How Can We Zero Out America's **Need to** Import Oil at the Soonest Possible Time?

Dr. Paul J. Werbos

personal, not official, views

Sources: IEEE-USA (Edison story), IEEE, NSF, US Senate, UN State of the Future; 1979-89: EIA/DOE lead analyst for long-term energy futures.

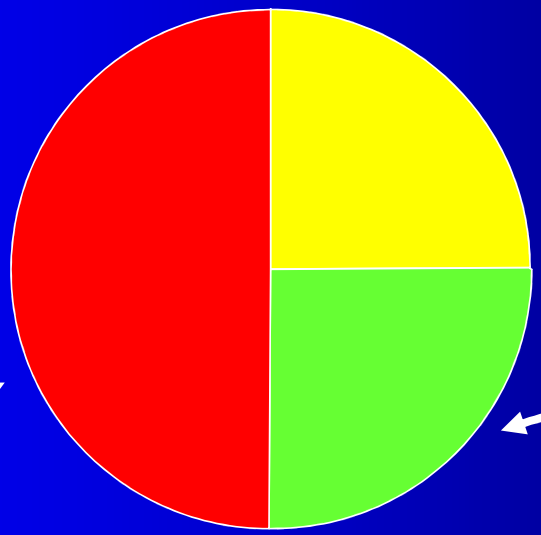
www.werbos.com/oil.htm

WE CAN Zero Out Gasoline Dependency:

A Definite Option for 100% Renewable Zero-Net-CO_2 cars & Total Security for Car Fuel

With GEM fuel-flexible cars, biofuels might supply ¼ of present liquid fuel demand trends

Highest mpg Hybrids Cut Gas per Mile By 50%



Plug-in Hybrids with 10kwh batteries get half their energy from electricity

GEM fuel-flexible plug-ins offer a 100% solution based on near-term technology! www.ieeeusa.org/policy/positions/PHEV0607.pdf

Optimal Strategy for Total Energy Security

Maximize Fuel-Flexible Plug-in Hybrid Cars

Maximize supply of Alternate liquid fuels
– Not oil
– Incentives, standards and R&D

Open door to US natural gas (e.g. to trucks) while it lasts

R&D for more efficient use of diverse fuels

R&D for batteries for affordable electric cars

Minimize cost and then maximize supply of renewable electricity

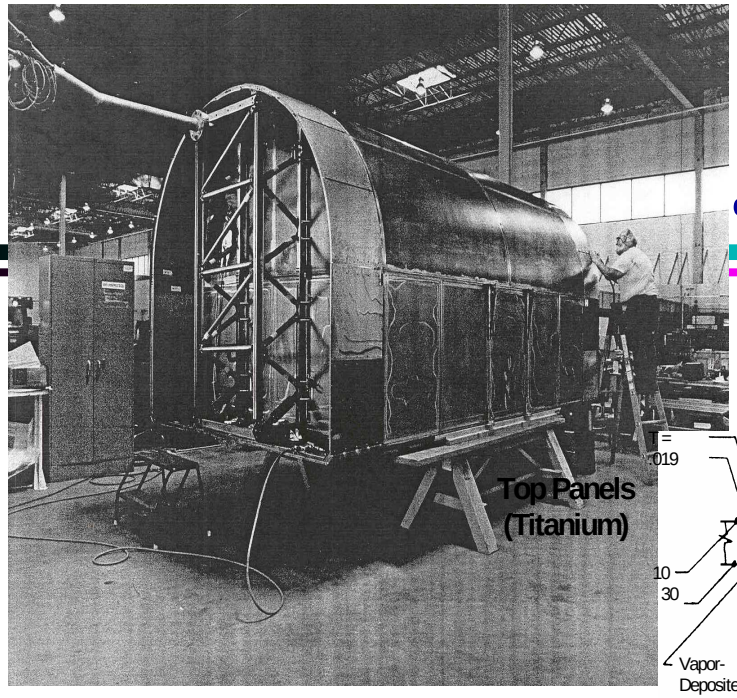
New Legislation Is Also Essential, To Move As Fast as We Can & Should:

