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The Role of Hydrail In Meeting Environmental Commitments

ENTE PER LE NUOVE TECNOLOGIE, L'ENERGIA E L'AMBIENTE

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From steam to diesel……from

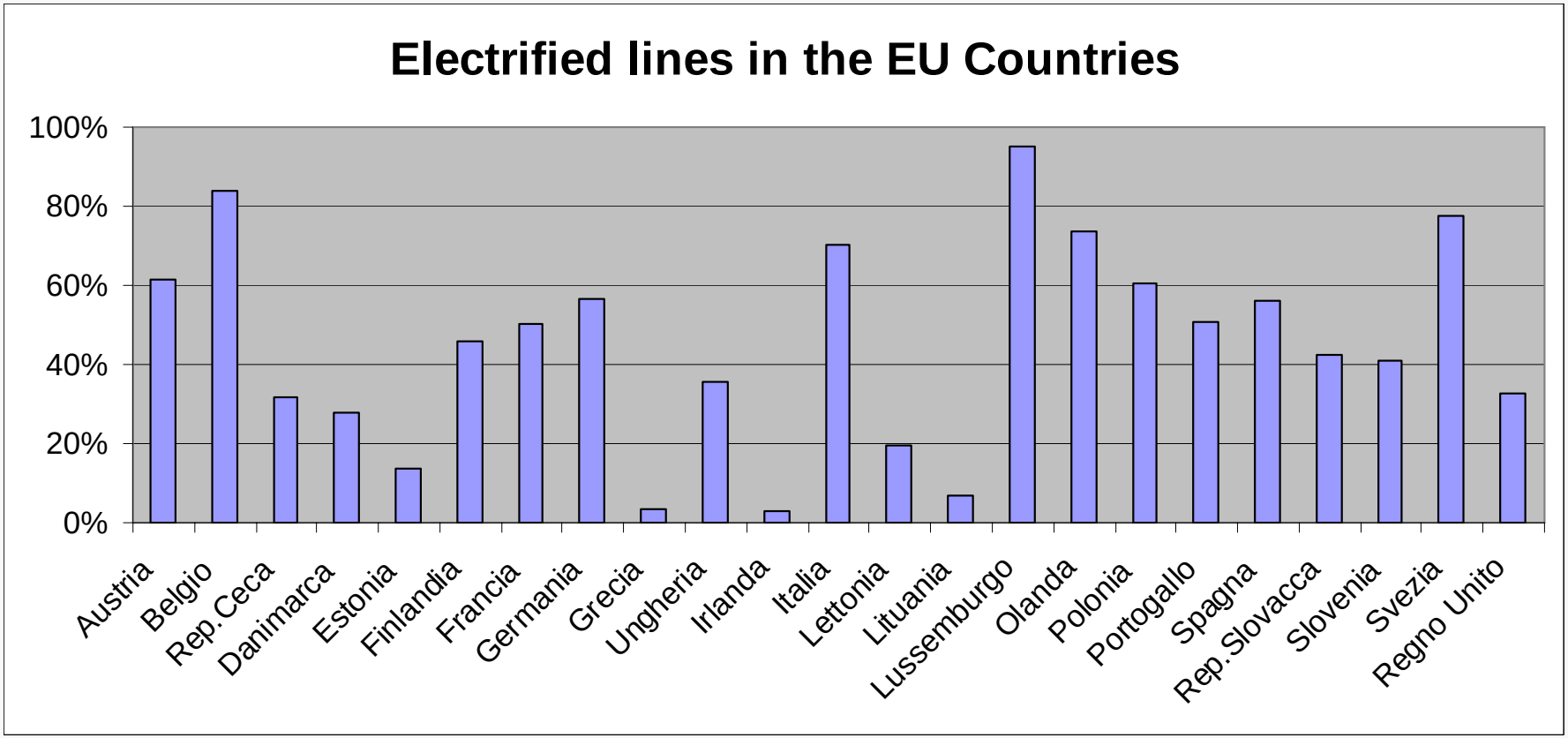
From *mass* transport …….to *mass&fast* transport…….. to *fast&clean* transport

Great Northern locomotives William Crooks, 4-8-4 Class S2 steam locomotive and diesel locomotive Class E7

Bombardier B81500 (dual mode train)

Electric traction:

1. more power,
2. less energy comsumption
3. zero-emission on-site,
4. less CO2 emissions (it depends on the Well-to-wheel energy pathway)



	Power source	*Peculiarity*	*Cost*
Electric trains	Fossil/Nuclear/Ren.		E.E. gener./distr.
Hydrogen trains	Fossil/Nuclear/Ren.	interoperability / no overhead lines	H2 prod./ distr./ use

