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UK policy challenges for hydrogen

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Introduction

Questions

- Where are we now?
- What are the challenges?
- How is the UK academic community contributing?

Sectors

- Transport
- Heat
- Electricity storage

Transport

- Where are we now?
  - UK government working through H2mobility
  - FCH JU
  - EU business cases focused on niches
  - Factories are being built for the mass production of fuel cells
  - Several models expected to come to market over the next few years
  - Performance is acceptable

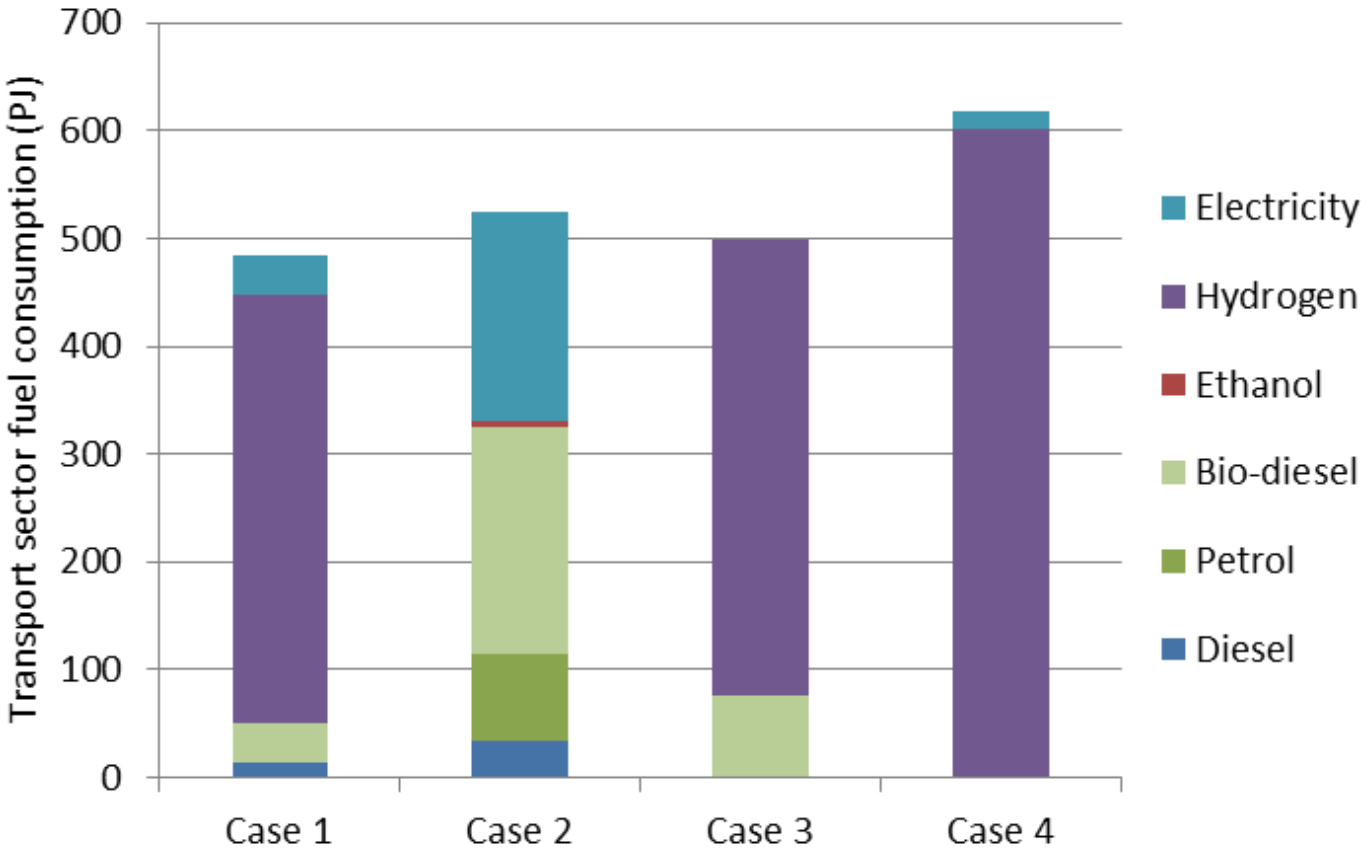
  BUT
  - Many companies still more focused on BEVs and hybrids
  - CNG is becoming trendy – tax break in Germany

