Impact of the use of the biomethane and hydrogen potential on trans-European infrastructure

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Aim and scope of the study

Study aims at a better understanding of:

- Potential of biomethane and hydrogen to contribute to the energy transition
- Economic and technical impacts of significant deployment of low carbon gases
- Readiness of gas network operators and regulators

Objectives affect the study boundaries !

- Explorative scenarios aim to assess the impact on gas infrastructure
  - Not to forecast deployment pathways for H_2 or bio-CH_4
- Potential assessment focuses on maximum technical potential
- Assumptions regarding
  - Supply of biomethane and hydrogen (focusing on domestic EU supply)
  - Sectoral end-use demand for electricity, methane and hydrogen
  - Availability and location of flexibility resources to 2050
  - Hourly profile for supply of renewables

Explorative scenarios

	Scenario 1		Scenario 2		Scenario 3	
Storyline from the gas infrastructure study	"Strong **electricity** end-use"		"Strong green **methane** end-use"		"Strong **hydrogen** end-use"	
Time horizon	2030	2050	2030	2050	2030	2050
GHG emission reduction target						
Total GHG emission reduction incl. LULUCF vs. 1990	-49%	-100%	-49%	-100%	-49%	-100%
End user preferences						
End-user decision	Electricity-based end user applications		Methane-based end user applications		Hydrogen-based end user applications	
Major energy carrier	Electricity		Biomethane		Hydrogen	
Strategy for the gas infrastructure to follow end user preferences						
Expected gas type	Natural gas (+ biomethane)	Biomethane (+ $PtCH_4$)	Natural gas (+ biomethane)	Biomethane (+ $PtCH_4$)	Natural gas (+ biomethane)	Hydrogen
Regional distribution methane supply	• For natural gas according to import routes and production sites • For biomethane according to availability and supply costs • For $PtCH_4$ according to renewable power supply					Close to CH_4 demand
Regional distribution hydrogen supply	In close proximity to hydrogen demand					Close to renewable power supply
Seasonal gas storage	Conventional large-scale CH_4 storage					H_2 salt caverns

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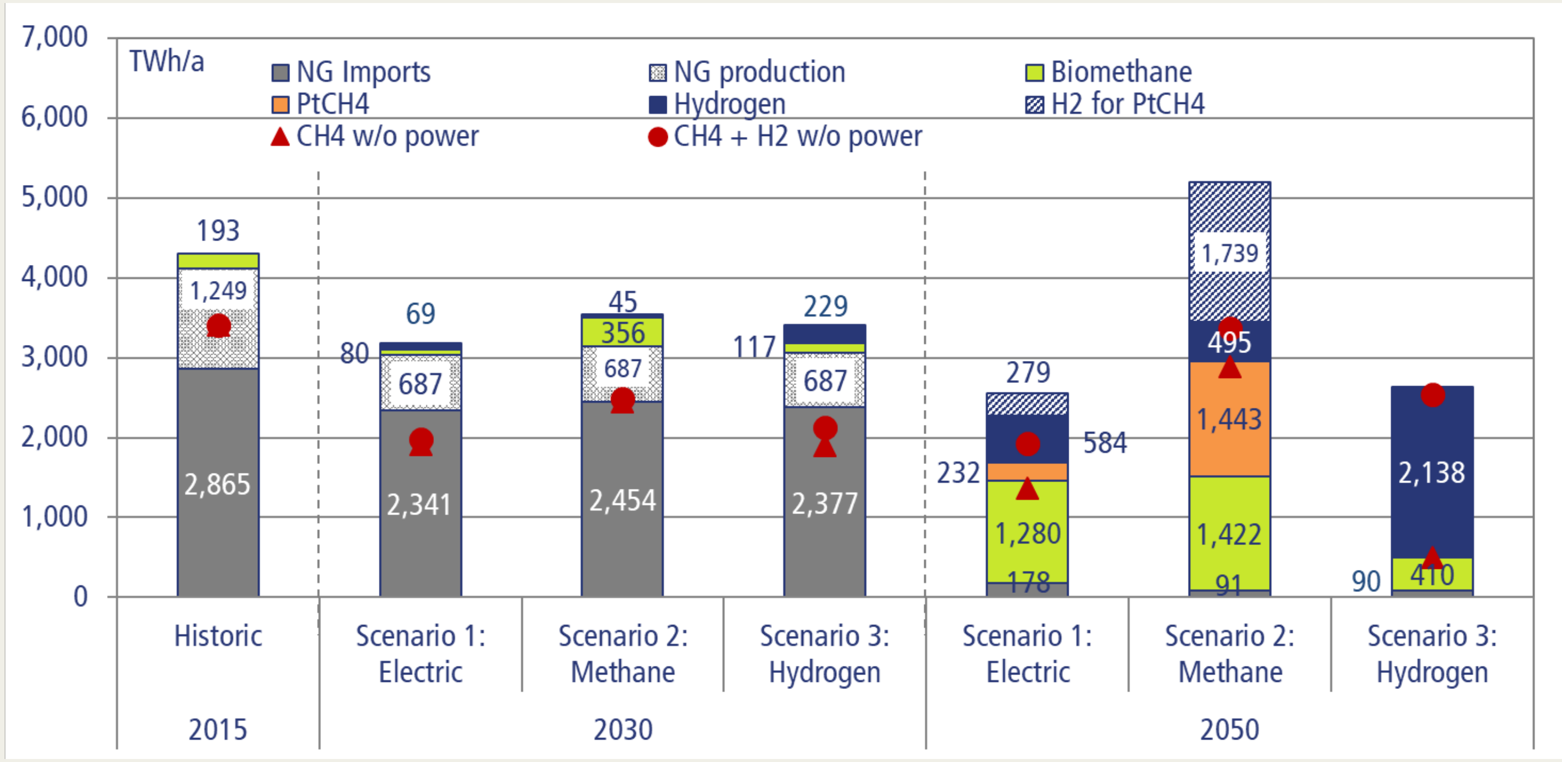
Diversified gas supply in the long-term

