GROUPE EUROPEEN DE RECHERCHES GAZIERES
THE EUROPEAN GAS RESEARCH GROUP

Gas Technologies in the European Energy Transformation

How to foster innovation in a fast changing energy landscape
8th October 2013

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The European Gas Research Group

- 52 years of collaborative R&D on natural gas topics
- Effective gas industry network for R&D information exchange
- 27 members from 14 countries - all active in R&D
- Growing associate Membership for non-gas industry cooperation
- High quality research resource
- Academic Network
- Some Current priorities:
  - Hydrogen/Power to Gas
  - Renewables integration and decarbonisation
  - Network integrity and safety
  - LNG infrastructure
  - New end use technologies, CHP, mobility
  - Interoperability of our gas and energy networks

EC-funded Projects

DEO • CONRAD • DIGBUILD • VOGUE • MICROMAP • PRESENSE • LABNET • GIGA • COMBO • NATURALHY • ORFEUS • INTEG-RISK • GASQUAL• LNG DENSITOMETER

Introduction

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- The Role of Gas – now and in the future
- The way forward for Gas
- Conclusions

The 3 EU pillars

Competitiveness

Security of Supply

Sustainability

How does the gas network contribute to our energy supply

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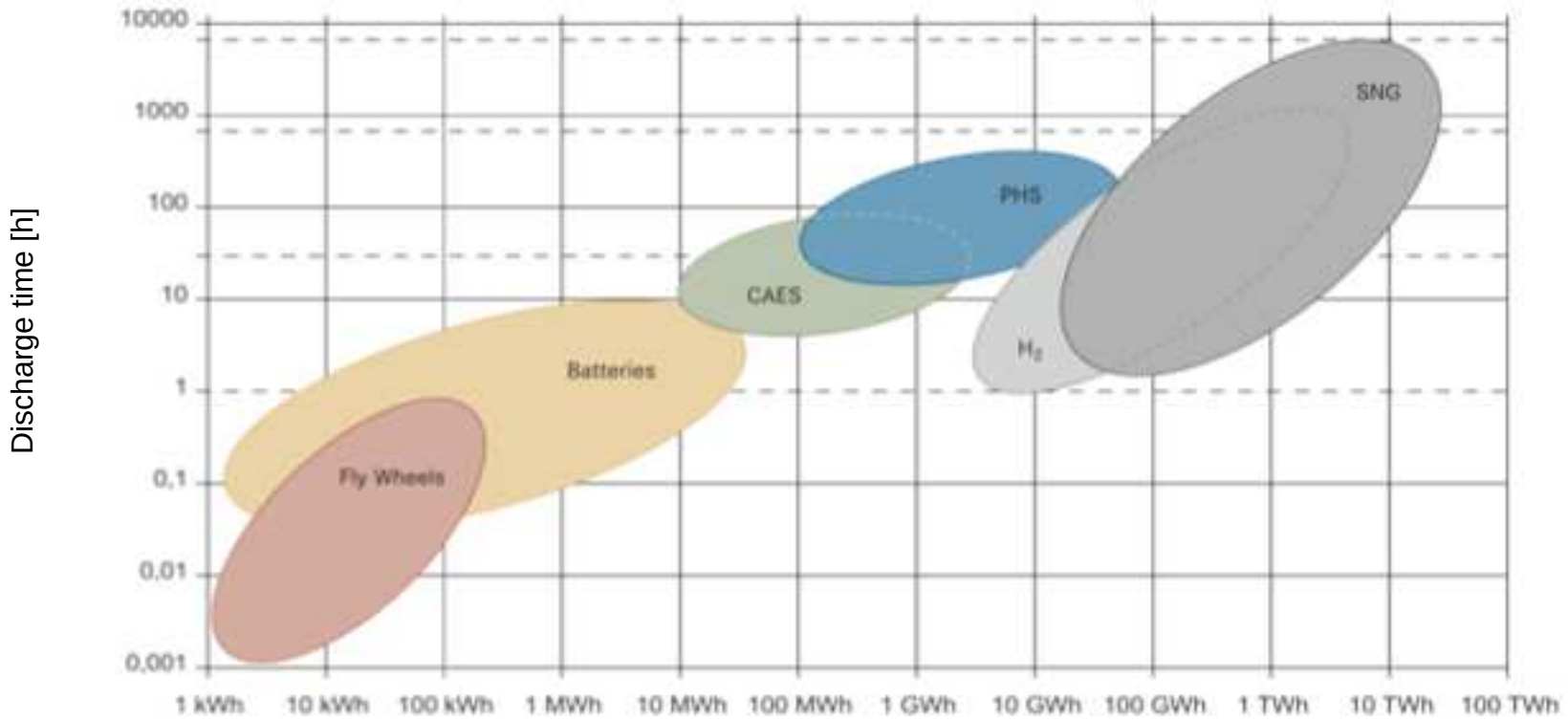
- Mature natural gas grids carry much more energy than electricity grids, and extra capacity is already available.
- In the UK the gas network carries three times as much energy as the electricity grid, comparable with energy consumed by road transport
- End use of gas can be over 90% efficient with low transmission losses

