

SMELLING LAND



The Hydrogen Defense against Climate Catastrophe

*David Sanborn Scott's work
interpreted and presented by Neil Alexander,
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David Sanborn Scott



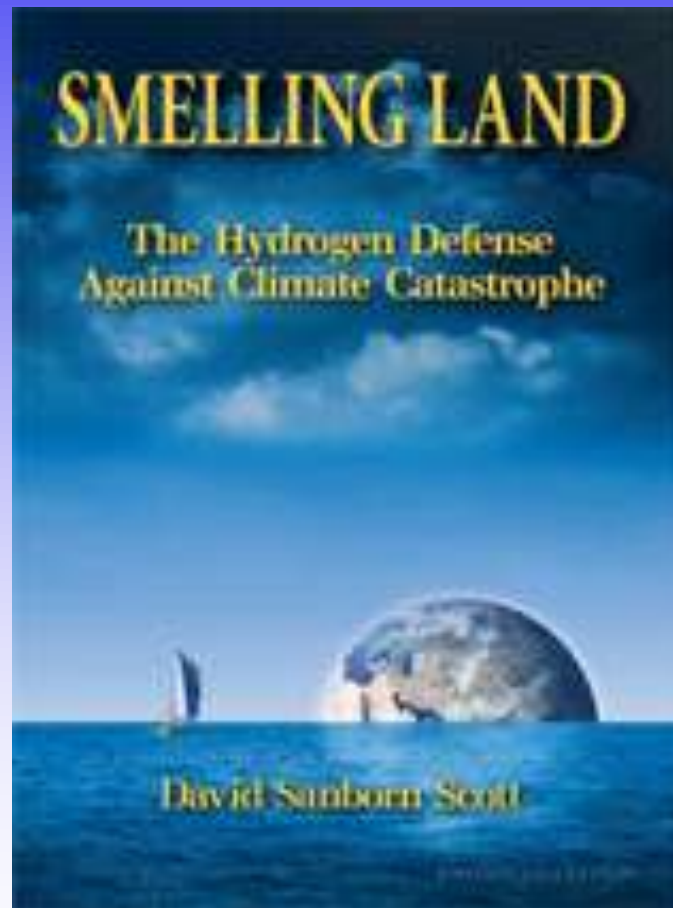
Three decades of experience in energy system analysis

Chair of Mechanical Engineering at the University of Toronto

Founder of the University of Toronto's Advisory Group on Hydrogen Opportunities.

Jules Vernes Award for Outstanding contributions to Hydrogen Physics

Author of "Smelling Land"



Conservation, Confusion and Language



- **Understand the problem**
- **Use language that drives the right behaviours**

The first step to wisdom is getting things by their right names

Chinese Proverb

The Issue



1. CO₂ from fossil fuels is forcing climate destabilization which, if unabated, will become catastrophic.
2. To eliminate CO₂ emissions requires: **BOTH** **non-C *sources*** & **non-C *currencies***.
3. Many Non-C ***sources*** available—or developable. (hydraulic, nuclear fission/fusion?, sunlight, wind...)

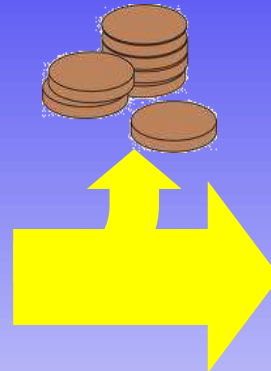
The Energy System



Currency?