Transport

- How is the UK academic community contributing?
  - H2mobility – not at all (Element Energy, McKinsey)
  - Imperial – hydrogen systems research (Nilay Shah)
  - UCL research (UKSHEC)
    - Storylines and scenarios for the transition to a hydrogen economy
    - Vehicles and infrastructure in systems models (Paul Dodds)
    - Infrastructure planning model – SHIPMod (Paolo Agnolucci)
    - Innovation research (Will McDowall)
    - Hydrogen in shipping (Carlo Raucci PhD)
  - Other UKSHEC research – public acceptability (Manchester)
  - DOSH research – techno-economic modelling (Cardiff, Imperial)

Information about the UCL models:
www.ucl.ac.uk/energy-models

Average annual car fuel consumption after 2050 with an 80% reduction in CO2 emissions



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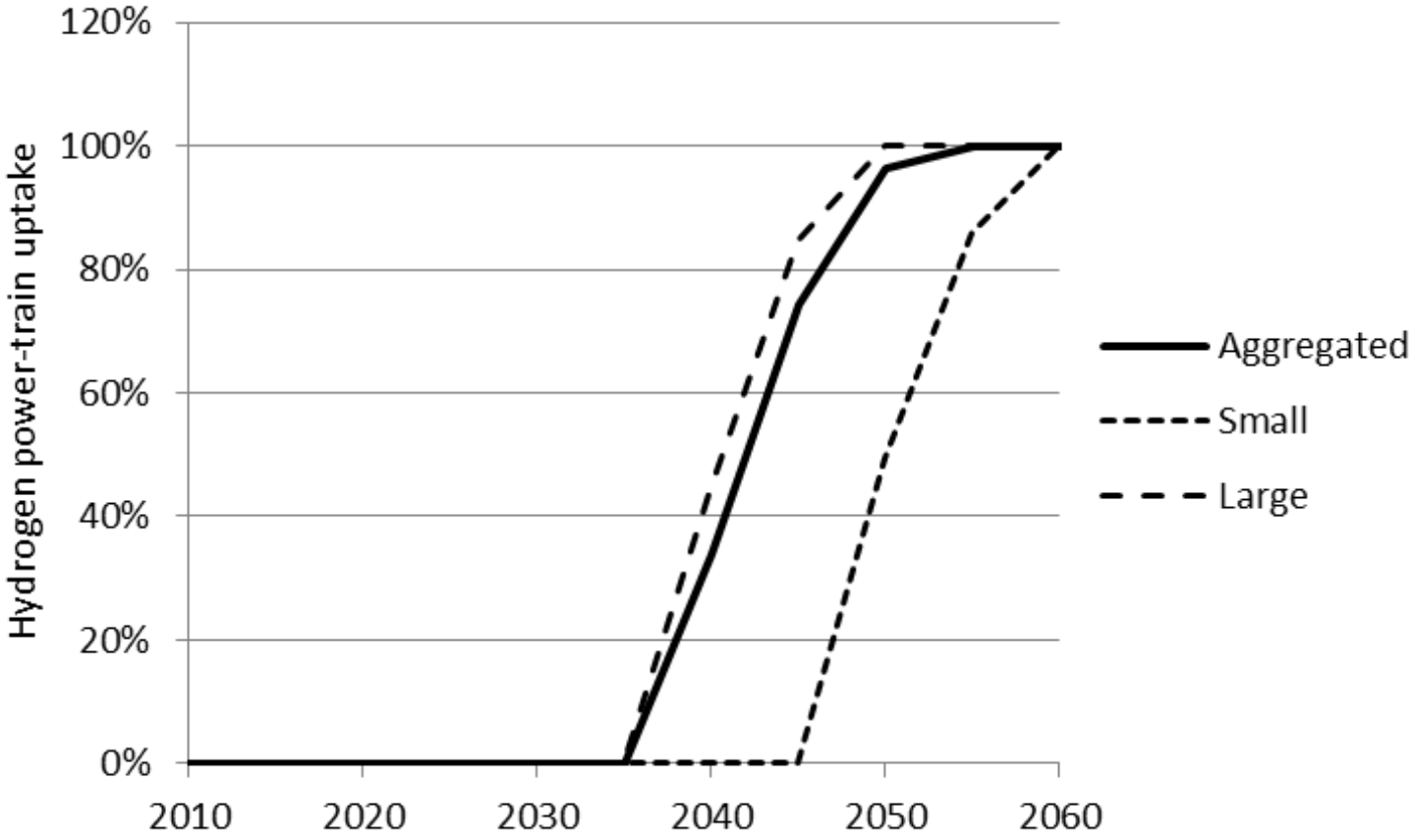
Transition to hydrogen cars



