“Hydrogen-Powered Vehicles: Pathways and Challenges”

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National Association of Environmental Professionals

Dearborn, Michigan
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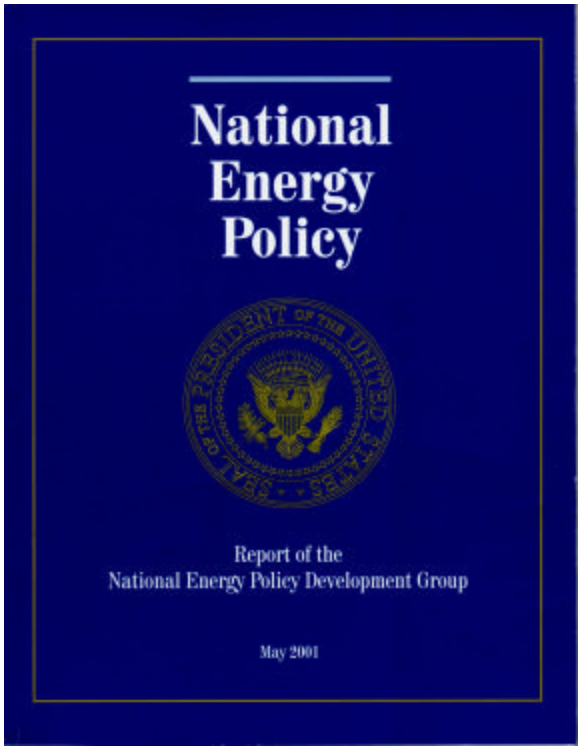
Key Messages

EERE Fuel Cell and Hydrogen Activities:

- **Aligned with the National Energy Policy**
- **Aimed at valuable national benefits**
  - **energy security via lower oil imports**
  - **reduced air pollution**
  - **lower carbon emissions**
- **Rely on extensive collaborations**
- **Focus on critical technology needs**



