Hydrail – Going Forward
Strategic Niche Management

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Recap

- 6th Hydrail Conference in Istanbul
- Significant interest in the subject, even by the media
- New Project Ideas
- But:

No concrete action!
Why could Hydrail be relevant?

- Diesel is the dominant technology if looked at worldwide.
- Europe shows high electrification and it is still growing.
- Hydrail could be an attractive way to create electric traction benefits without electrification, which will be slow.
Diesel - Operational Relevance

- On a worldwide base, diesel is the dominant logistic fuel
  - Cheap (directly/indirectly)
  - Ubiquitous
- In European Rail operations, significant differences exist and electrification rate does not tell all.
  - EU25 Electrification rate: 51.5% (2008)
  - Electric Energy Share of Energy Consumption: 80%


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Final Energy Consumption per Service Type

Rail is a slow innovation adopter

- Richard Trevithick
  February 13, 1804,
  Merthyr Tydfil, S-Wales
  - 1st steam powered train consisting of 1 Locomotive + 5 wagons,
  - 10 tons freight + 70 persons,
  - 10 miles distance
- It took 25 to 100 years before rail network development started!

Source: Gruebler, A., The Rise and Fall of Infrastructures, Physica Verlag, 1990
Innovation Diffusion

Christensen, Moore, Kemp: *Strategic Niche Markets*

- Geoffrey Moore, Silicon Valley Consultant and VC Fund founder; *Crossing the Chasm*, 1991/1995
- Clayton Christensen, Havard; *The Innovators Dilemma*, 1997
  - Incumbents can not handle disruptive technologies
    - Low end disruption
    - New market disruption
  - Management of disruptive sustainable transport innovation

Source: After Caneval BV, www.caneval.com
Bold Long Term Objective: Replacement of Diesel Rail

- Q: What do we need to get there?
- A: A solution that is economically and technically sound to operators and offers benefits for society.

Main Topics for Roadmap:
- CAPEX
- OPEX
- Durability
- Reliability
- Range

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Beachhead Selection

- Segment that cannot or only with great difficulty be addressed differently if the same benefits are to be accrued

- System Solution
  - Partnership of
    - Energy Provider
    - Mobility Technology Provider

- Offer a new distribution channel for energy people

- Modularize and capitalize on other developments, e.g. bus/car sector

- Limitation of risk for operator

- Avoid overpromise:
  - Railpowers Green Goat demise
Energy Partnership Option

- Transport greening requires:
  - Local zero or near zero emission
  - Increase of renewable share
- Stable hydrogen demand from rail could be attractive for renewable energy producers which face „the night valley problem“

- Target cost must be approx. equal to diesel: i.e. currently 0.087US$/kWh
- Corresponds to: approx. 3.0 US$/kg H2
- Emission premiums possible as regulated for road transport in Europe would allow a premium of 0.03US$/kWh (2009/33/EC)
Which Beachheads to go for?

- Historic rail sites
  - Their track structure is protected and cannot be changed
  - They were mostly designed for steam so electrification is a problem
  - As they are also often in naturally beautiful areas/reserves diesel power is not sustainable
- Mining/industrial rail
- Narrow gauge lines
  - This setor is quite reasonable in size, but the major suppliers do not spend R&D effort on it
- Shunting/Railyard Operation
  - Local emission issues may make continued diesel operation difficult
  - Depending on local workrules shunting with catenaries may not be possible
- DMUs on broad/standard gauge lines
- Freight on broad /standard gauge lines
Historic Rail Sites Examples

- Kalka Simla Rail
  - 1 of 3 Indian World Heritage rail sites
  - Tunnel systems and flooding issues prevent electrification
  - Could be built based on FC Bus technology
- Various European Steam rail lines
Mining/Industrial Locomotives

- Interesting, because of higher power and longer duty cycles than battery units
- Catenary is no alternative due to ignition risk
- Successful projects exist
Narrow Gauge Lines

- There are at least 15,000km of narrow gauge in Europe
  - With the exception of CH and part of AT most are not electrified
  - Example FEVE project

Source: FEVE Hydrogen Tram, Presentation CIDAUT, Daniel Sopena, Madrid 2011

Source: Stadler GmbH, GTW

Diesel ONLY

Diesel Hybrid

Fuel Cell

Source: Tognum AG

Source: Ballard
Shunting Locomotives

- Attractive solution
  - European Urban air quality concerns (PM!) and noise
  - Major railyards are in city centers
  - Lots of idle times
  - Hybridisation will reduce power of FC set und thus cost
  - Modular Upgrade concept necessary (150kW/300kW/600kW)
- US reference BSNCF may be helpful
Full Size Locos

- Feasibility Studies prove up to 5MWe (2.6MWe FC, Rest Battery/SC) in typical frames is possible
- Locomotive Manufacturers are hesitant regarding risk
- Project Concept:
  - Build 40’ Container with all technology inside
  - Use internal 2 or 3kV DC Bus of „regular“ electric locomotives as feed-in point
  - Add Hydrogen Trailer
  - Run realistic environment tests
If all this is successful:

Thank You for Your Attention
Contact

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