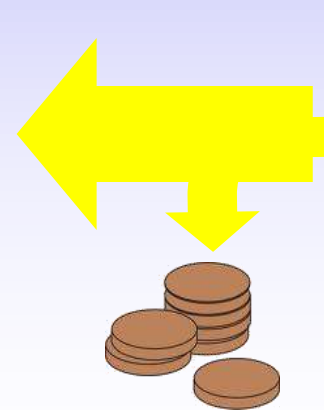


Not an energy source



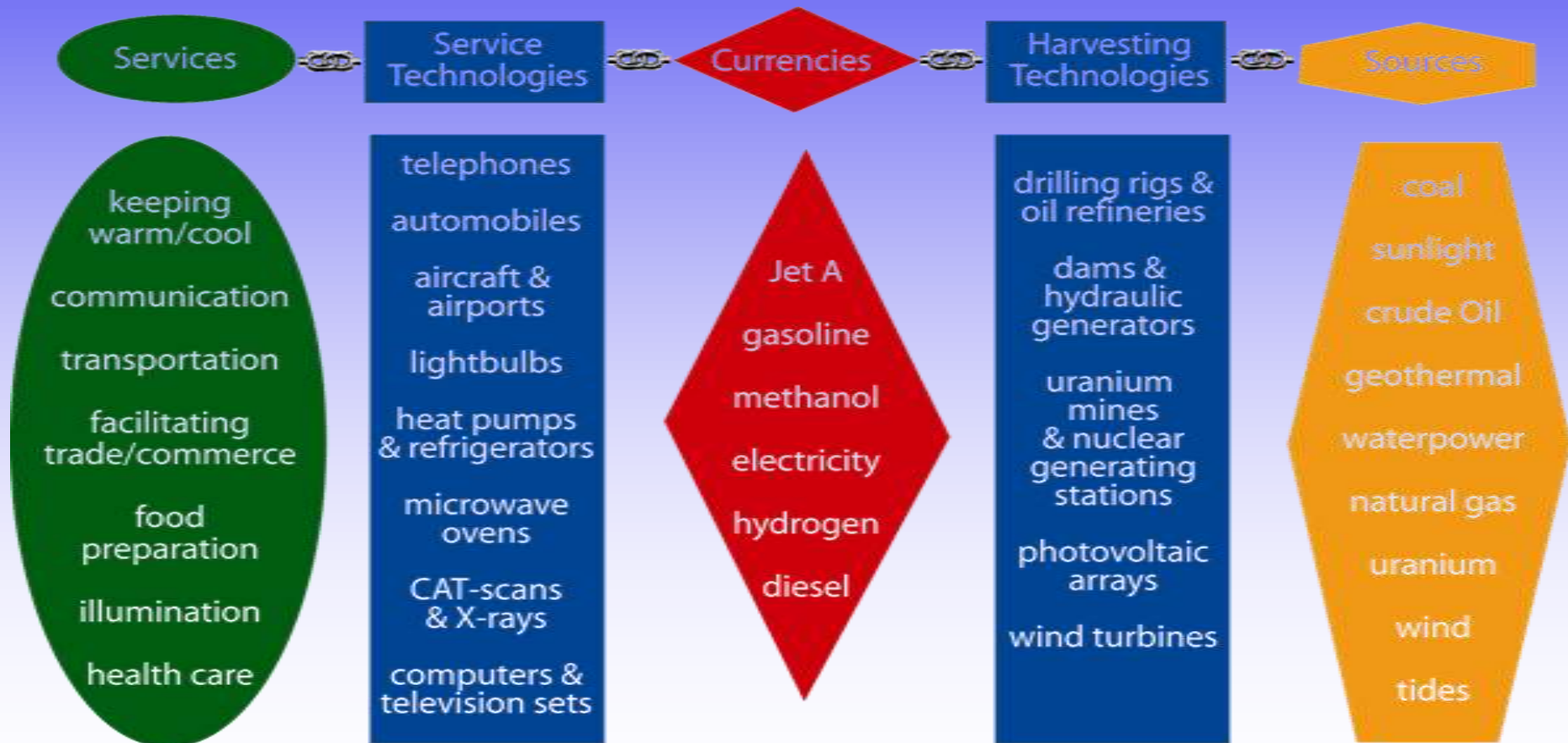
No single currency for all services/transactions