- Decreasing gas demand and supply in the mid- and long-term
- Fossil gas still dominant in 2030, major role for biomethane & H_2 in 2050 (and $PtCH_4$ in CH_4 scenario)
- Limited supply from biomethane by 2030, utilisation of full biomethane potential until 2050



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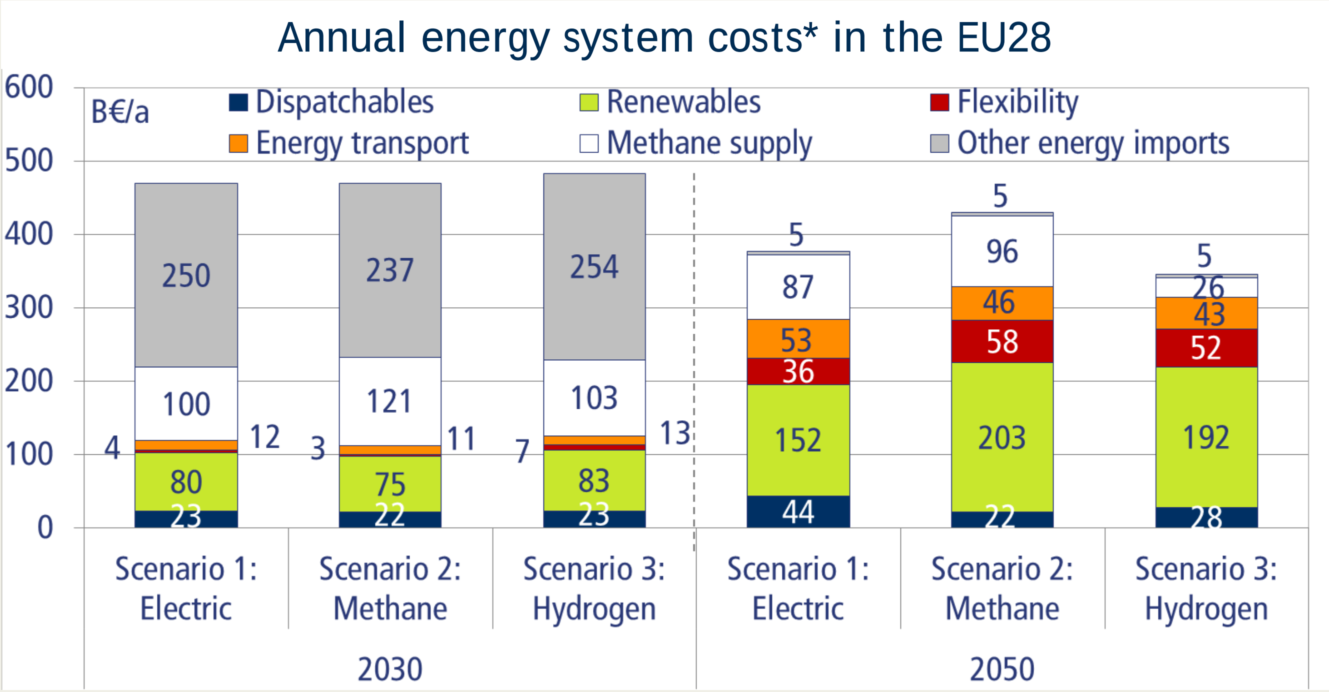
Sector coupling leads to lowest system cost

