

# Discussion of Three Presentations on Understanding the Transition to Hydrogen

Lew Fulton  
UNEP/DGEF  
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# Three Papers on Hydrogen Transitions

- **HDSAM Model (ANL)**
  - A US hydrogen pathways model; takes demand as a given under various scenarios
- **HyTrans (ORNL)**
  - A dynamic transition model for the US transport sector – attempts to capture fuel supply, vehicle supply, and fuel/vehicle demand dynamics over time
- **ETP (IEA)**
  - A global energy projection tool; covers all major energy types, global regions, supply/demand sectors. Hydrogen/transportation are among many components

# Some important questions

- **What will the various components (fuels, vehicles) cost? What factors will be most important? How can these be lowered?**
- **What will be the consumer (private) benefits? How will consumers react? What will determine demand?**
- **What are the key market dynamic factors? Will “chicken or egg” issues be important and how can they be overcome?**
- **What policies will be needed? What are the messages for policy makers?**

# Fuel cell/hydrogen costs

- **IEA work suggests that vehicle costs (or at least required incremental investments) could be several times greater than on the fuel side**
- **The cost per kilometer to run on hydrogen fuel might not be a “problem”, at least for some feedstocks**
- **Vehicle side – cost reduction could be a “showstopper”**
  - **We aren’t sure how low it can go, and how to get there**
  - **Reductions from R&D v. scale v. learning**

# Consumer benefits

- **Most are currently “disbenefits” – e.g. refueling time, range, fuel availability**
- **Possible performance improvements, electric power benefits – difficult to measure**
- **Vehicle reliability, durability?**
- **“Early adopter” role, size – will it matter? Is it worth modeling?**

# Market “dynamic” factors

- **“chicken-or-egg” potentially huge**
- **Vehicle manufacturers, fuel providers, consumers: really 2 chickens and an egg**
- **Particularly if risk factors are large**
- **Agents (companies, consumers) do not have perfect foresight, and tend to behave very conservatively**

# Feedstock impacts

- **A transition to hydrogen fuel cells would require an equivalent energy supply as currently is used for power generation**
- **HyTrans, ETP both show substantial increases in feedstock (e.g. natural gas) costs in a large-scale H2 scenario**
- **Sources of feedstocks, CO2 impacts highly uncertain**

# Government role, policies

- **Breakthroughs still needed**
- **Clearly a huge research/demonstration effort must continue- \$1b per year too low?**
- **Transitional help – major subsidies, investments in infrastructure will be needed**
  - Gov'ts may need to spend hundreds of billions of dollars
- **Figure out plan “b” (e.g. efficiency, biofuels)**
  - this plan “a” may take a while
    - Lovins – can get 85% of the way without fuel cells