

The Hydrogen Fuel Cell Locomotive as National Energy Policy Insurance

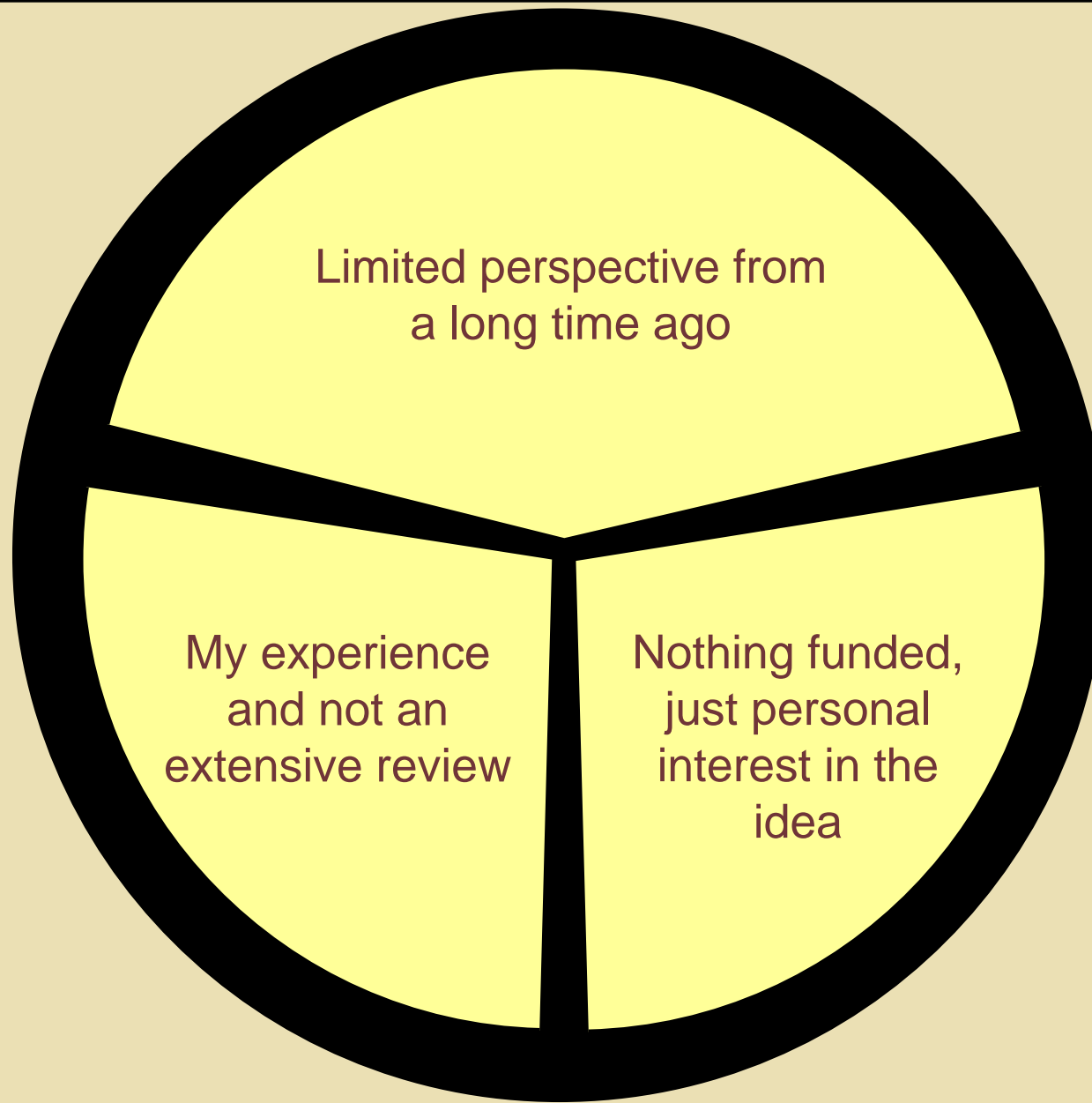
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Parts Unknown



