

26th World Gas Conference

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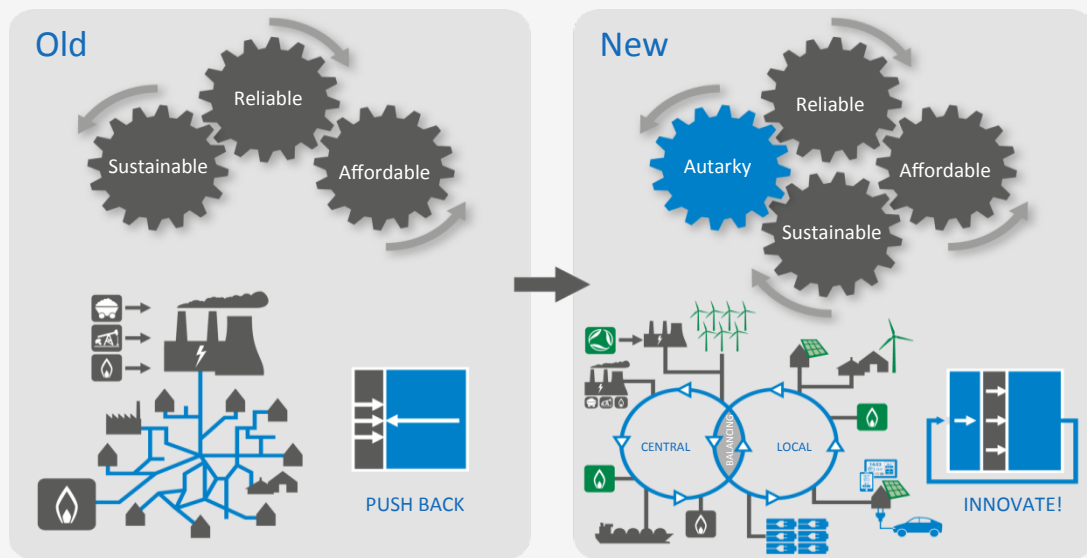
System integration: what **GREEN GAS** and gas infrastructure have to offer to a sustainable energy supply

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Society asks for a sustainable energy mix

The role of gas in the sustainable energy mix is not undisputed



Gas and gas infrastructure have a lot to offer in a sustainable energy mix. Gas is the energy carrier that can make a sustainable future reliable and affordable

Renewable gas is a cornerstone of the sustainable energy mix

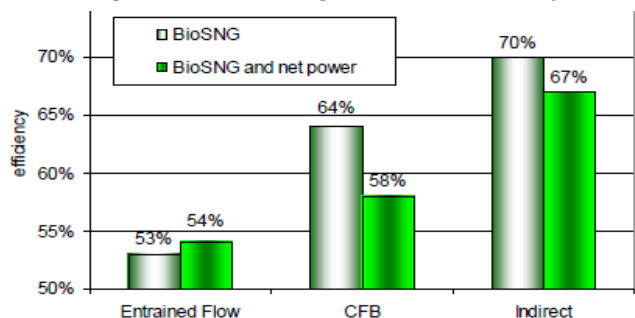
Role of renewable gas in the sustainable energy mix

- Renewable gas as a **direct contribution** to a sustainable energy mix
 - Anaerobic digestion
 - Gasification
- **Flexibility and back-up** for the sustainable energy mix: Power to gas and (green) gas to power
 - Central
 - Decentral
- **Emission reduction** by gas in transport
 - LNG and LBG for shipping and heavy road transport

Gasification for large scale bioSNG production

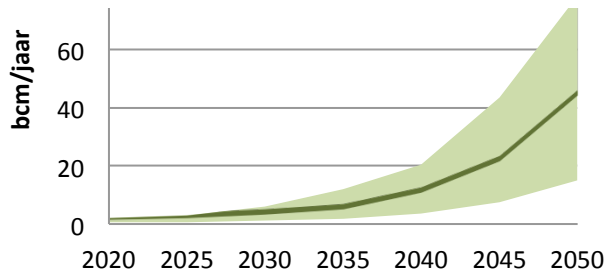
Gasification of sustainable biomass offers a highly efficient and competitive contribution to a sustainable energy mix