- Decreasing system costs due to increasing sector integration and substitution of energy imports
- Important role of decreasing specific renewable power generation costs
- Optimal system costs as a trade-off between renewables, system flexibility, and gas supply
- Electricity grid investments dominate costs for cross-border energy transport in 2030 and 2050
- CO_2 reduction costs are calculated as total system cost difference between 2030 and 2050 (excluding CO_2 costs) divided by emission difference
- This results in negative values ranging between -20 €/t_{CO2} in the methane focused Scenario 2 and -68 €/t_{CO2} in the hydrogen focused Scenario 3



* excluding national energy transport costs

Methane scenario 2050: following biomethane potential

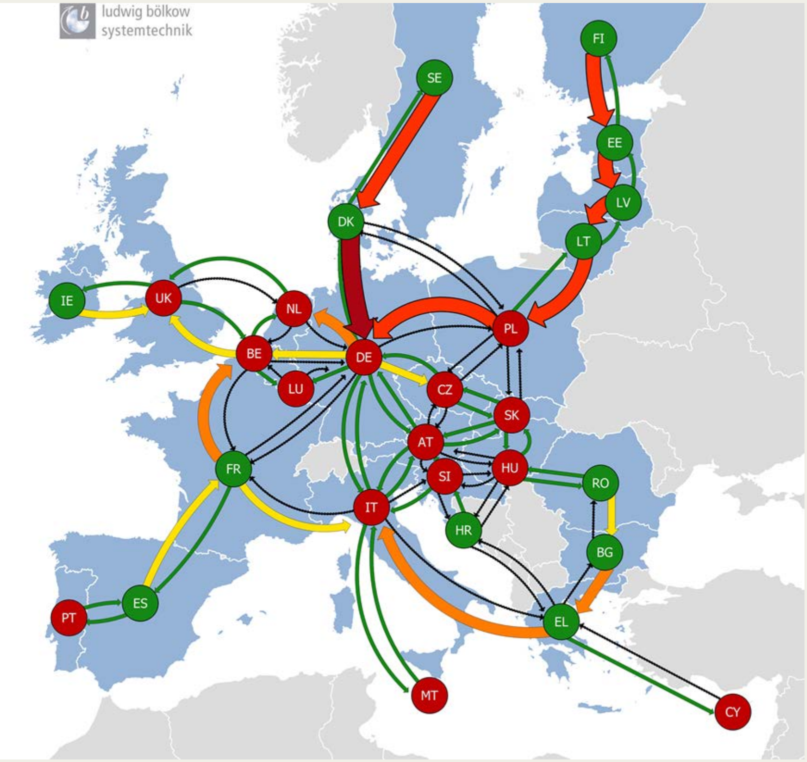
Gas Flows
- None
- <20 TWh/a
- 20 - 50 TWh/a
- 50 - 100 TWh/a
- 100 - 200 TWh/a
- >200 TWh/a