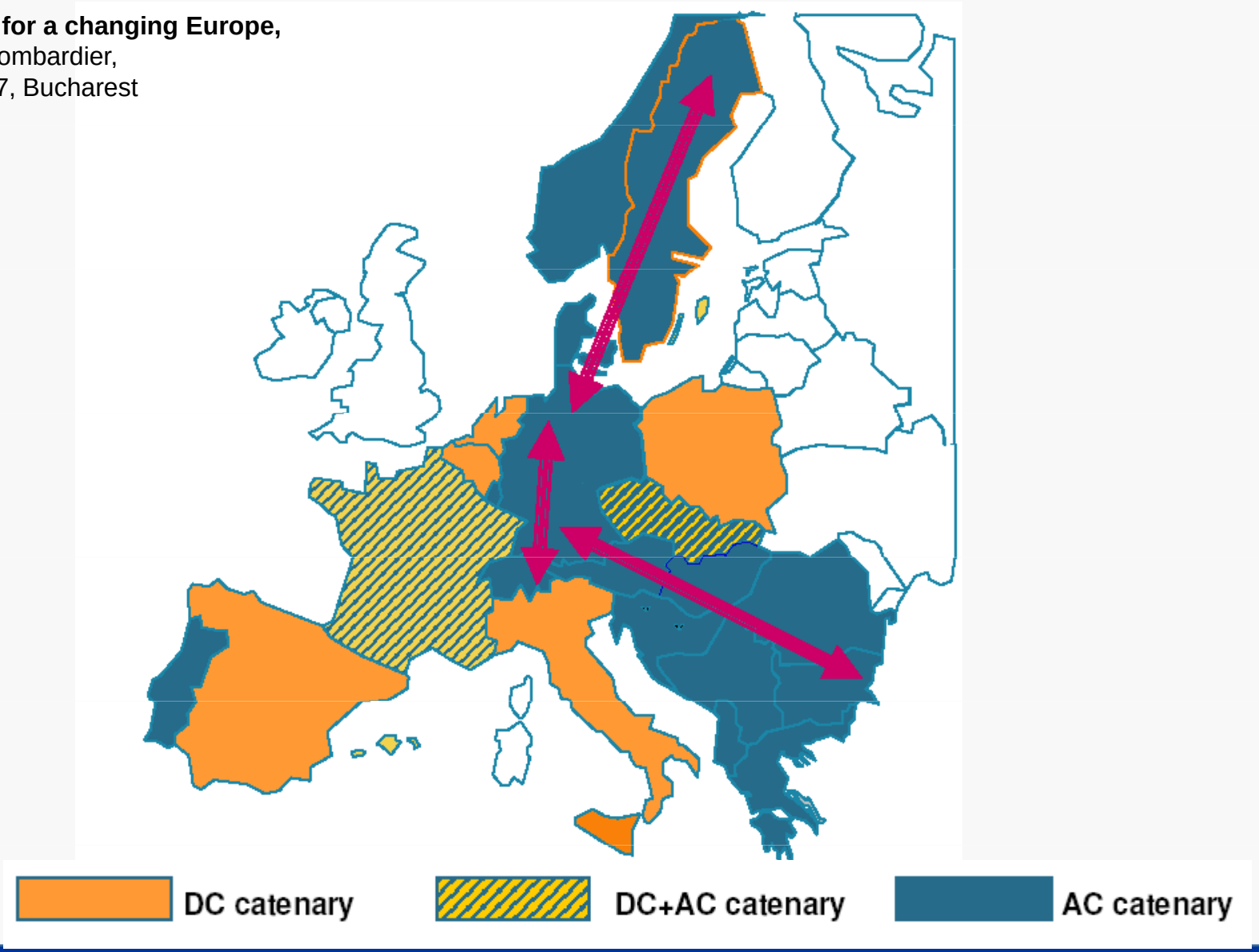
The rationale to consider hydrogen for railway market too

- In general terms, autonomous electric traction in rail vehicles could avoid electrification costs (2-3 MEuro/km) and represents an appropriate answer to promote interoperability throughout the EU.
- If diesel powered rail vehicles suffer form environmental problems like noise and air pollution, fuel cells systems represent an innovative solution for the on-board energy source, offering clean and efficient energy without sacrifice operational performance.