The History of the Idea



Circa 1995-1997



Three Reasons Supporting the Hydrail Marriage



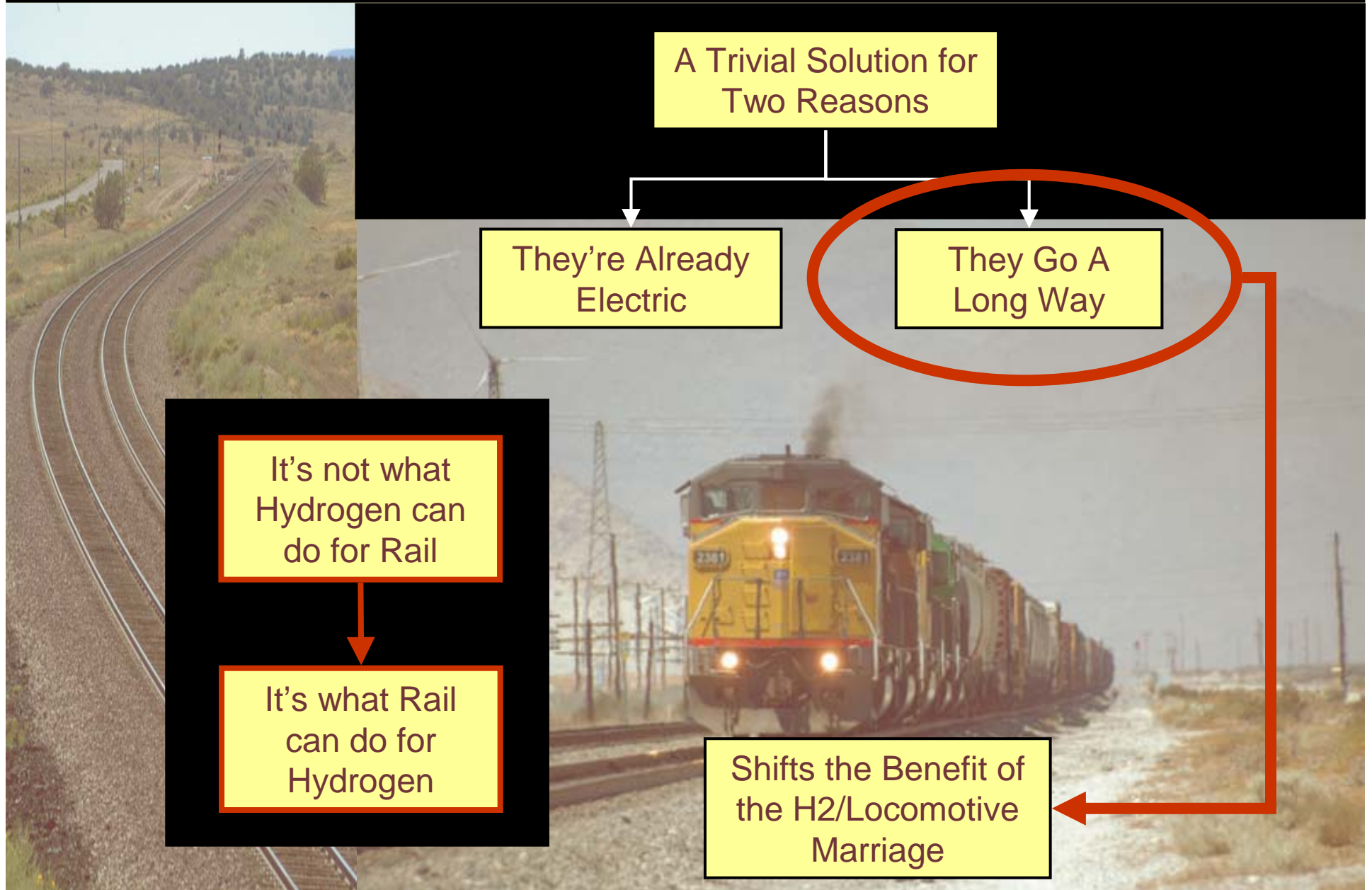
One of those Reasons flips the Rational on Hydrail

Why Hydrogen Railroads: Reason 1

Opportunity to Substantially Increase Locomotive Efficiencies

- Fewer moving parts.
- Many lash-up, fuel-tending, employment options.
- Net increase in fuel-to-traction energy conversion.
- Increasing efficiency decreases the size of the required engineering plant.
- No power loss along lash-up locomotives due to leading locomotive cooling plants.
- No emissions—tunnel crossing restrictions for simplified routing and scheduling (e.g. the Cascade and Moffet tunnels).