Net demand

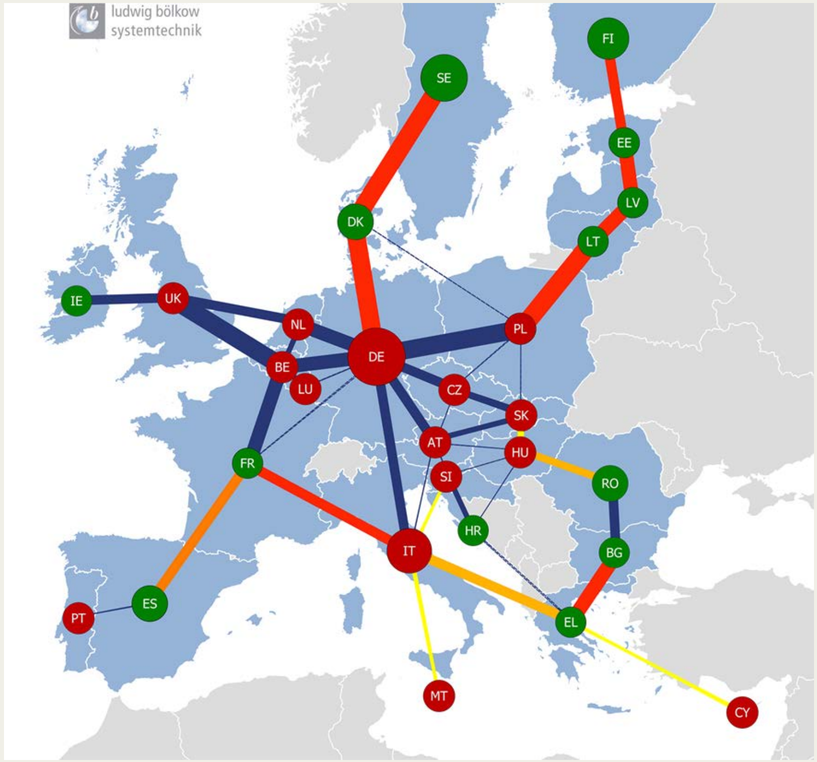
Supply surplus

Supply = Demand

Expected gas flows



Required gas infrastructure capacities



Required grid capacity
- None
- < 2 GW
- 2 - 10 GW
- 10 - 20 GW
- 20 - 30 GW
- >30 GW

