

The Hydrogen Economy A Debate on the Merits

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SAIChE Seminar

25 January 2007



There are compelling reasons to develop the so-called Hydrogen Economy. However:

- What do we mean by the Hydrogen Economy?
- Why is it going to take a very long time, if ever, to convert to a Hydrogen Economy?
- For which energy needs might hydrogen be a solution?
- The Hydrogen Economy is a bad idea, but are there any better ideas? I think so.

What do we Mean by a “Hydrogen Economy”?

A Hydrogen Economy is an economy where hydrogen is **extensively** being used as a means to store, distribute and convert energy into other useful forms.

Niche and small-scale applications are not the driving force for the substantial investments that are globally being made in developing the Hydrogen Economy, e.g.:

- Back-up power supplies,
- Battery replacements for portable power supplies
- Remote off-grid power supply
- Load leveling

Rationale for the Hydrogen Economy

Compelling Arguments

- Oil depletion
- Global warming
- National security – dependence on the Middle East
- Sustainability – diversity of energy sources

Dubious Arguments

- Wide variety of applications
- Urban air quality
- Less damaging to the environment

Hydrogen

- It is not a primary energy source
- It is expensive
- It is an inefficient energy carrier
- It is dangerous
- It has a low energy density

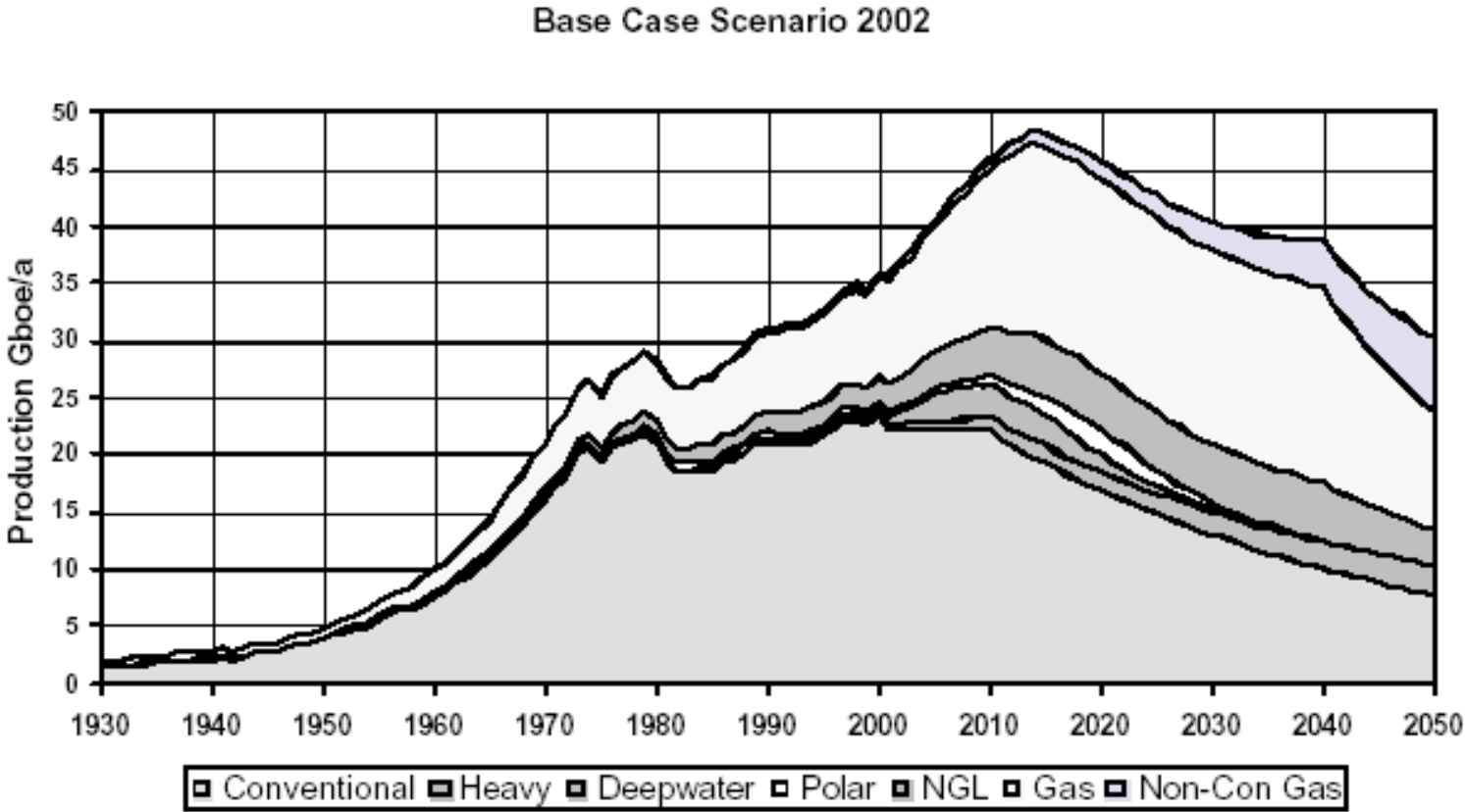
Potential *Extensive* Application of Hydrogen is Restricted – Only Transport/Mobile