Efficiencies gasification technologies to BioSNG and net power



BioSNG market potential EU28

based on available sustainable biomass and market demand

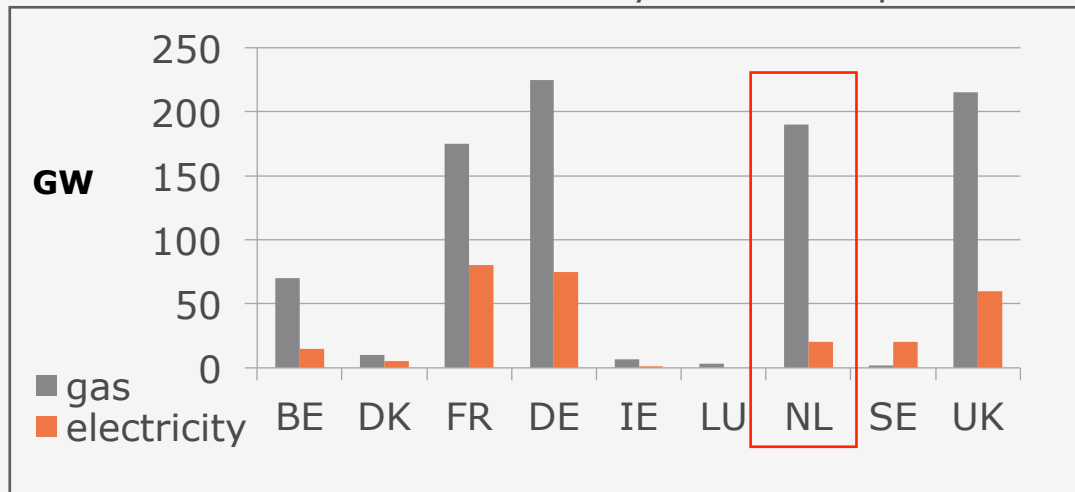


- Gasification converts biomass to bioSNG with an **efficiency** of up to 70%
- **Competitive costs** between 14 US\$/GJ (low cost biomass, 2 US\$/GJ) to 24 US\$/GJ (high cost biomass, 9 US\$/GJ) (ECN 2014); Gas 8 US\$/GJ
- Estimates for **sustainable biomass available** for energy production vary widely, but the potential is substantial (200-400 EJ/year)
- Additional potential considering **gasification of waste** (5 – 8 bcm gas/year, EU 28)
- **Lower CO₂ emissions** than coal, gas and burning of biomass
Possibility for negative CO₂ emissions in combination with sequestration
- Possibility to **extract BTX and other valuable components**

Gas peak demand is a multiple of electricity peak demand; gas cannot easily be replaced

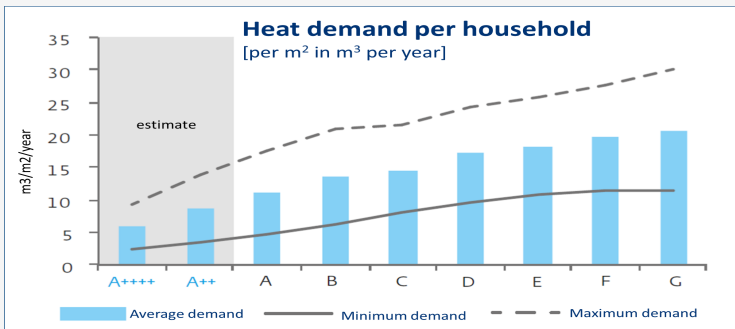
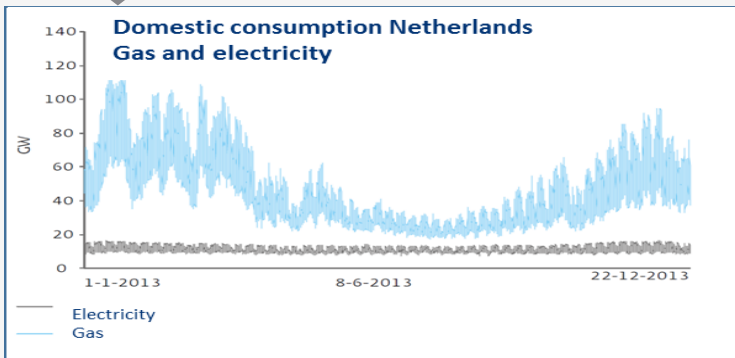
Dutch peak gas demand is 10x higher than peak electricity demand

Peak demand
Gas and electricity in NW Europe



High seasonal peak demand due to domestic heating

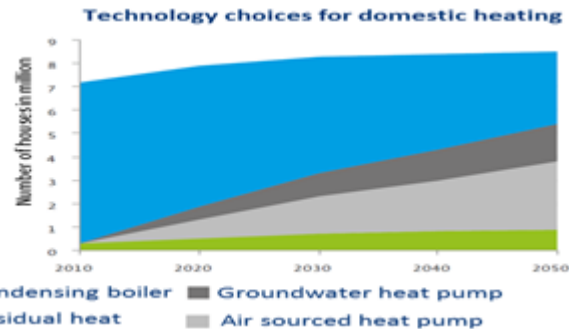
Domestic heat demand causes high peak demand; different technologies need to be used to reduce heat demand and CO₂ emissions



Sustainable heating. Main technology options after insolation

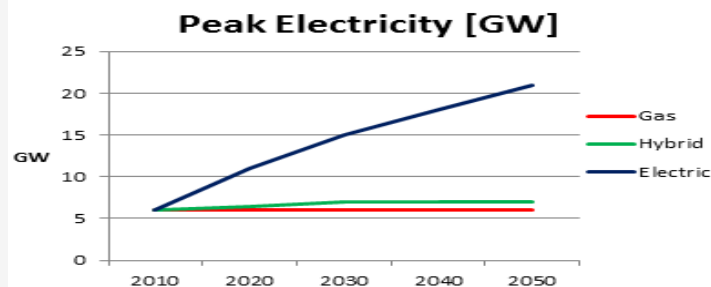
- District heating
- Heat pumps
- Solar thermal (limited applicability in Northern Europe)
- Biomass (wood chips and pallets)