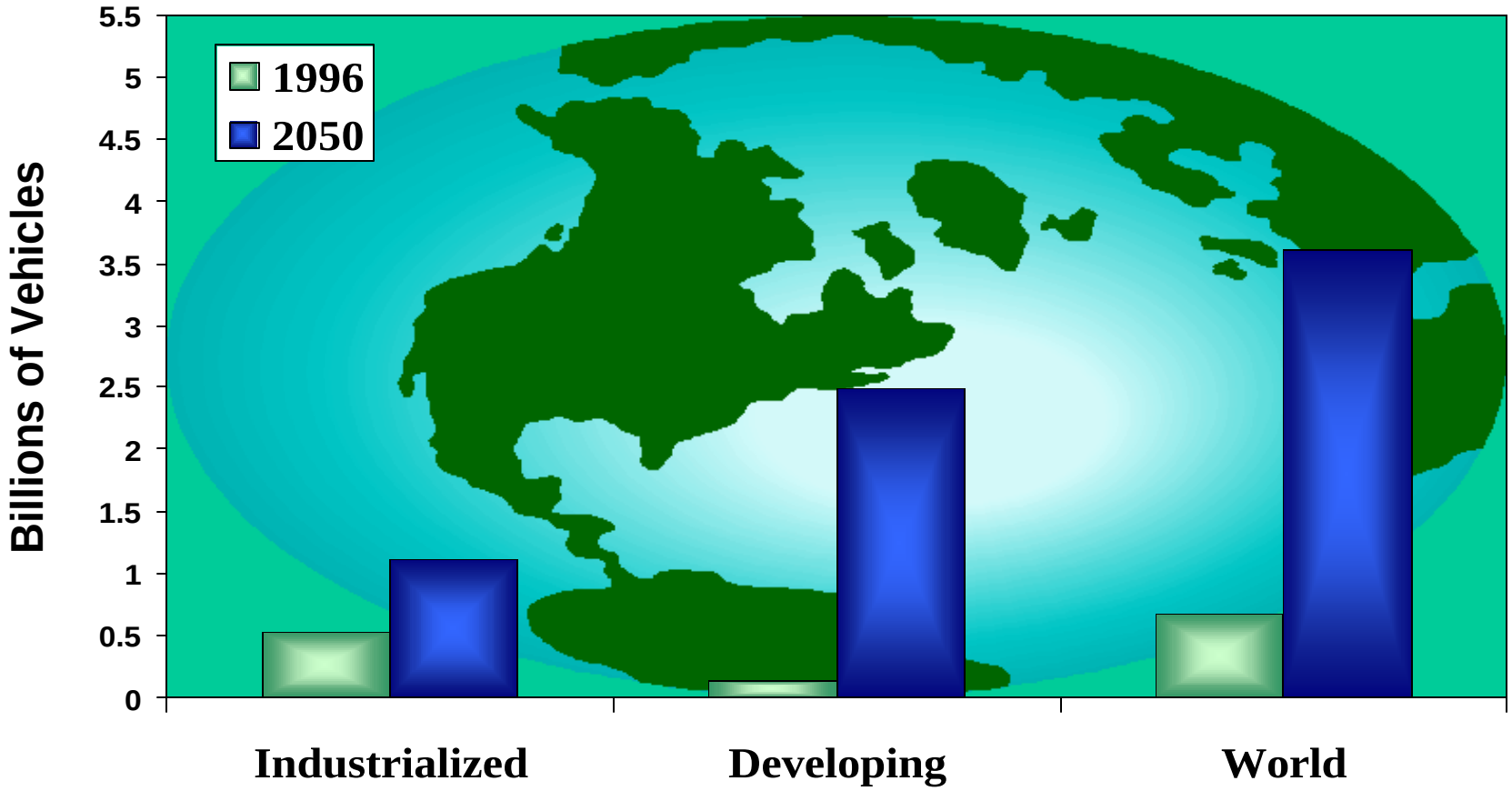
Stabilizing Concentrations

- **Net emissions must eventually decline to virtually ZERO**

...has non-trivial implications for energy.

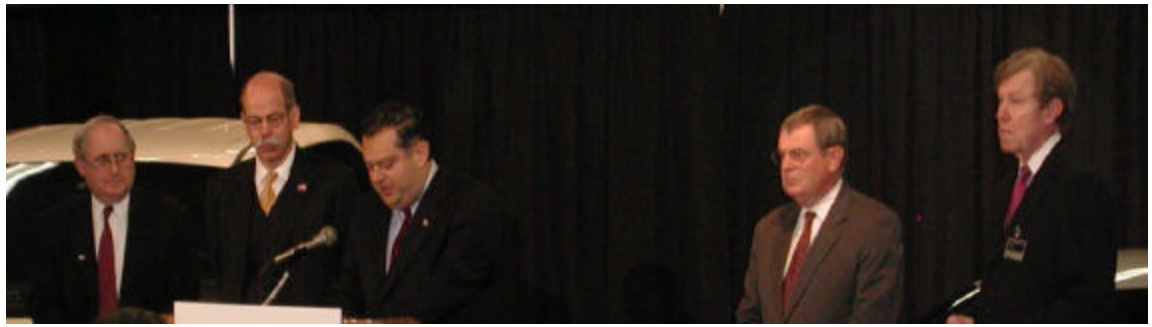
...requires fundamental change in the energy system.

World Vehicle Registrations



Source: OTT Analytic Team

FreedomCAR is a Partnership



January 9, 2002

Secretary Abraham announces the FreedomCAR Partnership

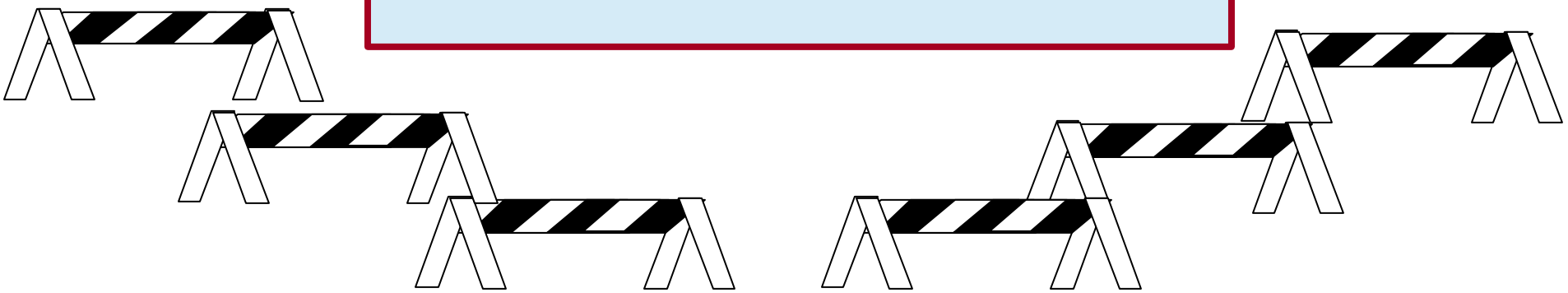
- **The CAR in FreedomCAR is for Cooperative Automotive Research**
- **The Partners are:**
  - **–U.S. Department of Energy**
  - **–U.S. Council for Automotive Research**

(USCAR is a cooperative endeavor of DaimlerChrysler, Ford and General Motors to conduct pre-competitive research)

Technical Barriers

There are significant technical and economic barriers that will keep fuel cells from making significant market penetration for 10 years.