Inter-currency conversion always < 100%

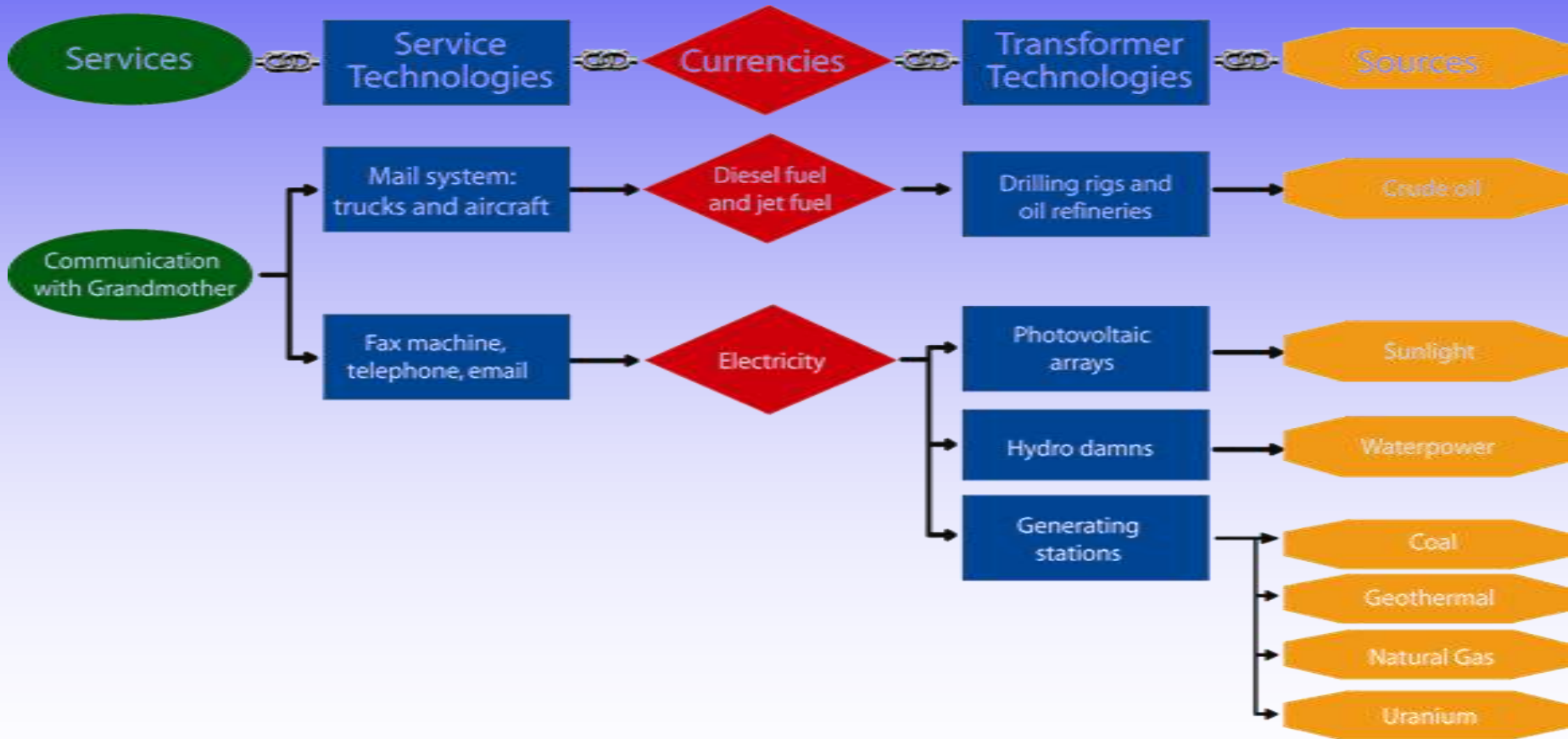


Usually more difficult in one direction than the other