The German Energy system

		Electricity	Natural gas
Consumption	TWh/a	610	930
Average power	GW	70	105
Storage capacity	TWh	0.04	210

The storage of energy as gas has huge potential



CAES: Compressed Air Energy Storage (Druckluftspeicherkraftwerk)
PHS: Pumped Hydro Storage (Pumpspeicherwerk)
H_2, SNG: Hydrogen, Synthetic Natural Gas (Underground storage includes the re-electrification in combined cycle power plant)

Source: Research Center Jülich

Power to gas :
using gas infrastructure to store electricity

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excess renewable electricity

Electrolyser

$2H_2O$ O_2

$2H_2$ $2H_2$

$2H_2$ direct injection into gas grid (10% ?)

gas storage

CO_2 O_2

methanisation

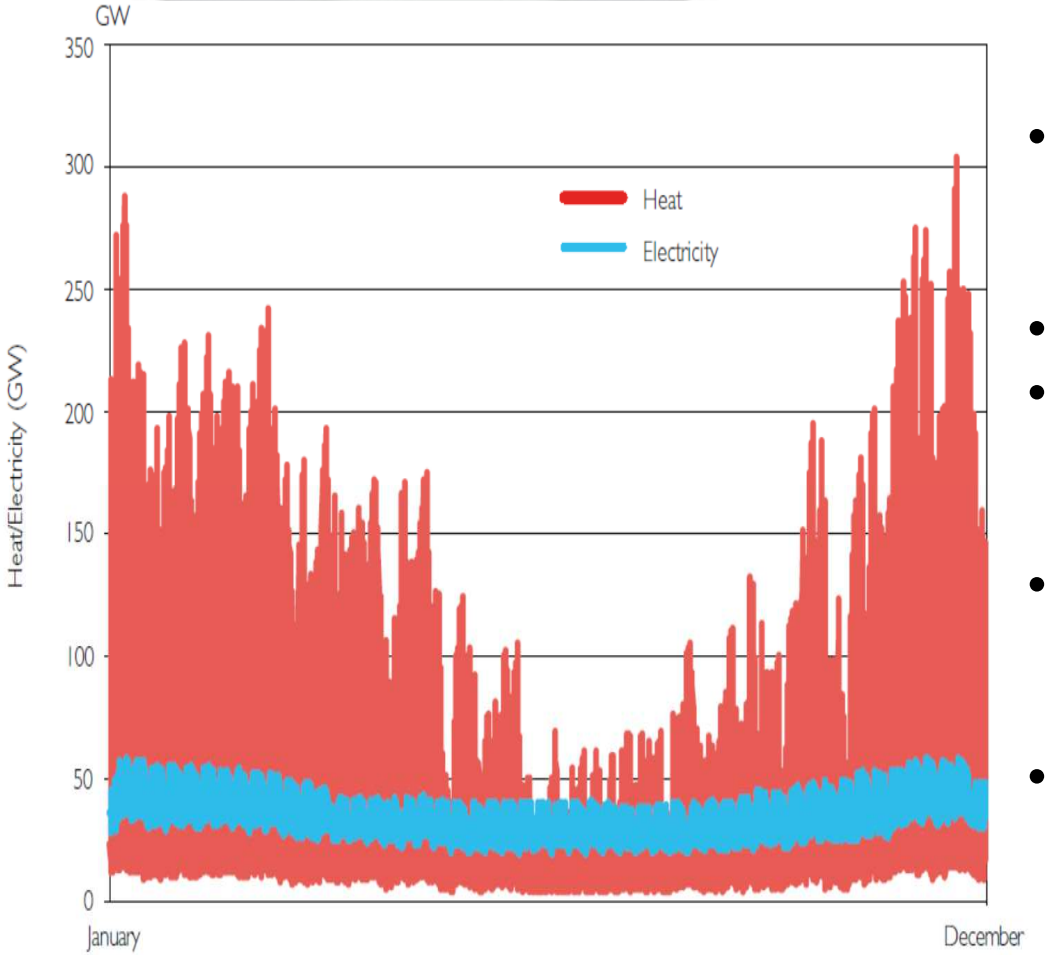
CH_4

injection into gas grid (unlimited)