Stationary Applications		
Centralized Power Generation	Energy storage for load leveling or bridging gap when using renewables	Hydro, thermal and redox flow batteries are more efficient. Potential for SOFC
Distributed power generation	Energy storage	Secondary batteries are more efficient
Portable Applications		
	Energy storage	Primary and secondary batteries are more efficient and convenient

Diversity of Energy Sources

- It is more efficient and much cheaper to refine oil and use it in ICEs than to reform it to make Hydrogen for use in FCs
- It is more efficient and much cheaper to use CNG gas directly in ICEs or gas turbines than to steam reform it to make hydrogen for FCs
- Coal to Liquids with conventional ICEs is cheaper although less efficient than Coal to Hydrogen with use in a FC
- Electrolytic generation of hydrogen is inefficient and thermo-chemical generation from nuclear energy is in its infancy. Nuclear fusion reactors are also not sustainable
- Renewable energy (wind, solar, ocean) etc is expensive and converting it to hydrogen is inefficient. Secondary batteries are more efficient

Oil Depletion



Oil Depletion and National Security: What will Happen?

- Fossil fuels are by far the cheapest source of fuel for transportation purposes if the potential environmental cost of global warming is excluded
- Oil production will peak and then decline – it is just a question of when
- Energy conservation and biofuels might postpone oil peaking by about 10 years
- Gas will be converted to liquid fuels – it is the cheapest alternative.
- Coal will then be converted to liquid fuels – it is the second cheapest alternative.
- The Hydrogen Economy or its alternative will only really take off when cheap coal production begins to peak

Global Warming

- The risk is real, but the debate on the causes and implications has not been concluded
- It is still going to take a long time before there will be any meaningful consensus between the major nations on what cost penalties to accept for CO₂ emissions – Regardless of all the debate many new carbon intensive projects are being planned and implemented
- There are many measures that are much more cost effective to reduce CO₂ emissions than introducing the Hydrogen Economy.
- It is more cost effective to replace fossil fuel based power generation with electricity from renewable sources than to use the renewable electricity to electrolyse water for use in FC powered vehicles

Romm's scenario

Alternative: The “Electricity Economy”

- Generation of electricity (solar in SA or nuclear)
- Storage of electricity (secondary batteries, metal/air batteries, redox/flow batteries, *fuel cells*, fly wheels etc)
- Logistics of distributing electricity in stored form

Advantages:

- More efficient than hydrogen
- Likely to be cheaper
- Safer
- Fewer technological hurdles
- Includes hydrogen as option whereas current focus on hydrogen excludes other alternatives