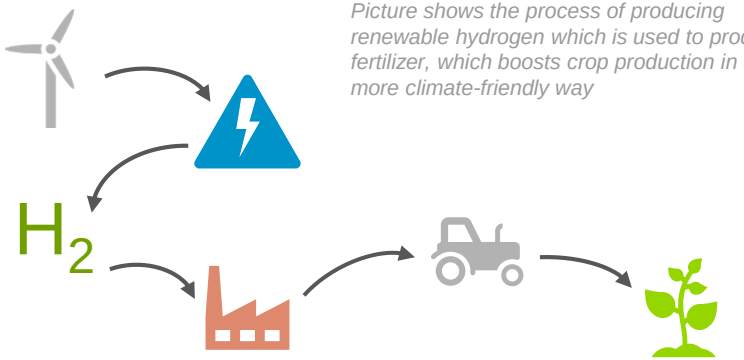
HEATING SUPPORT IN COLD SPELLS



Source: US National Weather Service

INDUSTRY

HIGH TEMP HEAT & FEEDSTOCKS



Picture shows the process of producing renewable hydrogen which is used to produce fertilizer, which boosts crop production in a more climate-friendly way

TRANSPORT

HEAVY ROAD TRANSPORT & LONG DISTANCE SHIPPING

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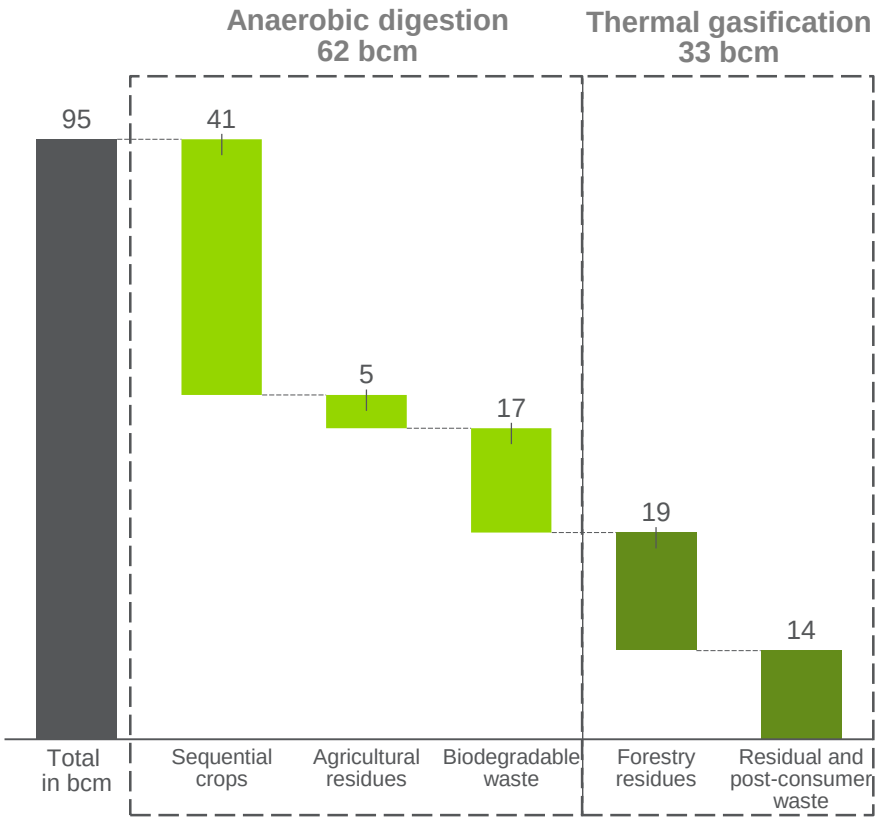
THE SUPPLY SIDE: BIOMETHANE AND HYDROGEN POTENTIAL

BIOMETHANE can supply up to 1,010 TWh (95 bcm) at strongly reduced costs of €47–57/MWh



Source: Navigant analysis

HYDROGEN can supply up to 1,710 TWh to the buildings, industry, transport and power sectors. Costs can come down to €52/MWh (based on dedicated renewable electricity)

- **Green hydrogen** has a large technical potential, linked to the potential of offshore wind and solar PV
- **Blue hydrogen** produced from natural gas combined with CCS can be a scalable and cost-effective option to **accelerate decarbonisation** in coming years.
- Navigant envisions that on the longer term the future energy system will be **fully renewable**, with blue hydrogen being replaced by renewable green hydrogen.