Source : GERG 2012 Meeting Europe's energy storage challenge

Back to the presentation

Heat loads and electricity demand: UK example



- Heat is 50% of final energy demand
- 30% of CO_2 emissions
- Efficiency benefits already realised
- Heat demand is peaked and highly seasonal
- Gas provides much of this heat

Decarbonisation of heat

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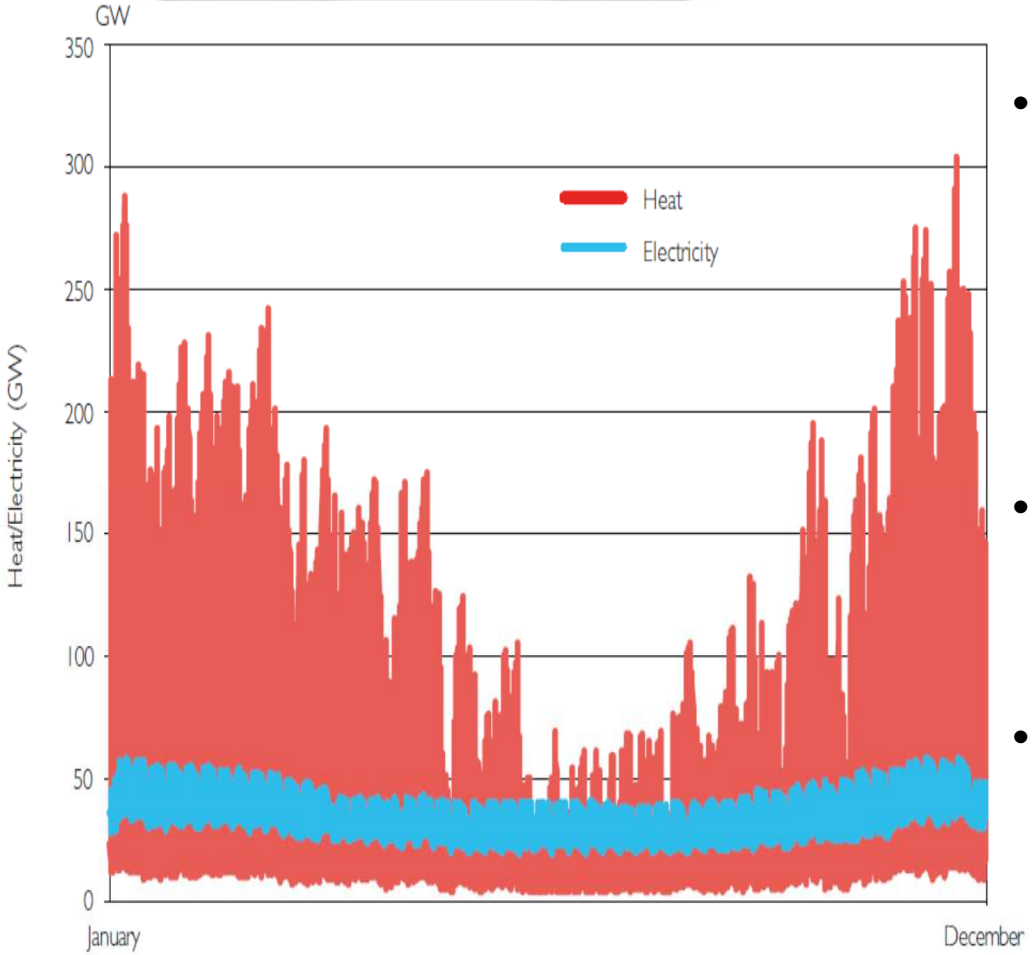

- Achievement of 80% Decarbonisation target by 2050 would require (eg Redpoint 2012) Near trebling of electricity generation capacity if gas is no longer provided to homes.
- However if gas supply is maintained to homes the level of investment drops by €50-100bn
- Additionally there is a growing commitment to greening European gas networks by 2050 which would further widen this investment gap.