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Innovation and transition dynamics: informing policy for a successful transition

- Major networked infrastructure transitions are rare
  - How does this process work?
  - How we can influence it?
- Need to understand how infrastructure investments, demand, and technological performance co-evolve
  - Looking to the past is helpful
  - Modelling to understand how factors interact in complex system
- This analysis is important both to understand policy options and to inform what we think is possible/plausible

Innovation and transition dynamics: informing strategic innovation policy for the UK

- Potential economic benefits are enormous, but there are also risks for early investors in hydrogen technologies
- Our understanding of what underpins relative comparative advantage in innovative sectors is incomplete but important for informing policy.
  - Studying existing innovation system performance and structure
  - Learning from both theory and from past examples

Transport

- What are the challenges?
  - Is it too late for the UK to gain first-mover advantage?
  - Car manufacturing and particularly engine manufacturing is very important to the UK
  - How do UK policies and programmes of research, innovation and industrial development compare with international developments?
  - Understanding market adoption and diffusion of hydrogen techs
  - Are there any no regret policies? What is the cost of keeping the hydrogen transport option open for the UK?

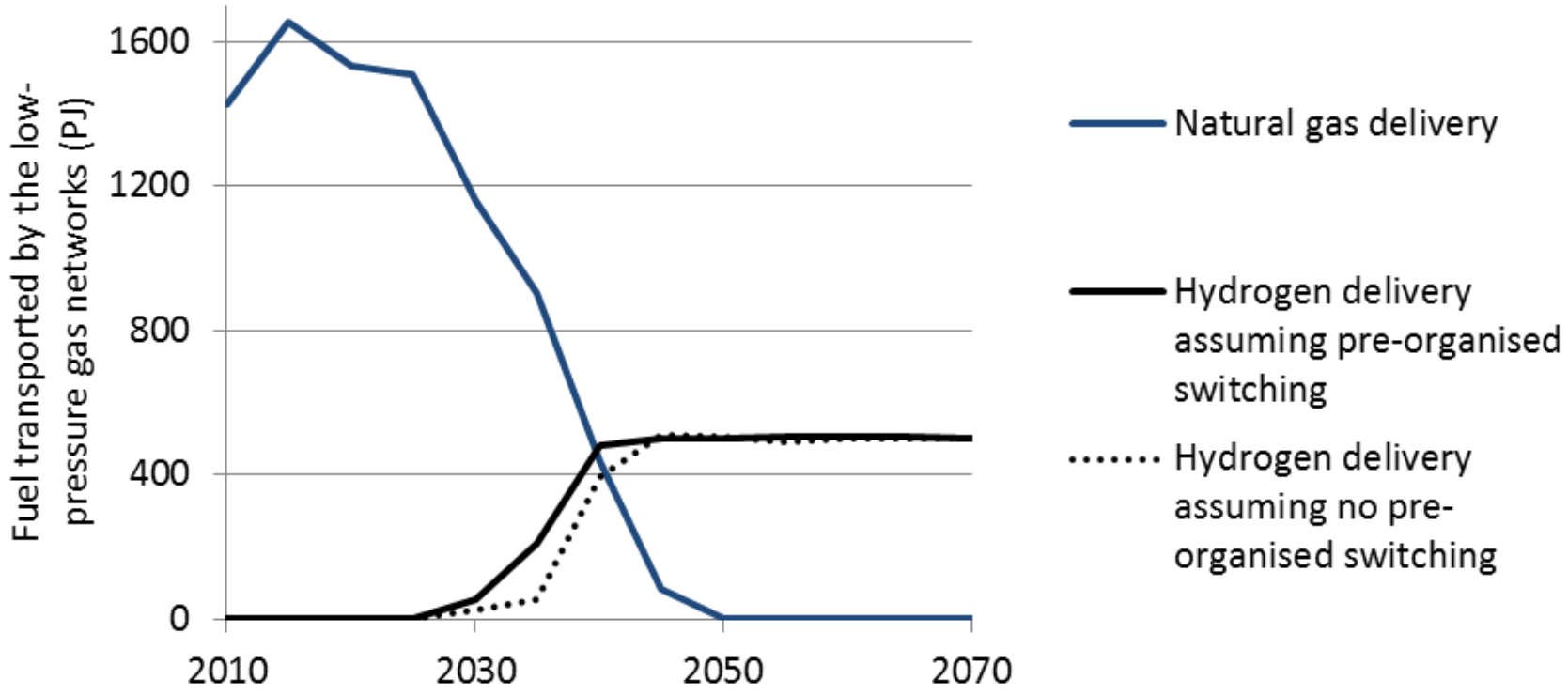
Heat

- Where are we now?
  - Heat accounts for 50% of carbon emissions
  - DECC released a heat strategy framework white paper in 2012
    - Heat pumps, heat networks, biomass – hydrogen mentioned
  - Heat strategy white paper released in 2013
    - Lots of new technologies
    - More circumspect about conclusions, particularly about the gas network
    - DECC plans to commission more work on the role of hydrogen

Heat

- How is the UK academic community contributing?
  - Fuel cell research (Imperial, St Andrews)
  - Safety research (Ulster)
  - UCL socioeconomic research (Paul Dodds)
    - Decarbonisation pathways for heat – whole energy system approach
    - Hydrogen use in the gas networks
    - UKERC Future of the gas networks conference
    - Impact of fuel cells on the electricity networks (Owain Jones PhD)