- **Fuel Cell Cost & Durability**
- **Safety/Codes & Standards**
- **Fuel Infrastructure**



Fuel Cost

<u>Today</u> (within 5 years)

Large on-site steam methane reformers

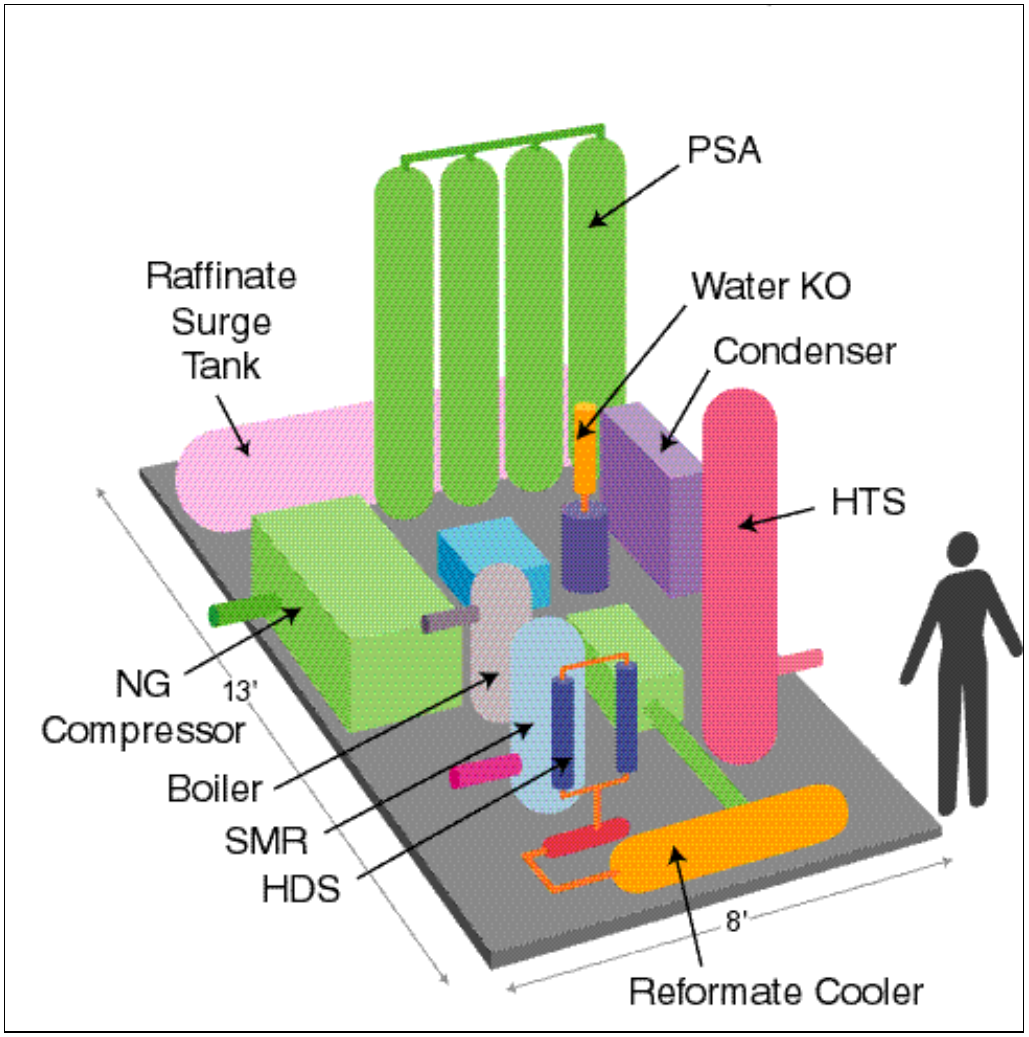
<u>Tomorrow</u> (within 10 years)

Distributed hydrogen generation at local refueling station from natural gas, and from electrolysis

<u>Future</u>

Production from renewable, fossil with sequestration and nuclear systems

Proposed SMR Assembly



Hydrogen Storage

<u>Today</u> (within 5 years)

Composite wall tanks that contain 5000 psi @ room temperature

<u>Tomorrow</u> (within 10 years)

Composite wall tanks that contain 5,000 to 10,000 psi hydrogen gas, or low-temperature or cryo-gas tanks

Metal hydride tanks

<u>Future</u>

Carbon-based or chemical hydride systems

Fuel Cell Cost and Durability

<u>Today</u> (within 5 years)