Scenario 100K heat pumps per year (NL)

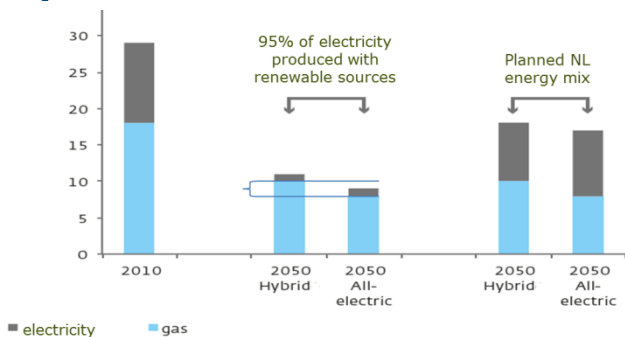


Hybrid heat pumps compared to all-electric avoid network investments at only marginally higher CO₂ emissions

Hybrid heat pumps offer nearly the same CO₂ reduction potential as all-electric heat pumps but avoid significant investment in electricity infrastructure



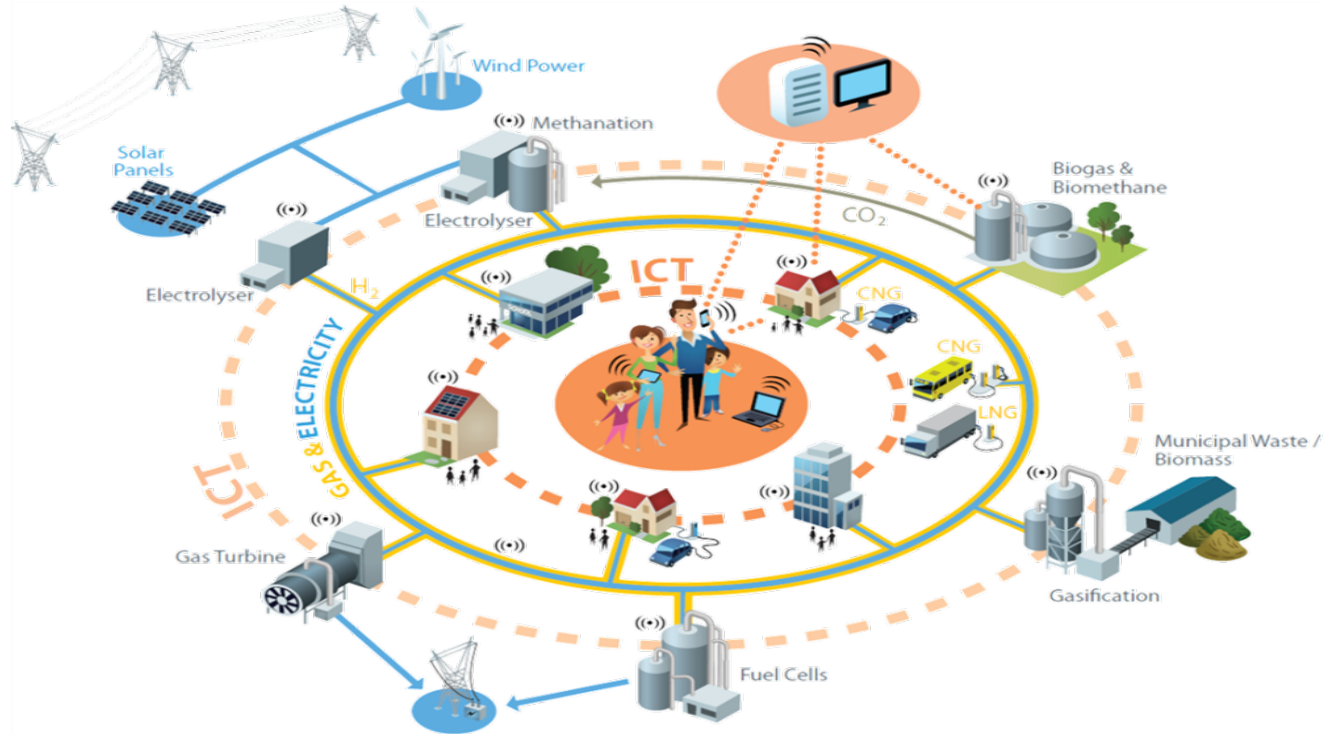
CO₂ reduction NL households with all electric and hybrid heat pumps



- Air sourced heat pumps
- Groundwater sourced heat pumps
- Highly efficient 400%; but decreases with lowering temperatures (AHP)
- All-electric solutions require a significant investment in the electricity grid for peak demand

→ **Hybrid (gas for peak) technologies**
High efficiency, low investment, near same CO₂ emission
No electricity grid extensions necessary, which is a significant contribution to **affordability at system level**

Vision of a sustainable energy system and the role of gas infrastructure



Hybrid technologies in combination with biomethane production make the transition to a sustainable energy mix reliable and affordable