Heat



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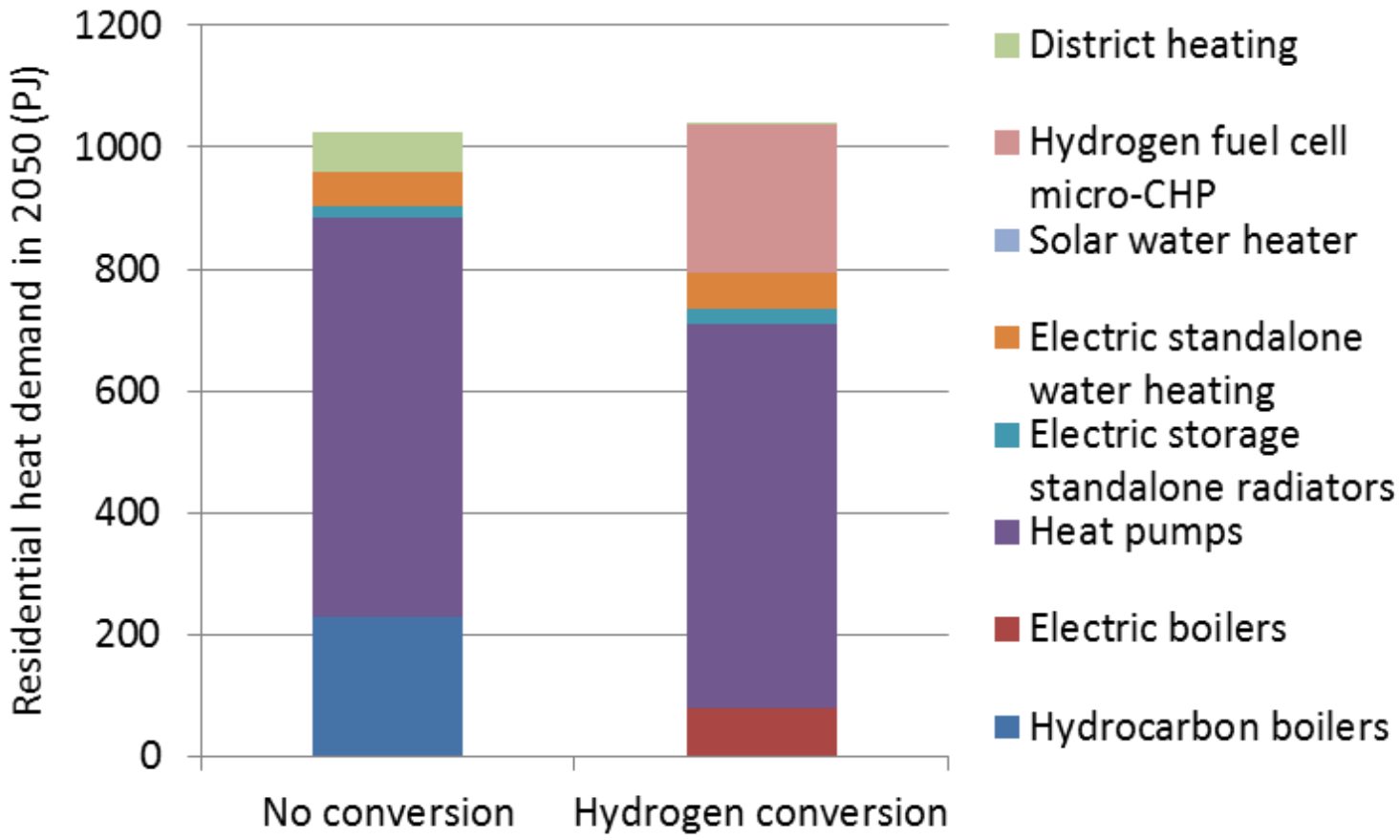
Heat