Grid capacity investment
- < 2 GW
- 2 - 5 GW
- 5 - 10 GW
- > 10 GW

Net demand

Supply surplus

Supply = Demand

Capacity
- 0 TWh/a
- <60 TWh/a
- 60 -120 TWh/a
- 120 - 180 TWh/a
- >180 TWh/a

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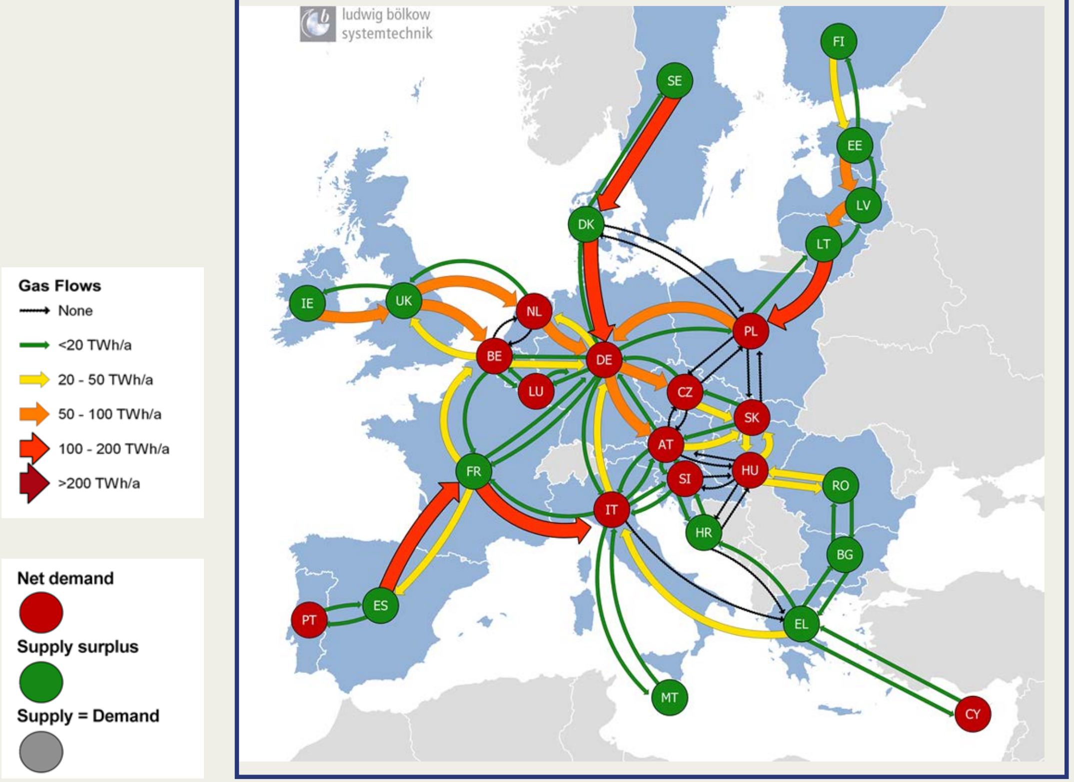
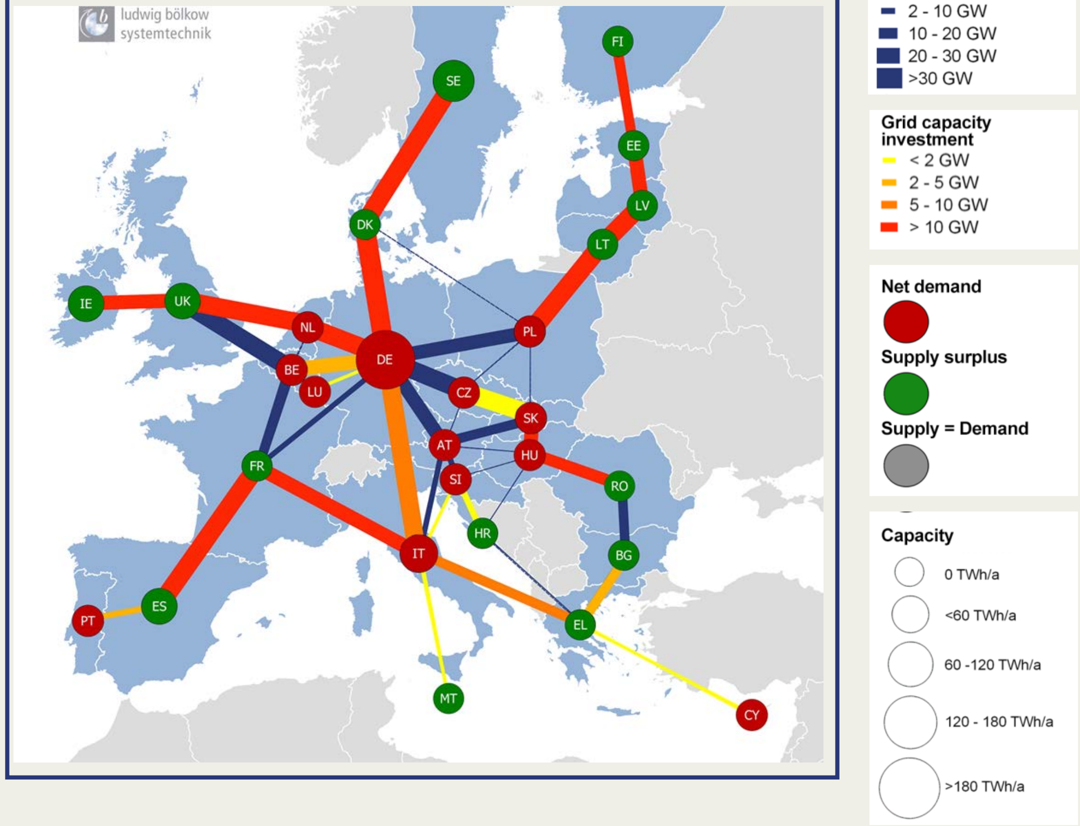
Hydrogen scenario 2050: following renewable power and electrolysis

Expected gas flows



Required gas infrastructure capacities



Recommendations (1/2)

Limitations and uneaqual distribution of **renewable gas resources require**:

- Integrated European gas systems and markets, with EU-wide guarantees of origin
- Technical standards and specifications to facilitate biomethane and H_2 trade

Separate H_2 networks more adequate than admixture for strong deployment

- Further analysis on H_2 role and strategies for H_2 network "islands"
- Further study on framework for cross-border trade – e.g. thresholds, (de)blending

Infrastructure planning

- Optimise use of existing infrastructure, possibly through conversion to H_2 networks
- Integrate across energy carriers and T&D, with clear policy guidance
- Shift to future-proof investments
- **TEN-E & CEF**: Support integration of renewable and decarbonised gases with review of scope & eligibility

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Recommendations (2/2)

Regulatory framework

PtG

Power-to-gas to be developed considering:
- Barriers to investment such as double grid charging
- Role of TSOs, weighing alternative approaches

H2

Policy guidance to reduce uncertainties regarding H_2 pathways and integrate 'H_2 islands' in the long-term
- With **regulation** inspired on current framework for natural gas and defined sufficiently ahead of actual deployment

Tranversal efforts

Transversal efforts across national frameworks to:
- Improve effectiveness and avoid stranded investments
- Avoid competition distortion between energy vectors
- Value economic benefits of local renewable gas

Mitigation measures

Measures to mitigate potential negative impacts on network operators and users could be considered

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E3Modelling Energy Economy Environment

Thank you for your attention, please contact us for more information

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