High cost	$200/kW @ 500,000 UNITS
Low durability	1000 hours

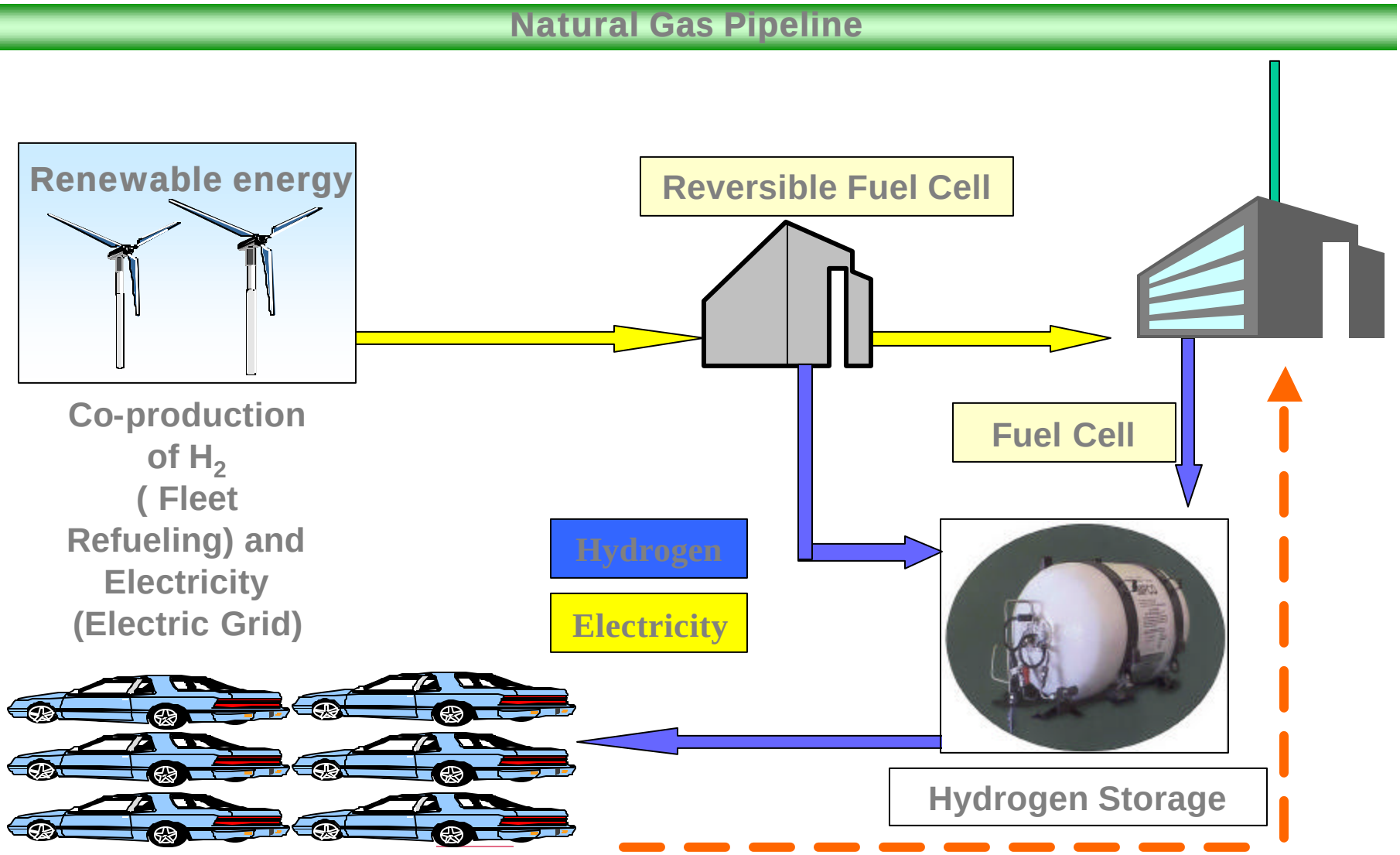
<u>Tomorrow</u> (within 10 years)

Cost	$125/kW @ 500,000 UNITS
Durability	2000 hours

<u>Future</u>

Cost	$45/kW @ 500,000 UNITS
Durability	5000 hours

Power Park Concept



Stabilization (S)

S = Zero or Very Low Carbon Emissions

Production

= Renewable

Fossil Fuels with Sequestration

Nuclear

Utilization

= ICE

Turbines

Fuel Cells

Conclusions

- If world economies adopt a stabilization policy, then hydrogen becomes a leading fuel for mobile applications
- There are no technical breakthroughs necessary for the implementation of a hydrogen vehicle
- There is a significant *"chicken and the egg"* issue involved in the implementation of a totally new infrastructure
- Public/private partnerships will be necessary to facilitate the transition