Why Hydrogen Railroads: Reason 2



Why Hydrogen Railroads: Reason 3



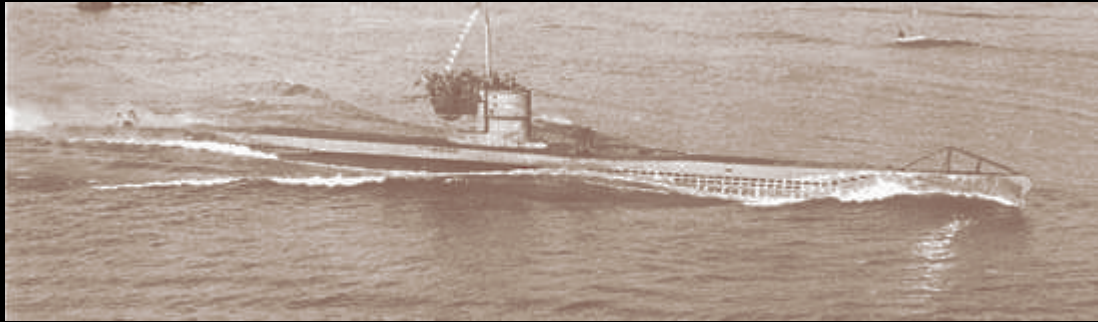
Railroads are
Insignificant

Compared to National
Automotive and
Aviation Interests

Capable of Meeting Most
National Transportation
Needs if Called Upon

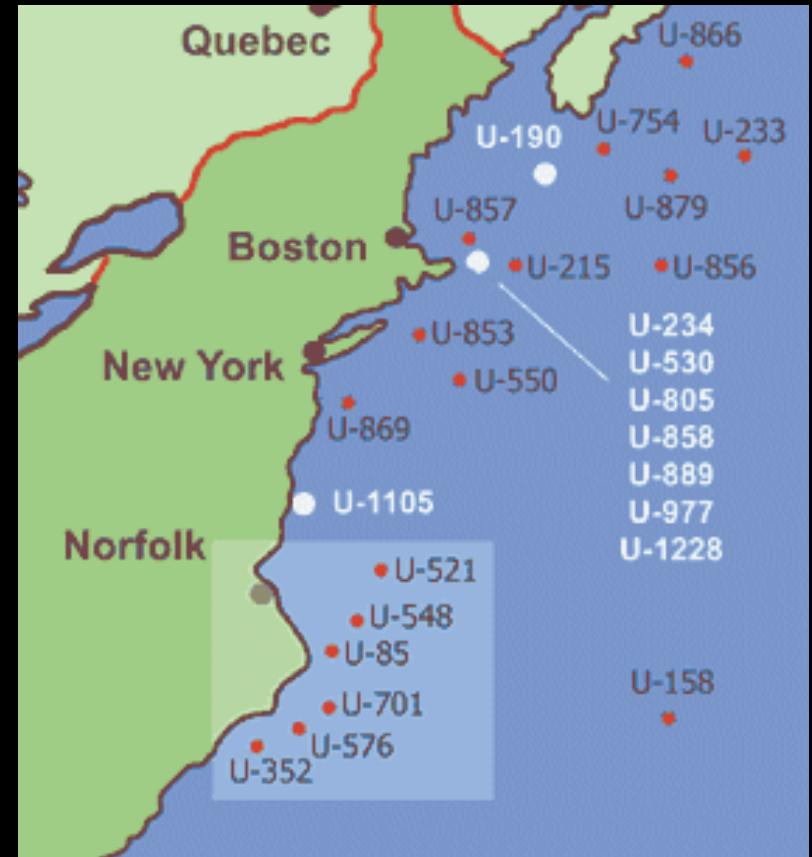


January-June 1942



Operation Drumbeat

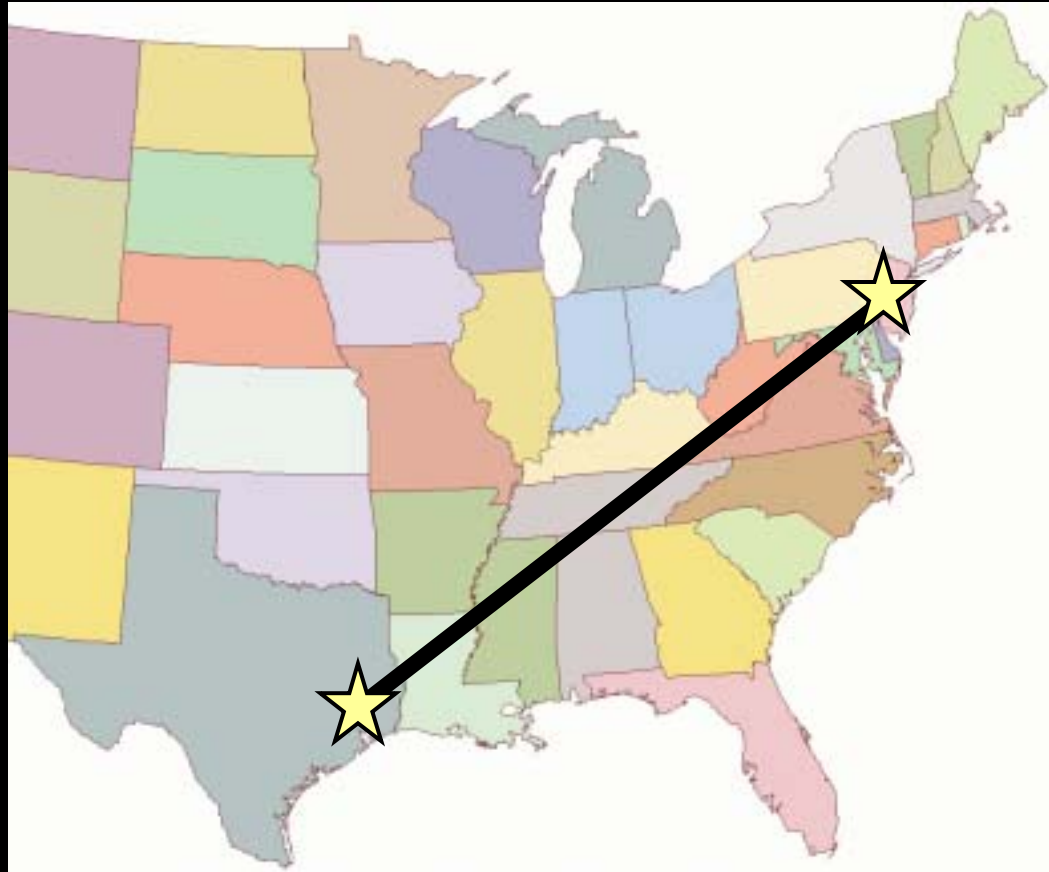
- German U-boat offensive to disrupt commerce shipping along the American seaboard.
- Admiral King did not view convoys as effective along coastal waters.
- 400 ships (3M tons) sunk between January and June 1942.
- 5,000 Merchant Marine.