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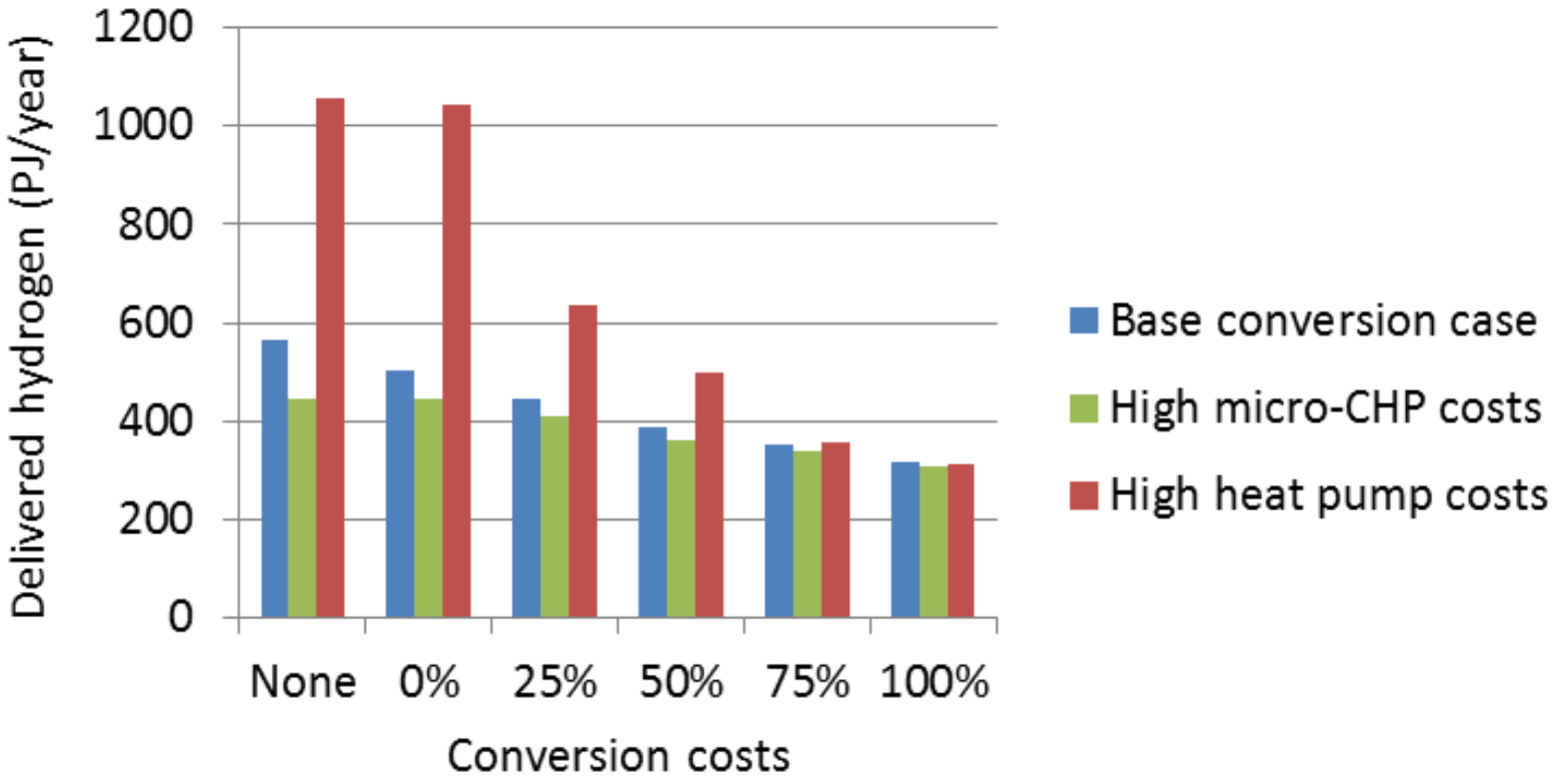

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Heat

- What are the challenges?
  - Uncertainties – DECC are commissioning more work
  - Can hydrogen be safely used in buildings? District heating?
  - Role of the gas networks in the future
  - Can hydrogen be used as an industrial fuel? Is it better used as a feedstock?

Storage

- Where are we now?
  - Large-scale energy storage not yet considered viable by utilities
  - Increasing intermittent renewable ‘lost generation’ from high supply/low demand periods
  - Power-to-gas demonstration projects, particularly in Germany
  - No decisive UK government policy as yet – but progress being made in the EU
  - Large manufacturers already producing electrolysers and hydrogen-compatible turbines

Storage

- How is the UK academic community contributing?
  - Hub work on inter-seasonal hydrogen storage – UK TIMES model
  - Hub work on hydrogen systems – Imperial College
  - Impact of weather on energy supply and demand
  - KIWA projects for National Grid on hydrogen – DomHydro, HyGrid
  - Much more research taking place across the EU
  - German energy industry is forecasting 1 GW electrolysis capacity in 10 years. Slogan: “No energy revolution without hydrogen”

Storage

- What are the challenges?
  - Is hydrogen storage economically-viable for incorporation into the electricity system?
  - Can the gas networks be used to store hydrogen, and what are limitations on this? Where can the gas be used?
  - Does power-to-gas depend on the electricity market design or is there a long-term role for it in the UK energy system?
  - What is the cheapest method to balance networks, storage and demand management between the electricity, gas and heat systems?

Conclusions

- Hydrogen is out of the doldrums
  - Progress in transport
  - New application in power-to-gas
  - Potential role in heat
- The role of the UK is more uncertain
  - Germany leading in Europe
  - Where could the UK best benefit from hydrogen investments?
- UK academic community is contributing in some areas

Thank you for listening

Questions?