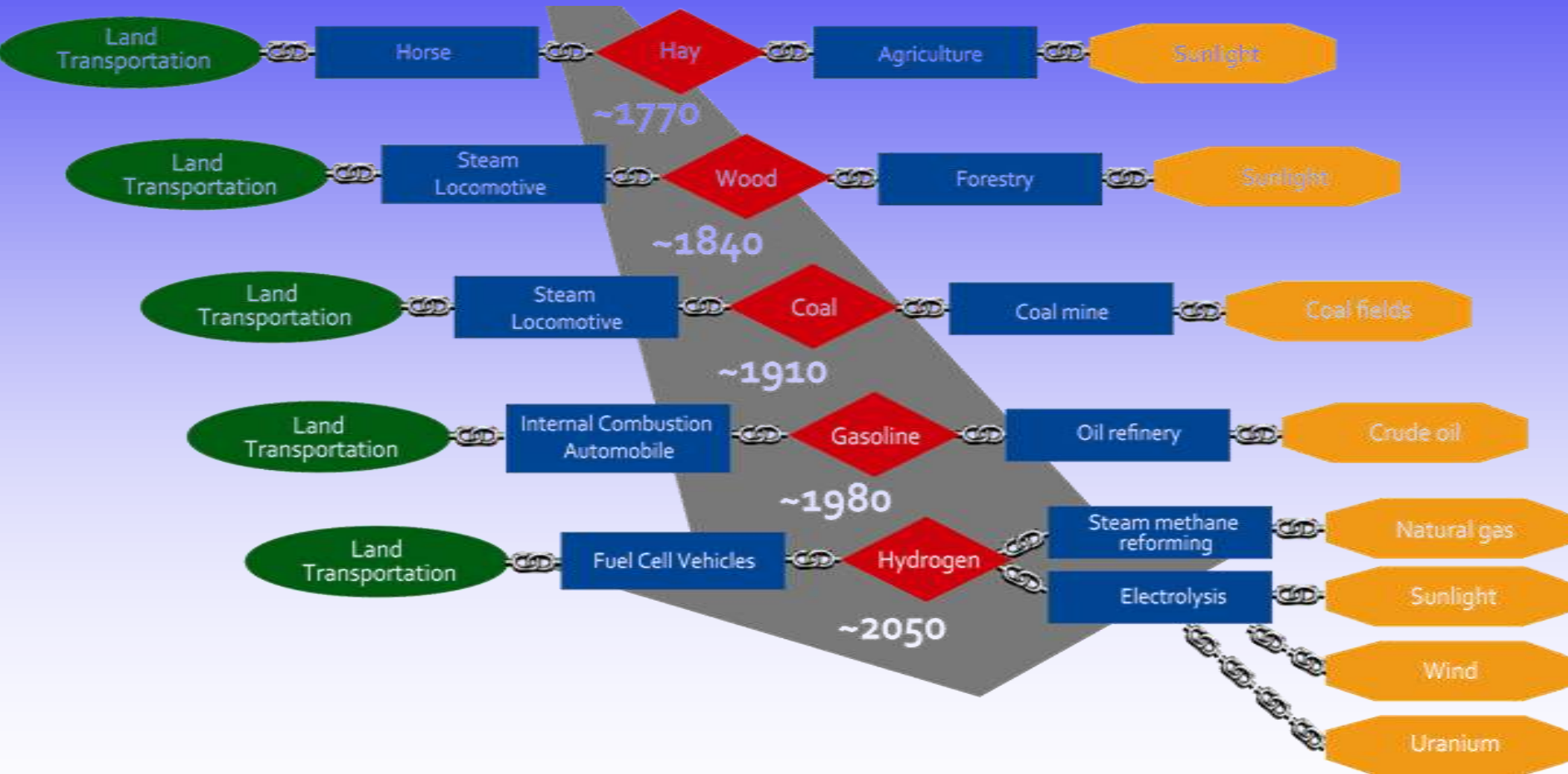
Examples



Communication



Currency Evolution



Hydrogen-Carbon Ratios



