Hydrogen – Some Socio-Economic Issues*

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OVERCOMING BARRIERS TO THE NEW HYDROGEN ECONOMY
London Hydrogen Partnership and Air Products
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Hydrogen research

- Ongoing research at Imperial College London Centre for Energy Policy & Technology (ICEPT) includes:


    - Project partners: *Air Products, BP, BMW, and BOC, and the Greater London Authority (GLA).*

  - EU-funded *ACCEPTH2* study
Hydrogen – energy carrier & GPT

• Hydrogen not an energy source but an energy carrier (so is electricity)

• Both are high-value carriers of useful energy derived from primary energy sources

• They offer the flexibility associated with a general purpose technology (GPT)

  • Stationary or mobile uses

  • Neither requires fossil fuel
Drivers towards H₂

- Climate change (if H₂ from renewables or nuclear; or fossil with CO₂ sequestration)
- Energy diversity / security
- Alternative to petroleum, especially for transport
- Local air quality
Hydrogen infrastructure issues & challenges

- Which feedstocks / technologies /scales?
- How many H$_2$ vehicles & when?
- Compressed gaseous &/or liquid H2?
- Pipelines? If so, when?
- Land availability / cost & planning issues
- Public acceptance
- Economics
Potential $\text{H}_2$ supply options

- Industrial hydrogen
- Centralised production from natural gas
- On-site reforming of natural gas
- $\text{H}_2$ from local resources (e.g. waste, biomass)
- On-site electrolysing (grid or local generation)
- (Renewable) $\text{H}_2$ from remote locations
Transition to a hydrogen economy?

• Transition to a hydrogen economy is likely to start small scale.

• Probable later move to larger-scale production.

• Probable later move to larger-scale production and use of pipelines.

• Carbon-neutral production is likely to start small scale.

• Initial production mainly from fossil fuels.

• Carbon-neutral production more probable in the long-term.
Centralised or decentralised production?

• Decentralised production probably favourable in the shorter term
  – avoids the need for distribution
  – economics more favourable if demand growth is low
  – however, possible NIMBY & land availability issues

• Centralised / remote production with pipelines often seen as the long term picture...

• …but how to get from one to the other?
Distributed small networks – the third way?
Addressing the ‘chicken and egg’ problem

• Buses and fleet vehicles ideal
  • depot refuelling limits infrastructure needs
  • But fast vehicle uptake essential for economic viability of infrastructure

• May offer platform for private vehicles…
  • But need significant extra infrastructure investment
  • Initial vehicle uptake rates probably slow
  • But more uncertainty, since infrastructure & vehicle decisions are separate
Who will finance a H$_2$ infrastructure?

- The government is unlikely to get directly involved in financing major infrastructure.
- Finance sector reluctant to lend money until H$_2$ has a proven track record.
- Likely to fall to industry - mainly the energy companies – to finance it, most likely “off the balance sheet” or through raising new share capital.
Which pathways might be financed?

- Reforming of natural gas widely considered to be the most likely feedstock for the early stages.
- An early transition to centralised plants is desired by the energy companies.
- However, an incremental approach is more likely given the level of uncertainty.
Knowledge and acceptability of H2 vehicles

• Acceptability only recently begun to be explored
  • Despite concerns about negative reactions

• 2003: we consulted experts in H2, fuel cells, LPG infrastructure, air pollution & local planning
  • Widely differing opinions about potential objections
  • Most thought safety a key issue
  • And agreed knowledge/awareness to be key influence on H2 vehicle acceptability

• What do studies say?
Knowledge and acceptability of H2 vehicles (2)

• Studies report some positive relationships between knowledge & acceptance of H2.
  • Direct experience: high acceptance by Munich respondents on H2 bus (Altmann & Graesel)

• London H2 FC taxi driver survey (Mourato et al):*
  • Familiarity with FC technology meant higher WTP for FC taxis
  • Air pollution concerns didn’t affect drivers’ short-term WTP for pilot FC taxi
    • Main concern: expectation of financial gain
  • But longer-term buying decisions somewhat affected by air pollution concerns

*Project supported by 11 organisations including UBS Warburg, GLA, Air Products, Shell, BP, British Gas
Knowledge and acceptability of H2 vehicles (3):

- Findings in line with other transport economics studies of ‘clean’ vehicles:
  - Environmental concerns not key determinants of transport technology choices
  - Have less influence than price and performance
- The few existing studies found relatively little concern with safety of H2 transport
  - Safety not an issue amongst taxi drivers (Mourato et al.)
- Imperial College study focused on London
Knowledge and acceptability: London Study (1)

• Imperial College Study by O’Garra et al.*
• Part of 5-city EU-funded ACCEPTH2 project
• 414 telephone interviews with Greater London sample
  • information on socio-economic characteristics, car ownership, environmental knowledge, attitudes & behaviour, levels of: H2 vehicle awareness, support for their introduction in London, and knowledge of them.
  • Note: sample biased upwards (income and education)

Knowledge and acceptability: London Study (2)

• Associations with the word ‘hydrogen’
  • Most fell in neutral category (a chemical, a fuel, etc.)—only 20% were negative
  • Suggests that public concerns with H2 safety not currently widespread.

• But self-reported H2 vehicle awareness modest, just before small-scale trial of H2 buses
  • less than half of respondents had heard of H2 vehicles
  • Less than one third had heard of FC vehicles
  • One fifth (18%) had heard of H2 and FC vehicles.
Knowledge and acceptability: London Study (3)

“How would you feel about hydrogen powered vehicles being introduced in London? Would you in principle support it, oppose it, need more information to make a decision or are you indifferent?”

![Graph showing the distribution of responses]

- Support: 36%
- Oppose: 0.2%
- Need more info: 60%
- Indifferent: 4%
Knowledge and acceptability: London Study (4)

- Prior knowledge of H2 was the main determinant of support for the introduction of H2 vehicles
- But this may reflect the – largely positive - nature of the available information
  - 60% of respondents said they would ‘need more information’
  - So potentially an additional 60% of the London population might support H2 transport.
  - Or might oppose, if negative information reaches them first.
Conclusions – London study

• A strong need to raise awareness among the London public about H2 and FCs
  – as this seems to be key to issues of public acceptance
• H2 awareness related to gender, age, education & environmental knowledge
• Information would need to be presented differentially so as to best reach the community it intends to inform
• And help them to reach informed decisions
Conclusions (2)

• Surveys to date suggest that:
  
  • the public need more information about hydrogen. to make an informed decision
  
  • negative associations (eg H-bomb or Hindenburg) are relatively rare
  
  • H\textsubscript{2} vehicles tend to be more favoured than infrastructure
  
• More research could be valuable
  
  • on both vehicle and infrastructure knowledge and acceptability
Thank you