Future efficiency improvements for gas appliances

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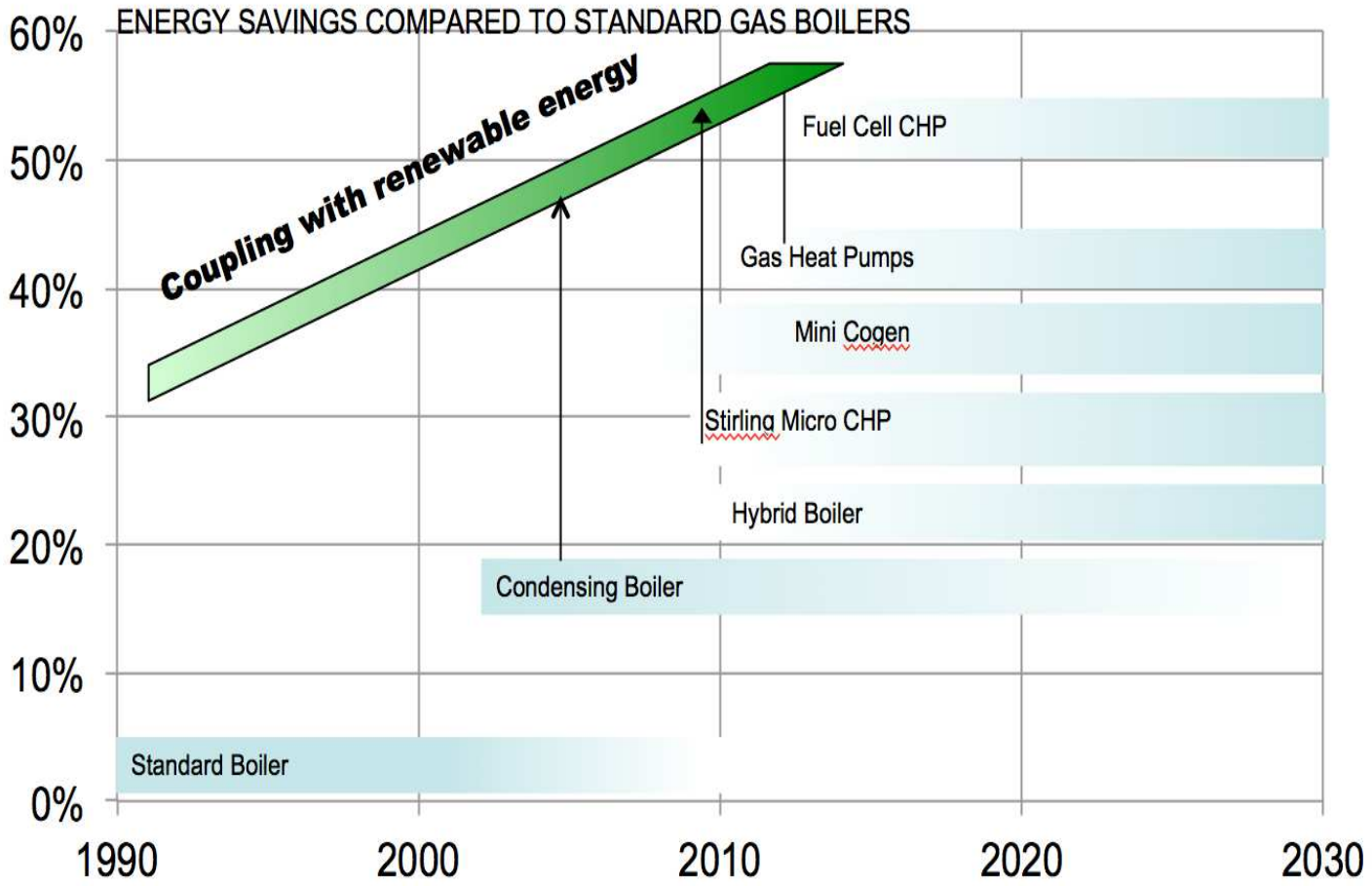