There was a plan for this?



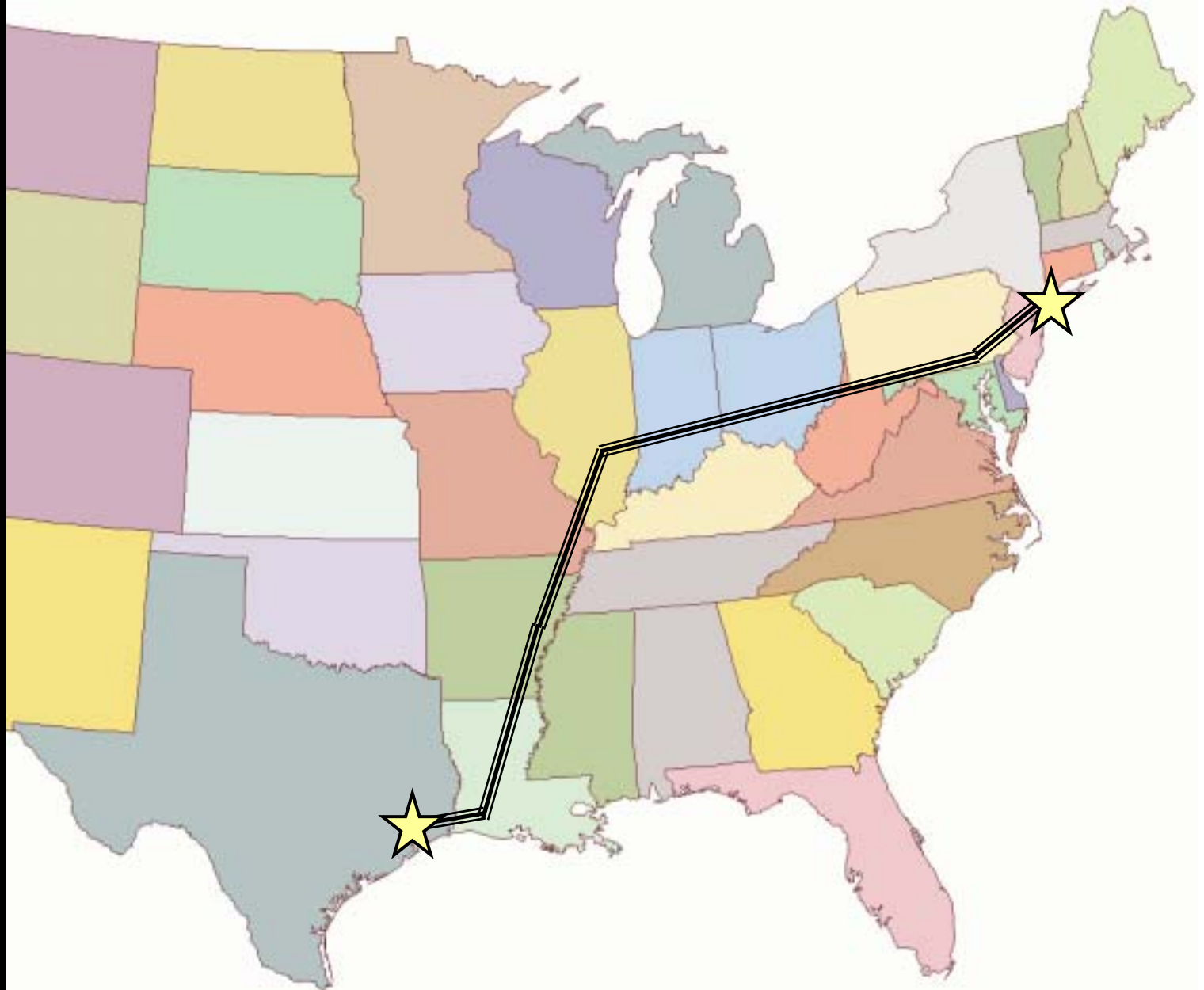
1940: Interior Secretary
Harold Ickes requests
plan to connect NYC
with east Texas



The Big Inch and Little Big Inch Pipelines

Jun 42-Feb
43: Longview
to Illinois Leg

Aug 42-Aug
43: through
to NYC



Goal of our mid-1990s Paper

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1.0 Abstract

Debates rage over fossil fuel availability during the coming two decades. Through renewable sunlight, electricity generation, and electrolysis, hydrogen fuel cells offer an alternative energy collection and distribution option which is sustainable and non-polluting. Equipping locomotives with fuel cells has received considerable attention, although most conclusions indicate rail-owners cannot justify the associated re-engineering costs. However, from a national policy perspective, there are three reasons full federal funding for this re-engineering could be demanded.