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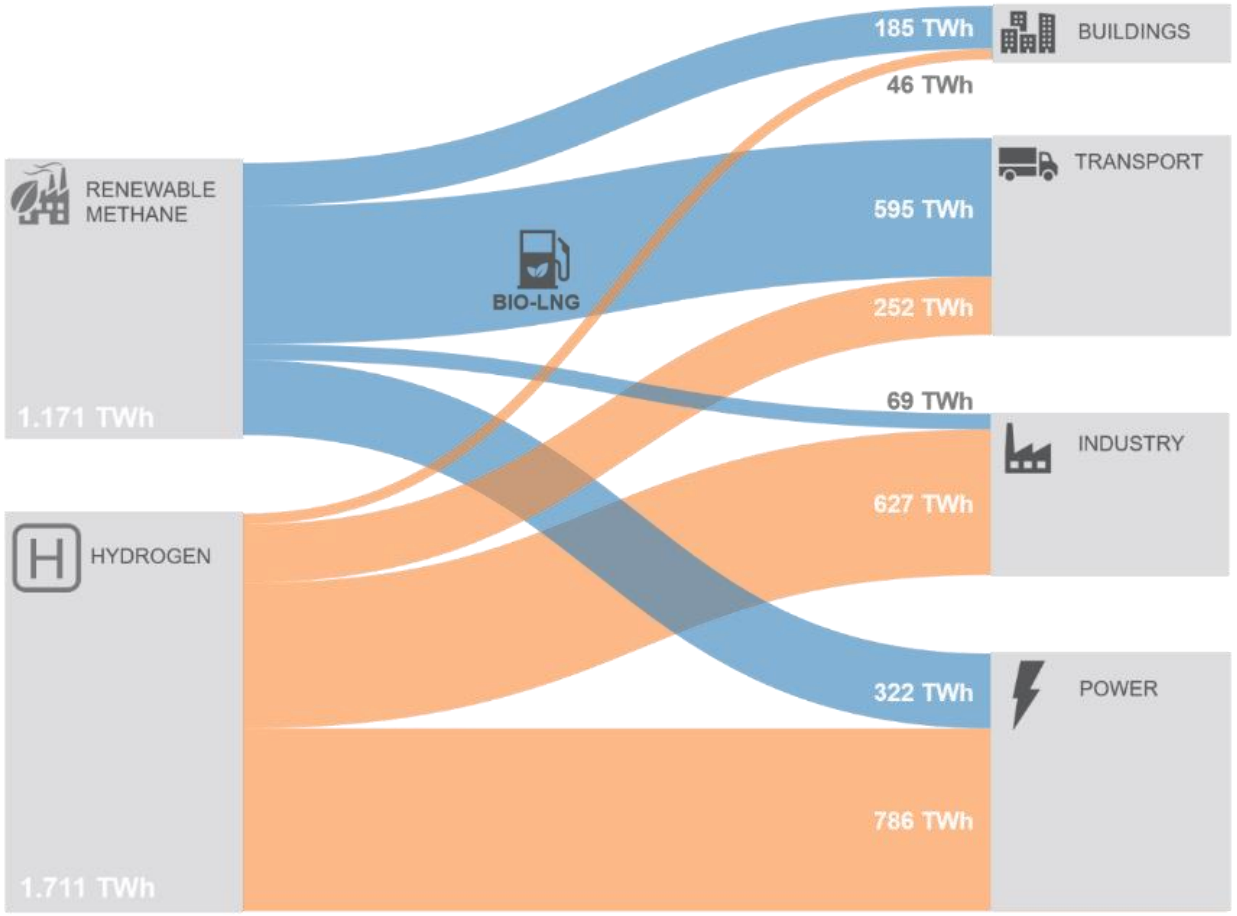
RENEWABLE AND LOW CARBON GAS SUPPLY AND DEMAND IN THE OPTIMISED GAS SCENARIO