Power Generation

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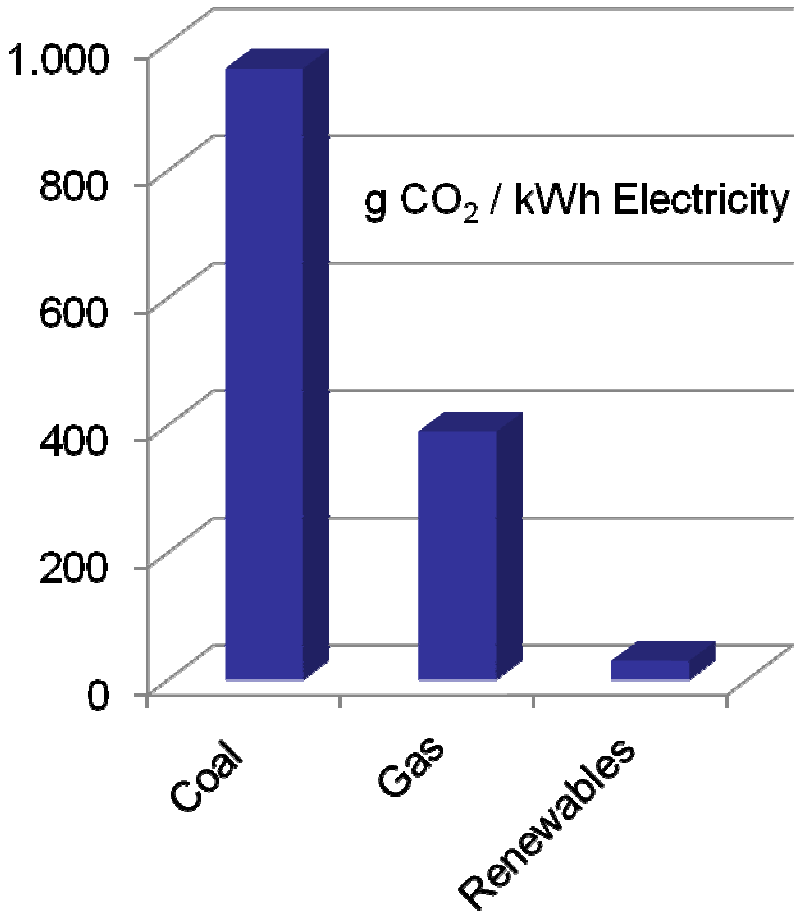

- Two investment cycles in gas power infrastructure between now and 2050
- Options open for the future
- “No regrets” option
- Increasing flexibility of gas power generation allows peak provision and turndown at high efficiency – enables integration of renewables
- Aim to improve flexibility of smaller scale CCGT and fuel tolerance of turbines

Benefits of gas technology In transport

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- Fuel Diversification and Security of Energy Supply
- NG is a cheaper fuel than diesel or gasoline as it doesn't need such a high level of refinement
- Decarbonisation of the transport sector - the combustion of NG allows lower carbon-related and other GHG emissions
- Development of small-scale LNG solution is leading to a viable and real solution for heavy duty and marine fleets
- Power to Gas is providing SNG in the gas grid from renewable sources (Audi e-gas)

Natural Gas and Renewables have to forge a new Partnership

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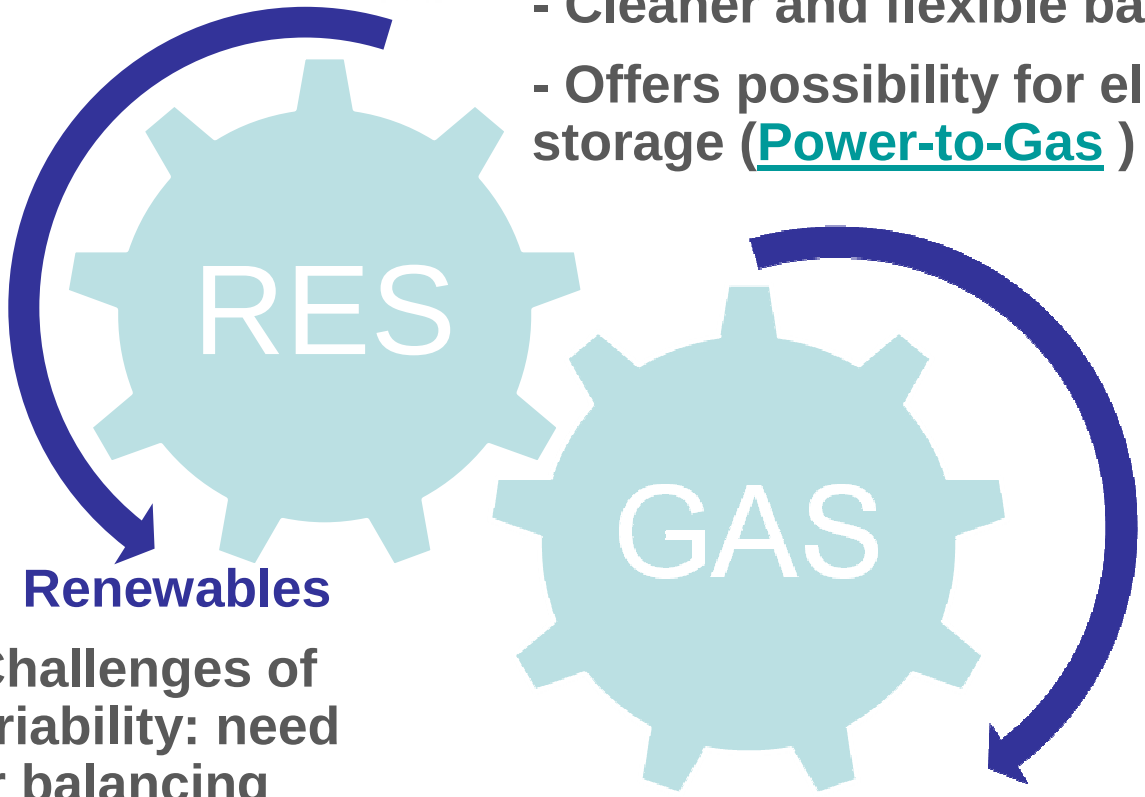
Natural Gas