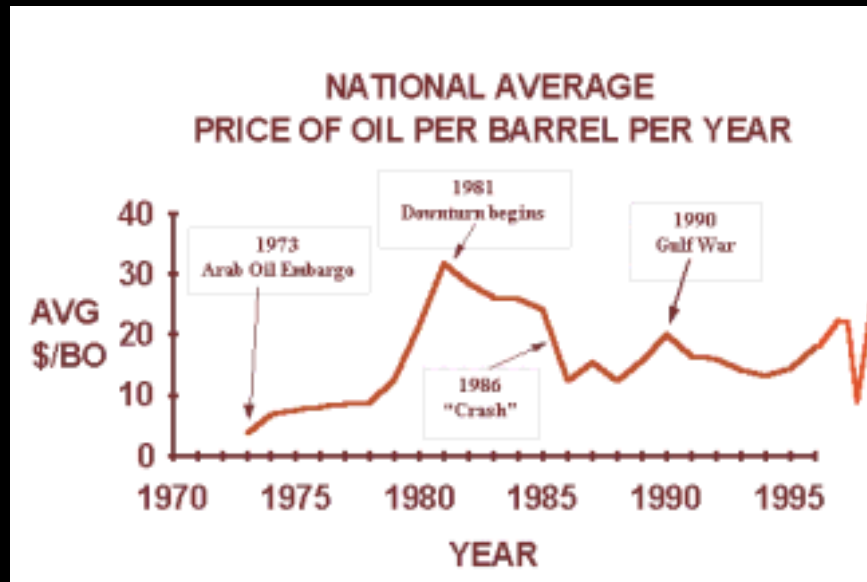
First, the hydrogen fuel cell has the near-term potential to double locomotive operating efficiencies, quite similar to the sweeping advantage of diesel over steam. Second, installing a hydrogen distribution network for the railroad would be as trivial as it is pioneering, because locomotives travel thousands of kilometers between fueling stops. Third, and most important, the rail sector is insignificant relative to other fossil fuel demands, yet capable of meeting most all national transportation needs if called upon. For the smallest investment, the federal government could purchase insurance against changes to world energy supply or policy. What is necessary is federal subsidy of the 1-5 MWe fuel cell for locomotive purposes, perhaps nothing greater than the money spent on diesel development during the two world wars. Given a united rail fuel cell commitment, the entire railroad sector could reap greater profits and national stature given any world energy scenario or crisis.

Mirror the 1940
Ickes Back-
Pocket Plan



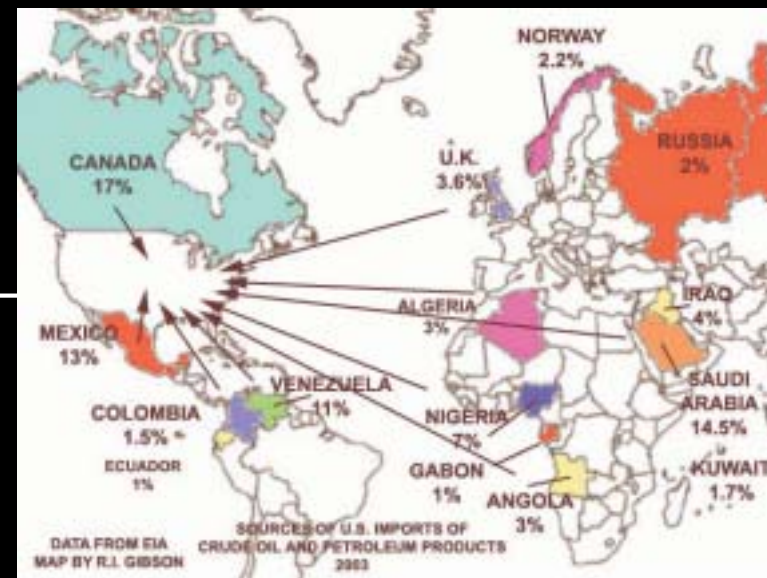
How to get the
Word Out

21st Century Givens



Oil at
\$50 a
Barrel

US dependent
on Oil from
Everywhere



Gasoline . . . is still Cheap!?!

200,000 Established
Facilitates

Support/Supply
Network

Customers

Regulation and
Management

Barrier to Entry

Build Fueling
Sites

Build
Support/Supply
Network

Get Customers

Create/Combat
Regulation and
Management

Alternate Fuel Cycle/Economy Goal

Minimize cost of fuel
cycle infrastructure
and set up

Gas Stations

Refineries

Distribution Costs

Ask not what
hydrogen can
do for rail . . .