Typical hydrogen/carbon ratios

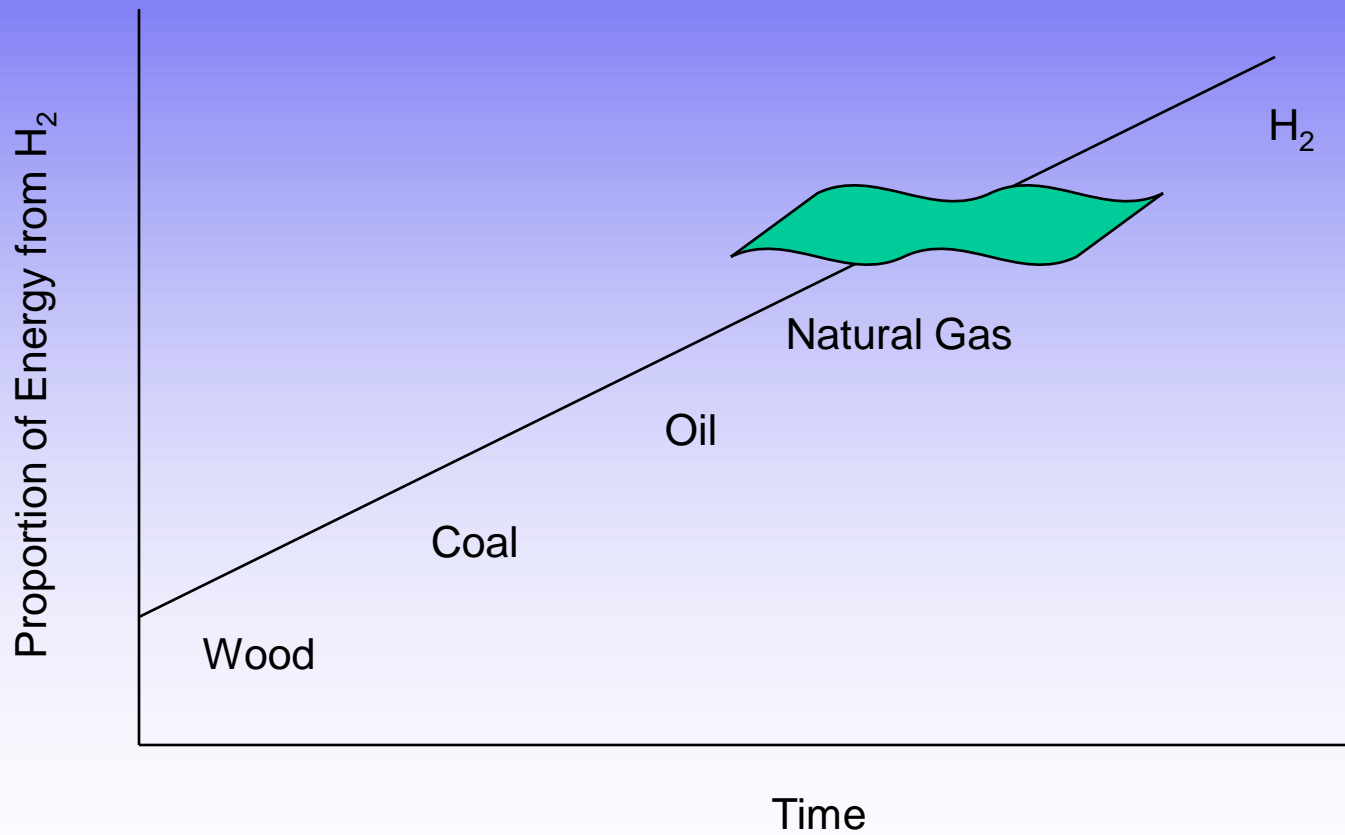
Most liquid fuels: $H/C = 2.1/1 \sim 2.3/1$