- Cleaner and flexible back-up
- Offers possibility for electricity storage (Power-to-Gas)



Renewables

- Challenges of variability: need for balancing capacity

What is needed:

A clear view on post-2020 energy and climate policy to provide the right incentives and competitive pressure on the market

Gas will not displace renewables, but enable their integration

gas naturally
making a clean future real

The Way Ahead for Natural Gas? (1/2)

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2013 — **Gas, the fuel of reason** — 2035

- **Gas in power generation, Gas for mid & base load and backing up variable renewables**
- **Gas for heating, hot water & increasingly in heavy transport**
- **Diversifying supplies: New investment in gas infrastructure, including new LNG sources, biomethane, renewable SNG**
- **Further deployment and integration of renewables in the energy system**
- **R&D investment in renewables, energy efficiency, gas technologies and CCS.**

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The Way Ahead for Natural Gas? (2/2)

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2035 — **Gas, part of the solution** — 2050

- **Gas for mid & base load and back up for variable renewables**
- **Further deployment of variable renewables**
- **Power-to-Gas : The gas grid stores and transports excess renewable energy**
- **Helping decarbonisation of EU power, heat and heavy transport sector**
- **CCS wide scale deployment**

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R&D Requirements

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- A Europe wide energy system model which incorporates the natural gas infrastructure as a key element
- SMART Grid concepts should incorporate gas generation, transport, storage and use
- R&D provisions to reduce the cost and improve efficiency of peak and flexible power provision
- Support for injection of renewable gases
- Options assessments and demonstrations of power to gas
- Making the natural gas infrastructure H_2 ready – “Power to Gas” and repurposing for the future
- Invest in advanced end use technology and hybrid systems for end use efficiency gains
- Technology support to integrate a new generation of gas for mobility.

Conclusions

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- New gas technologies used in integrated with renewable energy can increase load factor, flexibility, and total capacity of renewables by opening up options for the future:
- The existing gas grid provides a highly flexible storage medium for electricity and avoids costs of electricity grid reinforcement and under-utilization of renewables.
- Smaller-scale flexible gas powered generation is developing which can load follow to support the intermittency of renewables.
- The gas network will become increasingly de-carbonised through a mixture of power to gas and biomethane injection.
- The integration of a new generation of gas end use appliances with electric heat pumps and solar heat and power will provide a lower cost and flexible alternative to a total dependence on increases in electricity transmission capacity.
- In summary, the gas network and gas technology will be vital in enabling the smart supply and demand managed, low-carbon integrated network of the future.

How to foster innovation?

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- The partnership between gas networks and renewable technologies can accelerate the market readiness of low carbon technologies, by reducing the cost of integration into the energy system and opening up new options for the future.
- P**romising gas-based technologies** such as the storage of renewable electricity as hydrogen or synthetic methane in the natural gas grid, micro-CHP, CCS with gas, small scale LNG and biomethane should benefit from R&D support.
- Support measures should be targeted, coordinated and clearly limited in time and expenditure.
- Cost-benefit analyses with respect to GHG reduction potentials would be helpful. Progress should be measured regularly using key performance indicators.
- The objective is for low-carbon technologies to compete as soon as possible under normal market conditions.
- Horizon 2020 is an excellent opportunity to demonstrate how correctly targeted support measures can build the technology partnerships to bring forward market readiness of innovative energy technologies.
- These technology partnerships can be many and varied and should be free from any preconceptions or prejudice.

Thank You.

