The Hydrogen Fuel Cell Locomotive as National Energy Policy Insurance

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Stephen J. Bespalko
Parts Unknown
Limited perspective from a long time ago

My experience and not an extensive review

Nothing funded, just personal interest in 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

A Trivial Solution for Two Reasons

They’re Already Electric

They Go A Long Way

It’s not what Hydrogen can do for Rail

It’s what Rail can do for Hydrogen

Shifts the Benefit of the H2/Locomotive Marriage

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Shifts the Benefit of the H2/Locomotive Marriage
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

Hydrail – The History of the Idea
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
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 then 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.
21st Century Givens

US dependent on Oil from Everywhere

Oil at $50 a Barrel
Gasoline . . . is still Cheap!?!?

- 200,000 Established
  - Facilitates
  - Support/Supply Network
  - Customers
  - Regulation and Management

Barrier to Entry

- Build Fueling Sites
- Get Customers
- Create/Combat Regulation and Management

Hydrail – The History of the Idea
Hydrail – The History of the Idea

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
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

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
17 Fuel Depots and 500 Mile Range

New Presidential Helicopter Purchase

$360 million per gas station
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 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