Ask what rail
can do for
hydrogen

Move Stuff

Move People

Ensure Connectivity

Maximize the
ability to facilitate
commerce

Scan by Wes Barris

Trains go a long way



Rail Solution is Trivial

Already Electric

Go a Long Way

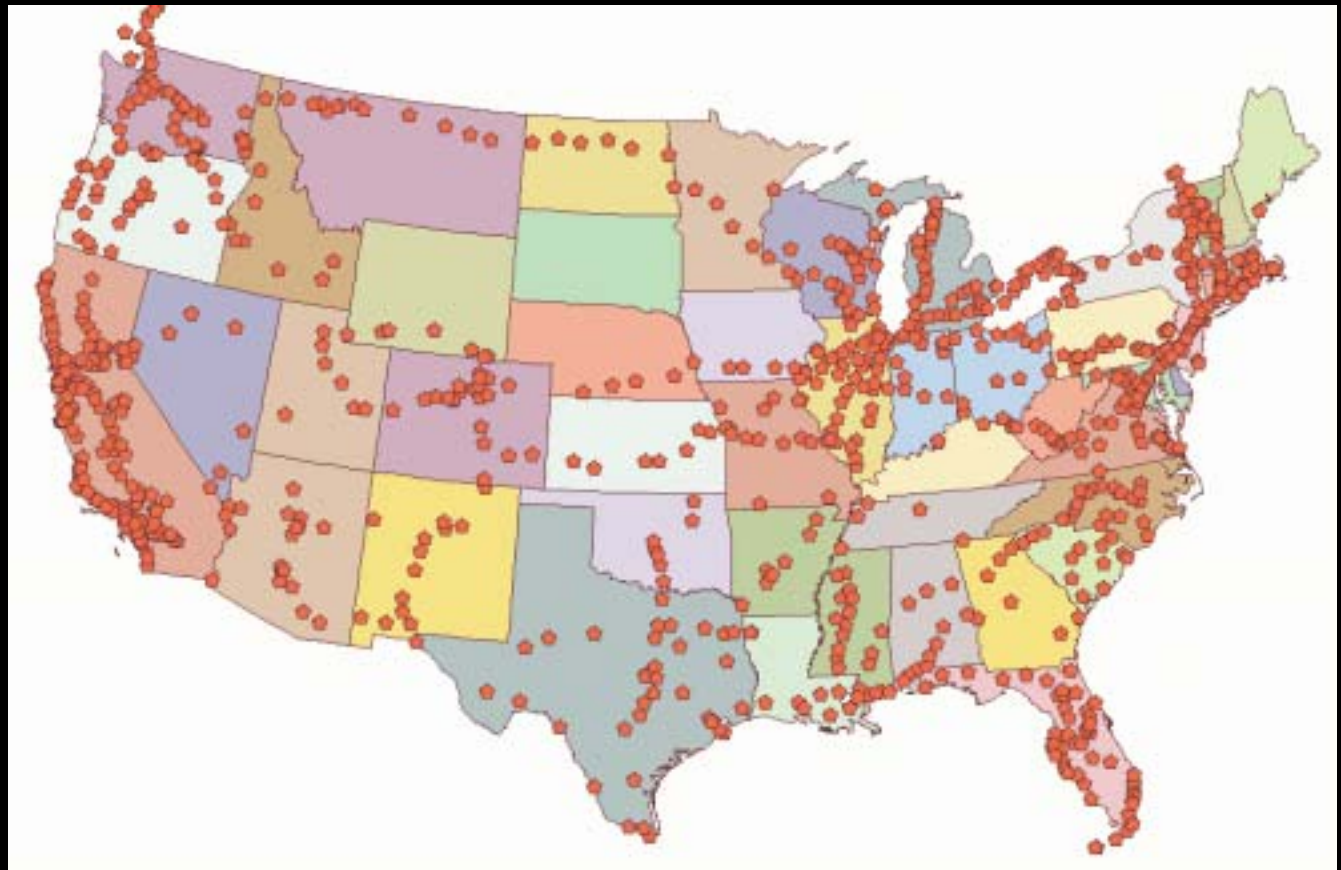
How far do they need to go?