- Renewable methane is used primarily in the buildings and power sectors and in the transport sector (as bio-LNG)
- Hydrogen is used primarily in the transport, industry, and power sectors



Source: Navigant analysis

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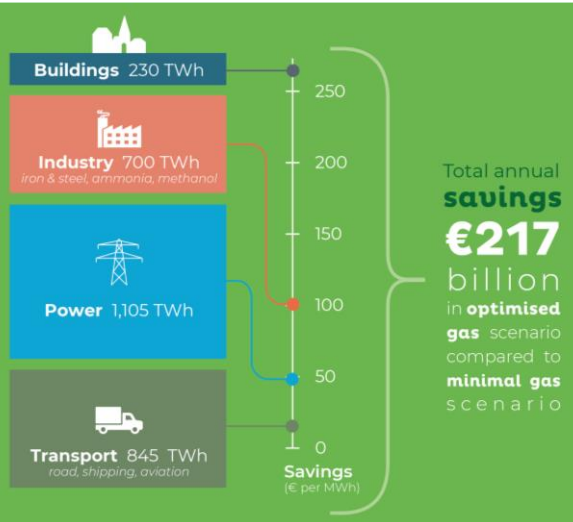
FUTURE GAS IN EXISTING INFRASTRUCTURE CREATES VALUE

Renewable methane and hydrogen used optimally in the energy system can save society €217 billion annually compared to an energy system with a minimal amount of gas



- Gas used in existing gas infrastructure is indispensable to achieve cost-effective full decarbonisation. Not scaling up renewable and low carbon gas and decommissioning gas infrastructure will lead to unnecessary costs.
- Large cost reductions in green and blue hydrogen, biomethane and power to methane are possible, requiring dedicated efforts by companies and governments
- Using existing gas infrastructure is vital to maximise public acceptance to the energy transition by avoiding unnecessary new overhead powerlines

Gas infrastructure can continue to ensure the reliability and flexibility of the energy system, even when quantities of gas decrease. Current gas grids would almost completely continue to be used, to transport and distribute renewable methane and hydrogen.

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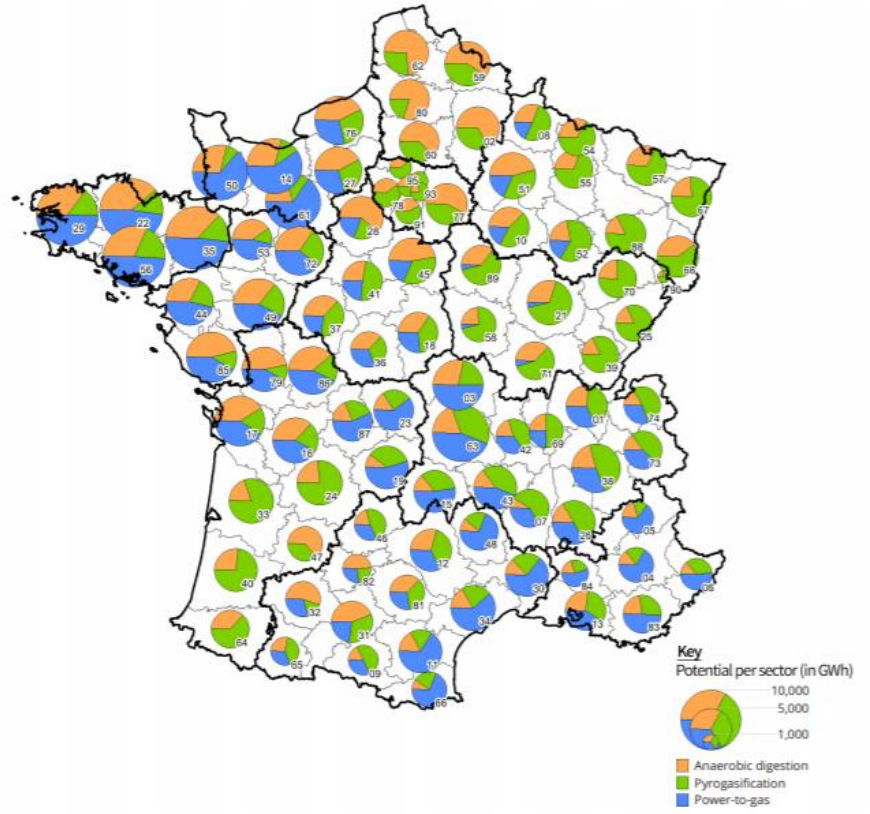
GAS INFRASTRUCTURE NEEDED TO SCALE UP RENEWABLE GAS TO 272 BCM BY 2050