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Decarbonisation of Heat, UK (Redpoint)

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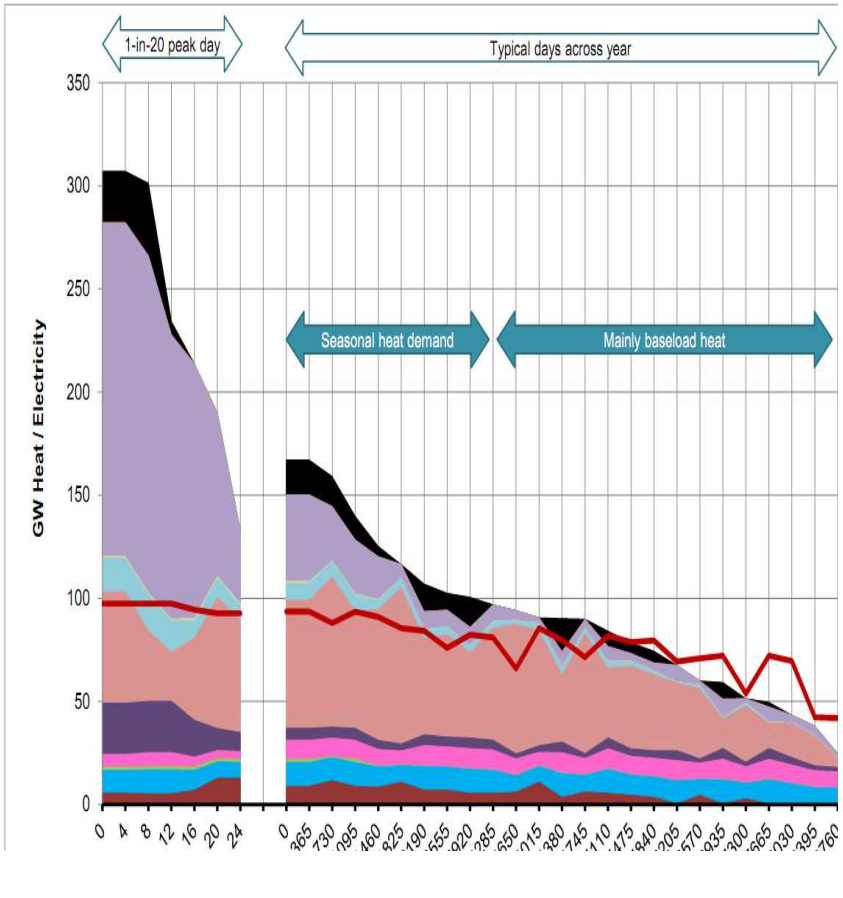
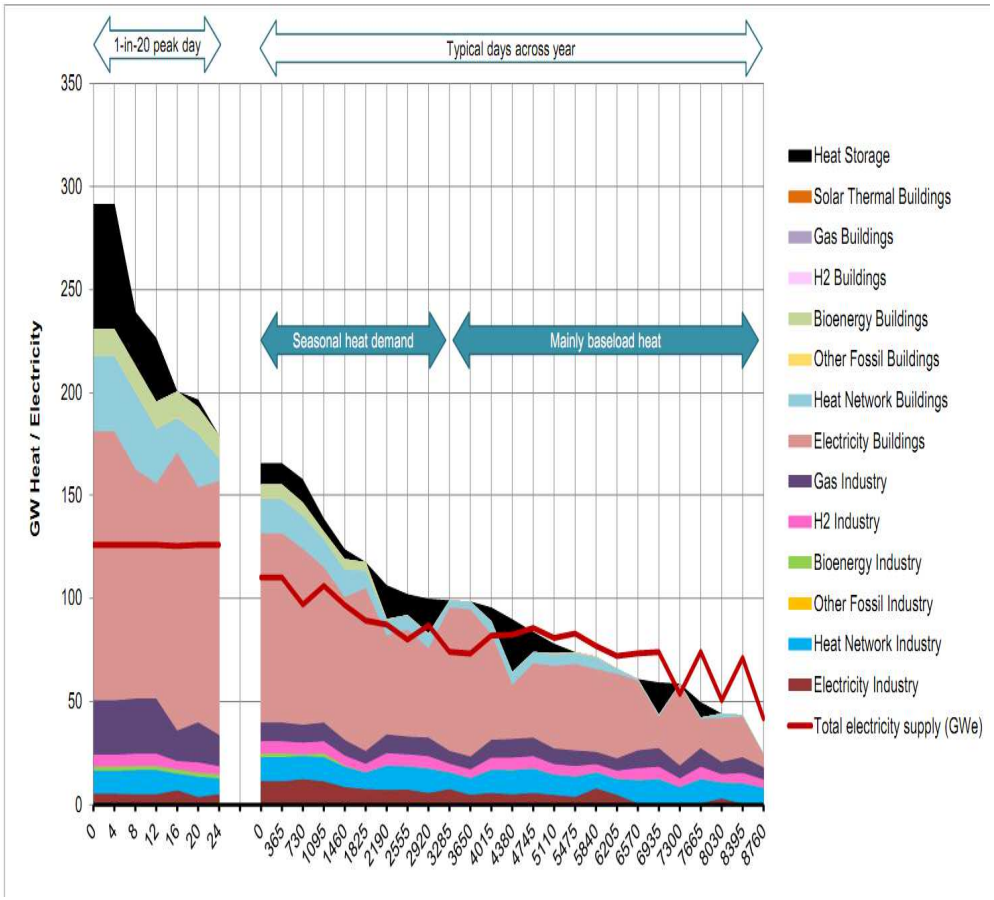
2050: gas in buildings