USA: in a box
1,500 x 3,000 miles



Existing Rail Stations

923 Stations



Existing Miles of Rail

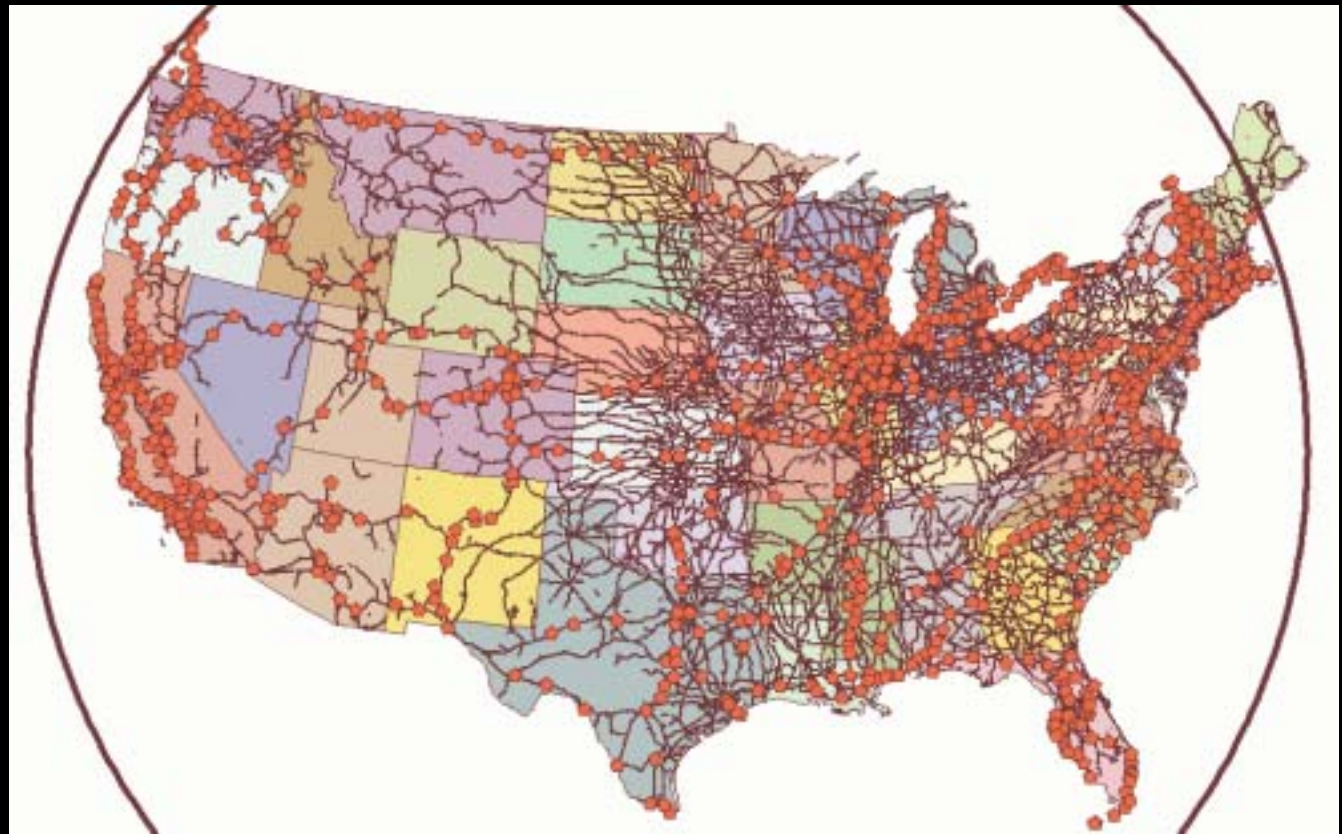
100,000 miles



Hutchinson, Kansas and 1,500 Mile Range

Hutchinson, KS

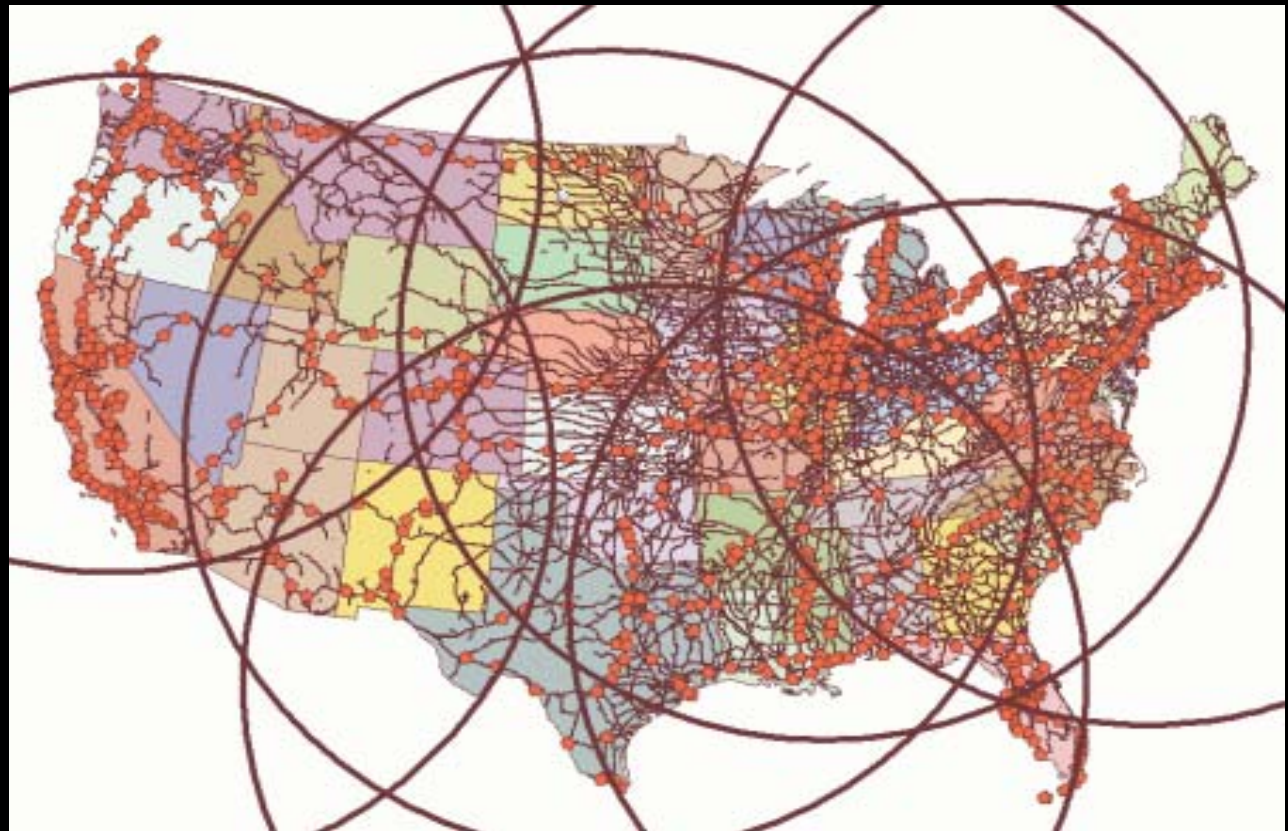
1 Fuel Depot and
1,500 Mile Range



7 Fuel Depots and 1,000 Mile Range

Hutchinson, KS
Portland, OR
Barstow, CA
Houston, TX
Chicago, IL
New York, NY
Jacksonville, FL