Most conventional crudes: $H/C = 1.8/1 \sim 1.9/1$

Athabasca (& Orinoco, Olenek): $H/C = 1.4/1 \sim 1.6/1$

Most coals: $H/C = 0.7/1 \sim 0.9/1$

The Trend





H Hydrogen
Atomic Number: 1
Atomic Mass: 1.00797



e^- H_2 Similarities



- H_2 and **electricity** can be manufactured from any source
- H_2 and **electricity** can be interchangeably converted
- H_2 and **electricity** are renewable

e^- H₂ Synergies

A composite image showing a sailboat on the ocean with the Earth in the background. The sailboat is in the center, and the Earth is on the right side, partially obscured by the horizon. The sky is blue and the water is dark blue.

- **H₂ can be stored** in enormous quantities, electricity cannot.
- **Electricity** moves energy **without material**, H₂ cannot.
- **Electricity** can process & store **information**, H₂ cannot.
- **H₂ wins for long-distance transport (on Earth)**

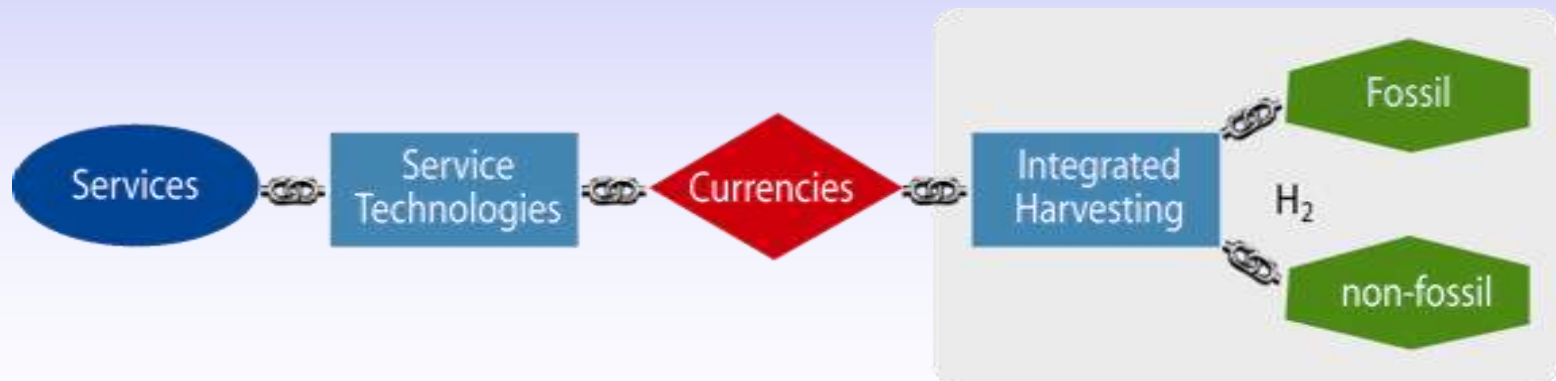
Hydrogen's Two Pathways

Neat hydrogen (feeds service technologies)

- LH₂ aircraft.
- LH₂ automobiles, ships, locomotives.
- H₂ mobile phones, laptops.

Tether hydrogen (in harvesting technologies)

- Linking fossil/non-fossil sources.