2050: no gas in buildings (+€50 to 100bn)



Decarbonising heat – UK (Redpoint)

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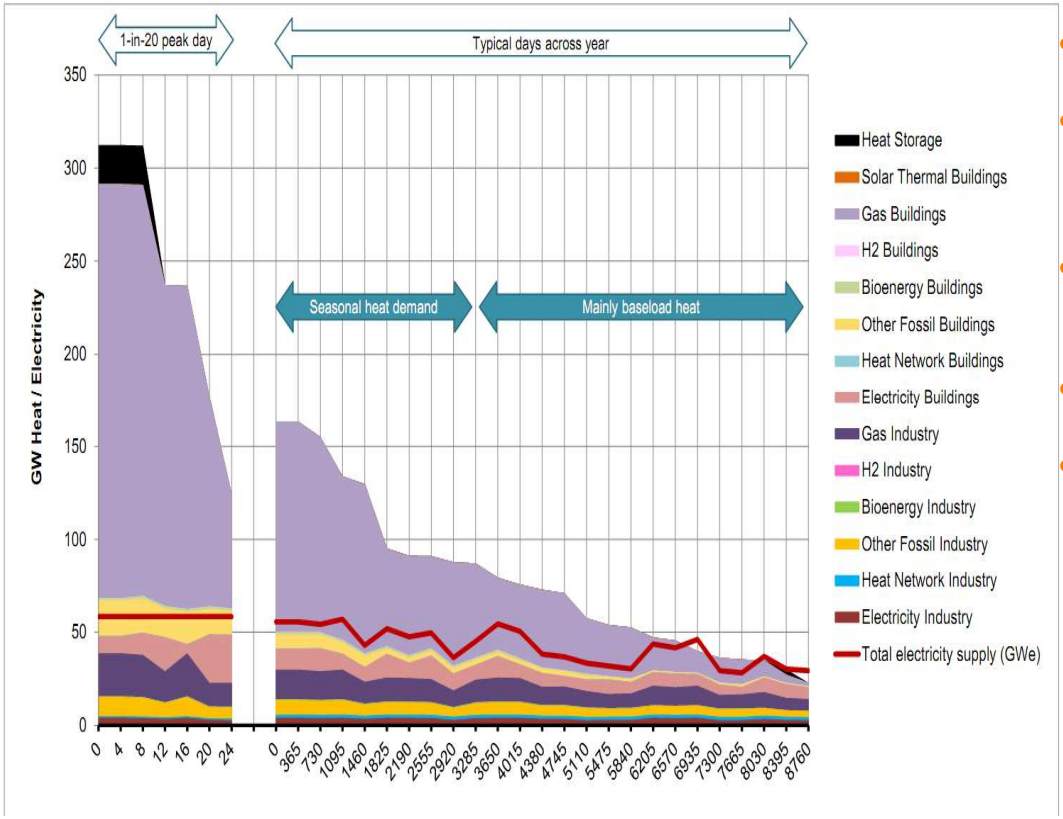
2011 -2012 model



- Heat is 50% of final energy demand
- 30% of CO_2 emissions
  - already has efficiency advantages
- Heat demand is peaked and highly seasonal
- Gas provides much of this heat
- Condensing boilers already 90% efficient

The Road?

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Low cost electrolysis

Renewable gas

Power to Gas

hydrogen and renewable gas distribution

Smart energy grids

Fuel cells and hydrogen infrastructure

2010

2050

Increasing renewables integration