7 Fuel Depots and 1,000 Mile Range



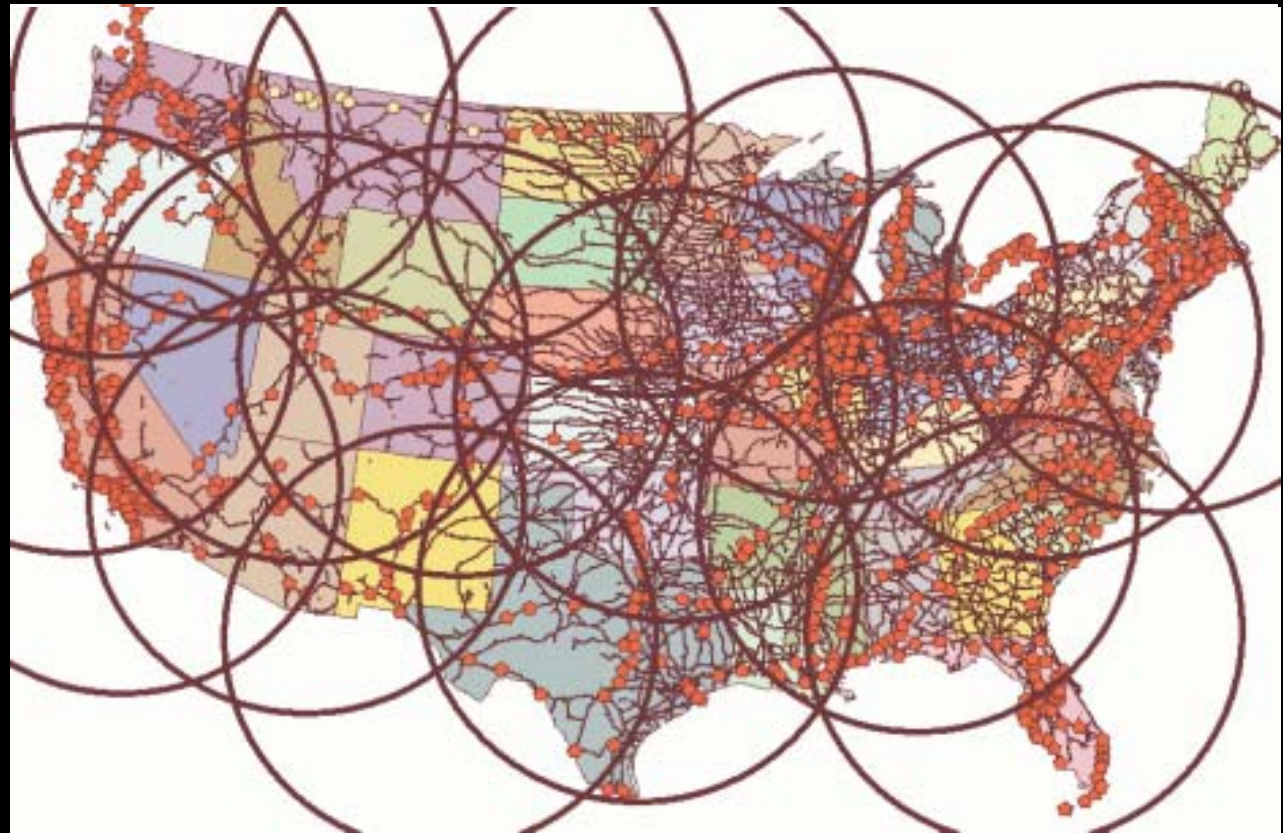
17 Fuel Depots and 500 Mile Range

New Presidential
Helicopter
Purchase/17



\$360 million per
gas station

17 Fuel Depots and
500 Mile Range



Benefits of a Hydrogen Rail Economy

- A complete and fully functional alternative fuel cycle.
- An avenue to establish a fuel cell operating history for further policy development.
- The creation of a manageable and supportable demand for a new energy industry.
- A no-impact economic demonstration for established energy firms to evaluate.
- An insured ability to meet national transportation needs in the event fossil fuel supplies are lost.

**The Hydrogen Fuel Cell Locomotive
as National Energy Policy Insurance**

The History of the Idea

Sandia NRL



There is no
Manhattan Project



The approach is
grassroots
systemic



It's going to
Happen



Is in the Room



Where to from here?

Where does the hydrogen come from?

Hydro-carbon Conversion

Power Plants and Peaking

Solar/Alternatives



Fuel Storage

Fuel Cells

Fuel Cycle

Engineering Processes

Making it Work

Leadership & Vision

Anger & Frustration

Do-It-Ourselves Attitude



The future is as bright as the light in our eyes