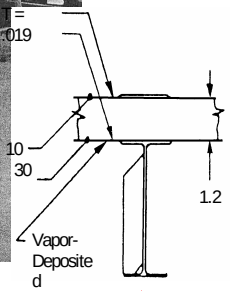
- Thanks to Senate Legislative Counsel: bill & explanations posted at last paragraph of www.werbos.com/energy.htm. All 4 together to escape "who goes first":
- For vehicles:
  - Extend tax incentives for all fuel-flexible and hybrid vehicles (including plug-ins and even fuel cells) until most cars sold are "futuristic cars." Need the extension now to allow new investments aimed at future. (Pryor/Inhofe.)
  - Require GEM flexibility in liquid fuel systems (open fuel standard, Brownback).
- For refueling stations (recharging or gas stations):
  - Extend tax incentives, include retrofit and public access electric recharging.
- For actual fuel use and production:
  - Modification of Waxman/Markey "Low Carbon Fuel Standards," with penalty for oil shale removed, credit for natural gas and electricity required, and faster encouragement of new technology/fuel/combinations
  - Support prices for alternative liquid and gaseous fuels
- Aggressive new R&D:
  - $60 million for well-focused new R&D living up to unmet opportunities here, through ARPA-E/NSF partnerships open to all universities, small business, etc.

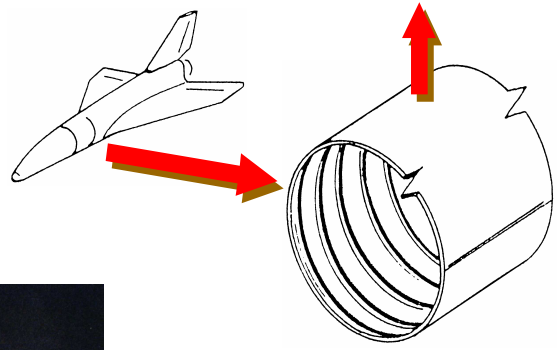
Workshop on "Drug Discovery Approach to Breakthroughs in Batteries" Sept 8-9 at MIT

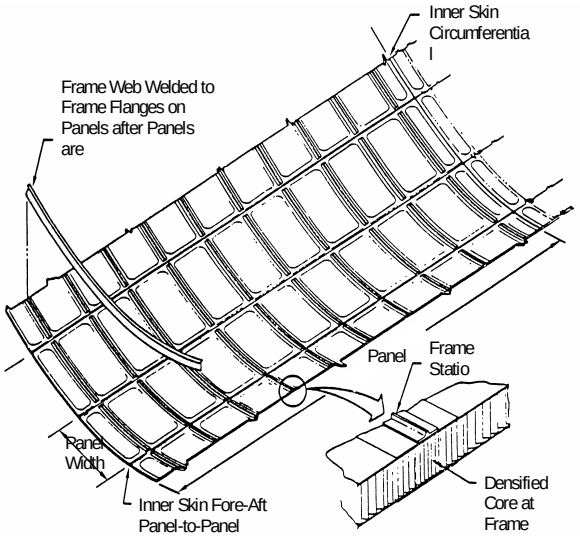
- Focus: How could new crossdisciplinary research maximize the probability of breakthrough battery designs, suitable for new plug-in hybrid cars but costing only half as much or less as what is coming already?
- Motivation: IEEE white paper argues that fuel-flexible plug-in cars offer our best near-term hope for independence from oil imports, but the high cost of batteries for new cars like the GM Volt is the main obstacle.
- Sponsors: ECCS. Participation from DOE, DARPA, GM. Strong encouragement from OSTP. http://web.mit.edu/dsadoway/www/nsfworkshopMain.htm
- Key findings:
  - The "design space" is huge, and poorly explored due to cutbacks in US electrochemical engineering (other than fuel cells), and the slow speed of traditional Edisonian "shake and bake" methods.
  - Systematic exploration, using computational approaches (quantum modeling, learning from data, stochastic search) as now used in the pharmaceutical industry show great promise. Sang-Tae Kim, former OCI Director, helped build new partnerships here.
  - The uncertainties are great, but somewhere between 2X and 10X improvements are likely to be possible, **if** we follow up on this opportunity. No one else is doing it yet in the US.
  - A new EFRI topic in this area would have huge workforce benefits for the US in this key area even in the worst case where GM imports batteries from China, whose industry is now well ahead of the US industry in this area.
  - In addition to battery design, new lifetime analysis, catastrophic safety analysis and open-source models for battery management systems are all badly needed.

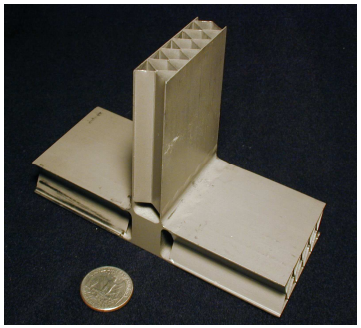
alidated Structures, TPS

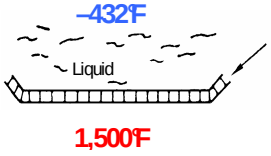












RENE' 41 Panel

- **Existing Material Technology**
- **Multifunction Metallic Surface**