Thoughts on Hydrogen and Governance

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Hydrogen is a permanent solution for the present energy problems.

Will transition to hydrogen economy cause economic hardship?
Probably yes! But, continuing the status quo may cause even harsher economic hardship in the long term (price of oil, depletion, geopolitical issues, effects of global warming and climate change)

Can the present energy system be extended for another century or so?
Probably yes, but this will make (the inevitable) transition even harder and more disruptive later.

Carbon management/sequestration is not a solution – it only delays the solution.

Nuclear energy could and should play an important role in the transition period if it can produce relatively large amounts of hydrogen at reasonable cost.

What we could do with hydrogen if it was available in sufficient quantities at reasonable cost?

- Transportation fuel – buses, automobiles, scooters
- Transportation fuel – boats, ships, submarines
- Transportation fuel – airplanes
- Domestic fuel – heating, cooking,
- Decentralized electricity generation/cogeneration
- Portable power

Technologies for hydrogen utilization exist, but are not commercialized. What is preventing them?

- Chicken-and-egg problem – inability to commercialize one hydrogen technology without the changes in energy supply chain.
- Technical issues: performance, durability, cost (materials, manufacturing process)
- Public acceptance issues (concept vs. misconception; real vs. perceived safety issues)

- Political/business issues – large stake in the existing energy system and resistance to potentially disruptive technologies; no sudden moves

What the engineers/scientists should be working on?

- Fuel cells – materials: new improved catalysts; new improved proton conductors; system simplifications, manufacturing processes
- Internal combustion engines; jet engines
- Hydrogen storage (size, weight, safety)
- Hydrogen transport and delivery
- Hydrogen production (from water and biomass; involving electricity and heat)
- Safety related issues (understanding and preventing hazardous situations)
- System studies; techno/economic analyses as guides for public policy/legislation (what if scenarios)

Are any breakthroughs needed?

Probably, in cost reduction and hydrogen storage
Breakthroughs are difficult (if not impossible) to plan
Breakthroughs are often accidental, but more likely to come from a systematic (R&D) activity

What is the role/potential/implication of renewable energy sources (such as wind)?

Technology for electricity generation from wind is already commercial and cost competitive.
Hydrogen ultimately makes sense only if it is produced from renewable energy sources.
Hydrogen (and electricity as energy carriers) and renewable energy sources make a clean, permanent energy system.
Mixture of renewable energy sources and technologies; mixture of large and small plants
However, renewable energy sources cannot support indefinite economic growth, and therefore not going along well with capitalism!

- Steady state economy is possible, but at what level?
- Economic and social changes: shifting priorities

Hydrogen will cause an energy revolution.

It will revolutionize the way we use energy.
Development of human civilization through a series of revolutions: industrial, automobile, electricity, information … energy is next.