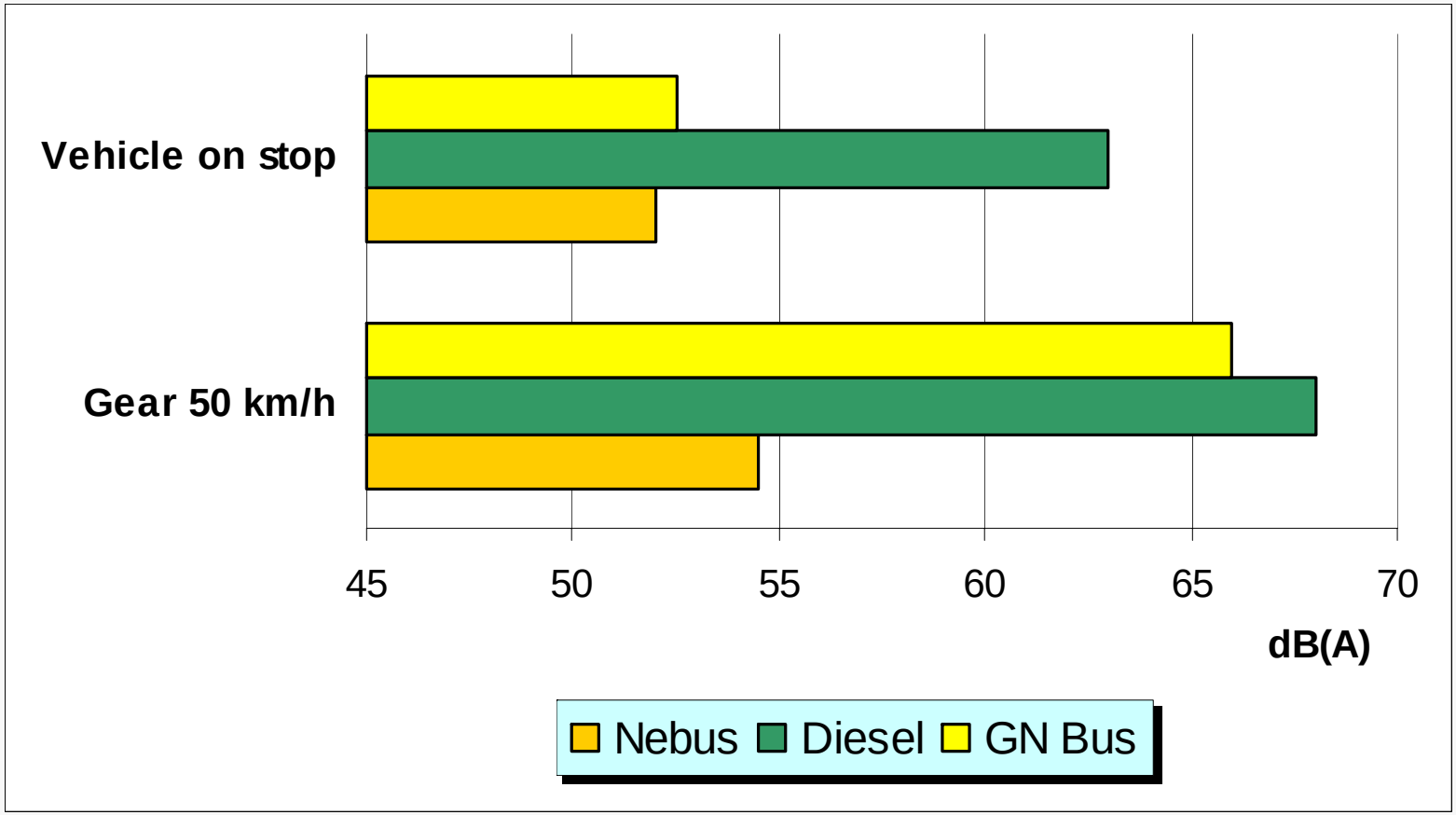
Possible applications for hydrogen trains

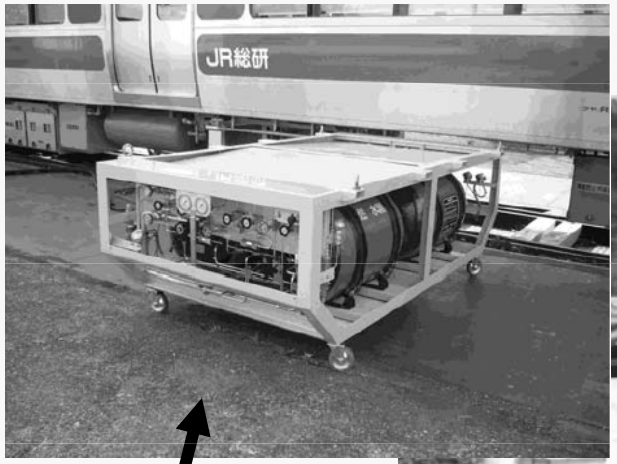
- High power generation units (8 MW) as high temperature FC could provide dual-mode locomotives for long-distance transport indipendently on different national solutions (25.000 AC, 3000 DC, etc)
- Innovative on-board generators (4-500 kW) as automotive derived fuel cell systems could provide dual-mode railcars for short-distance transport and tram-trains operating in urban and extra-urban areas
- Switcher locomotives retrofitted with 150-200 kW fuel cell systems could operate in silent and zero-emission mode in the urban areas, where they are often used.
- Auxiliary power units (50 – 70 kW) for emergency and service (light and hotel) use, reducing emissions at enclosing stations.