Medium and low pressure gas networks can serve to collect biomethane where it's produced and distribute it to buildings and other sectors



Source: ADEME

High pressure pipelines can serve to transport hydrogen, carrying offshore wind energy from the North, and solar energy from the South

Source: Navigant, on map by ENTSOG

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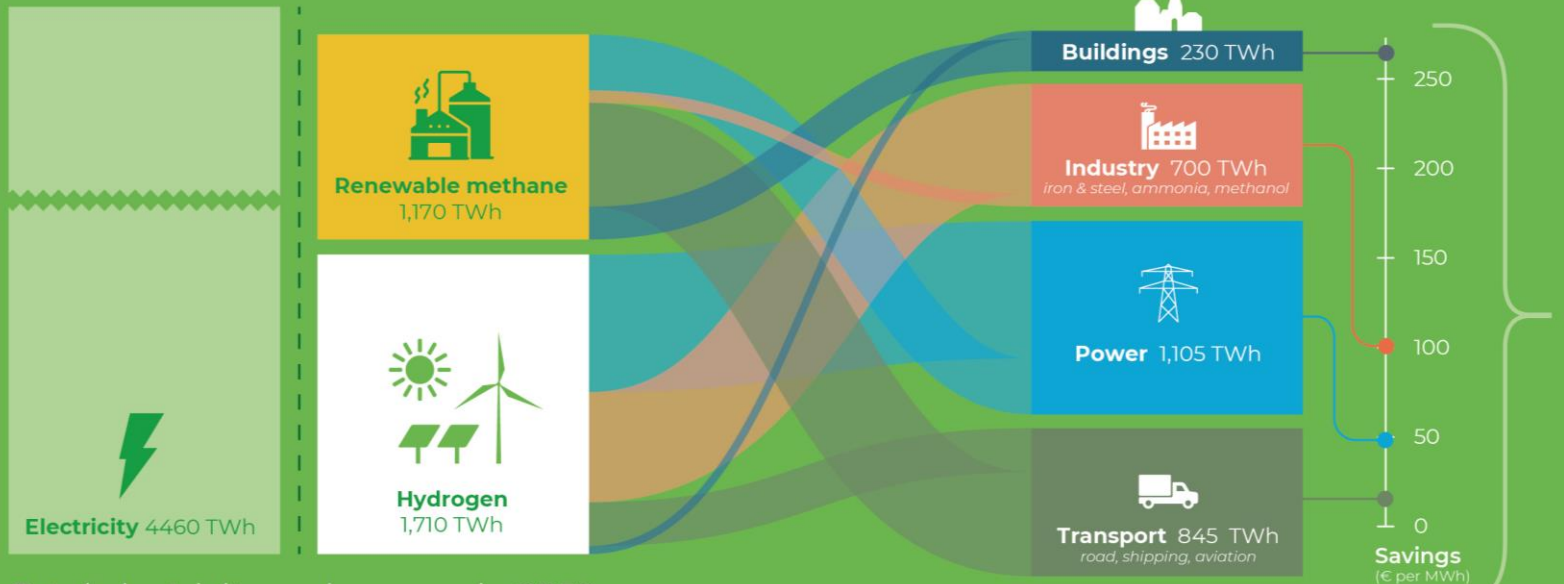
A smart **combination of renewable gas and electricity**, together with **existing gas grids**, will be the optimal way to **decarbonise** the EU energy system, with the system becoming **fully renewable**



Total annual **savings** **€217** billion in **optimised gas** scenario compared to **minimal gas** scenario

Total electricity and gas use in 2050 in optimised gas scenario

This quantity of renewable and low carbon gas equals 272 bcm of natural gas equivalent (energy density).

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