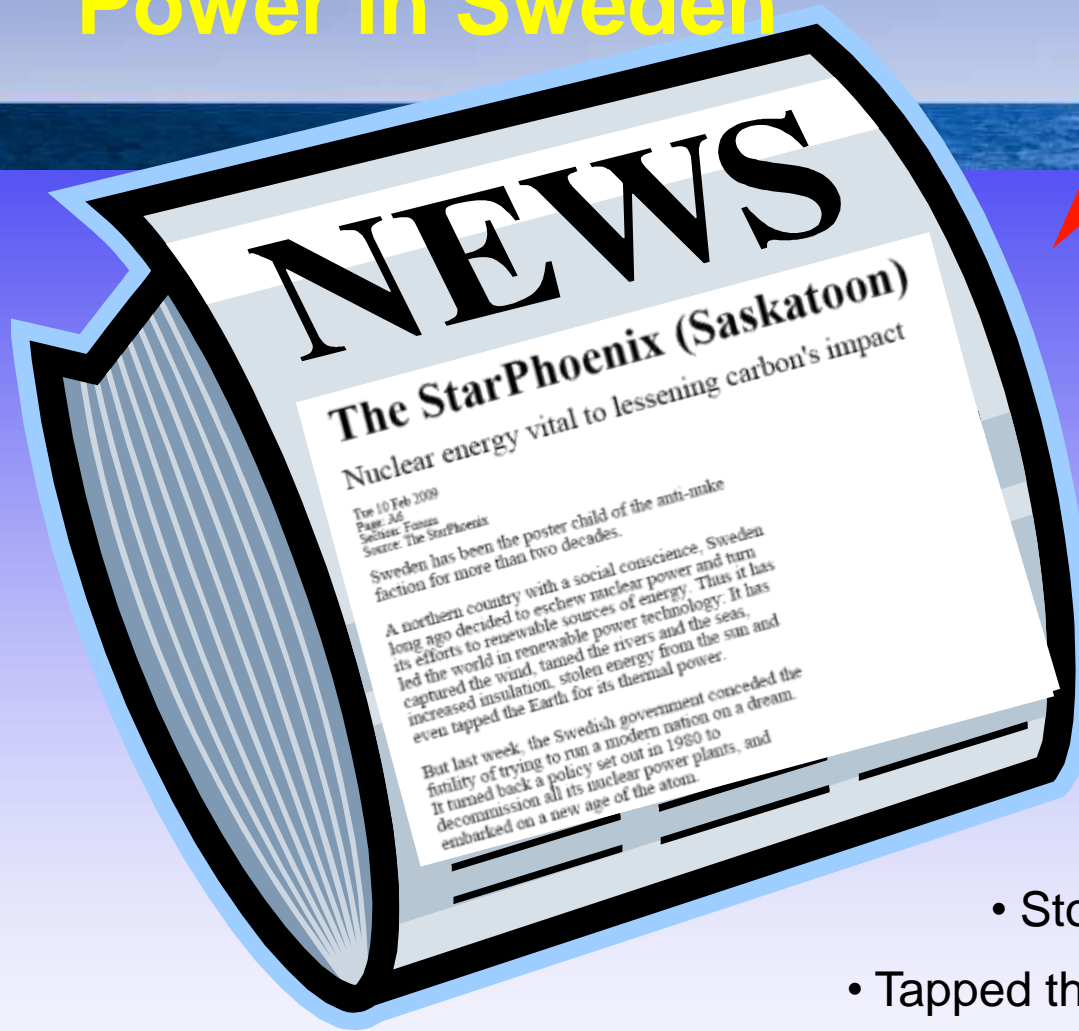
Harvesting Technologies



WHIMSICALS: ~> “renewable” wind, sun, tidal . . .

- Harvesting rate must be less than replenishing rate
- Capped by large land area requirements
- Capped by intrusion on other renewables (forests, fish, water, wildlife)
- Requires storage or spinning reserves

Power in Sweden



- Captured the Wind
- Tamed the Rivers and Seas
- Stolen Energy from the Sun
- Tapped the Earth for Thermal Power

“Conceded the futility of trying to run a modern nation on a dream”



At last the oil sands!

Observations



- ☺ **Gasoline is a great way to tether Hydrogen and deliver it through an existing infrastructure to use for land transportation**
- ☺ **Oil sands oil could continue the trend to hydrogen if we upgrade the oil by adding Hydrogen rather than removing carbon and reduce carbon consumption during its production**
- ☺ **Better to change the process than to add clean up equipment to the wrong process**

Clean(ish) Oil Sands Oil