Locomotives for a changing Europe,
Janis Vitins, Bombardier,
Infratrans 2007, Bucharest



In urban areas, low noise and zero-emissions are of outmost importance.





The composite cylinders can store 18 kg of hydrogen at 350 bar

120 kW	Start-up time	Within 5 min.
Pure hydrogen	Weight	2000 kg
Air	Outside dimension (Without Radiator)	1.65(L) × 1.25(W) × 1.50(H) m
900~600 V		

The world's

Vehicle platform is based on Green GoatTM diesel-battery hybrid switcher

FC systems (n.2) corresponds to the Citaro Bus power plant

T

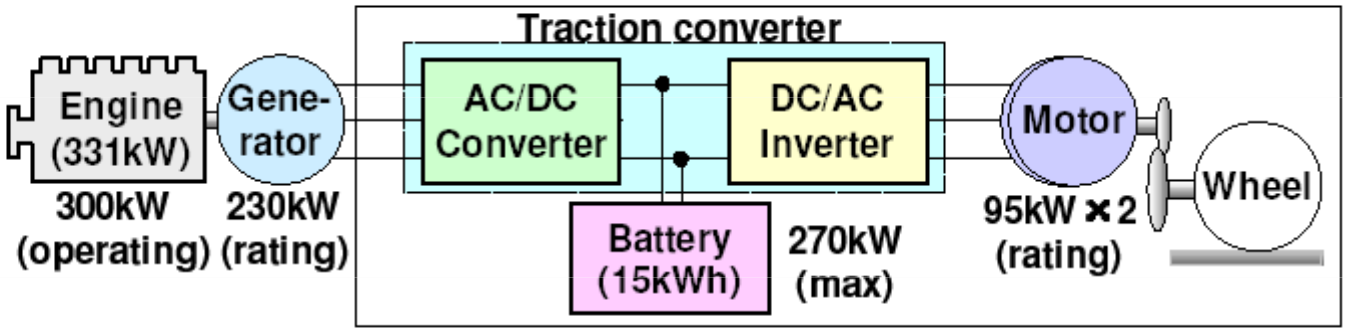
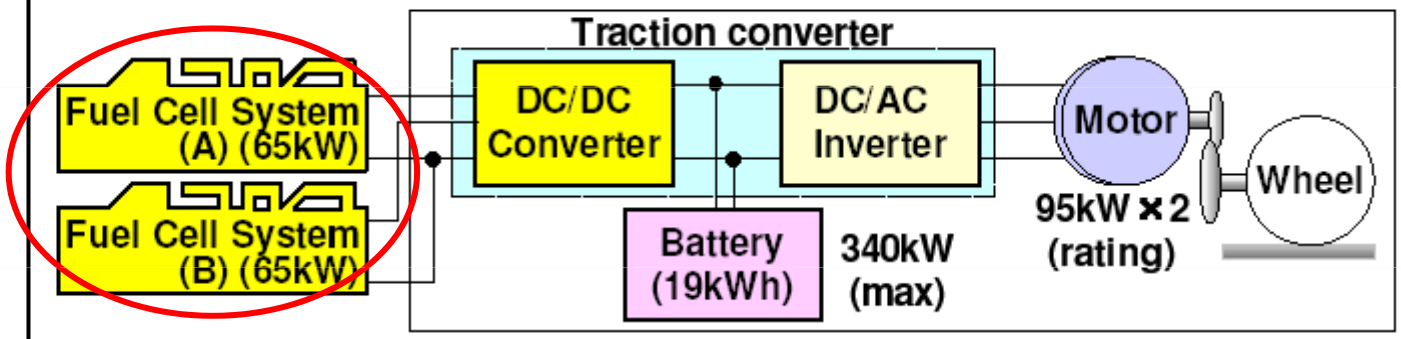
1. Engineering design; project manager
2. Fuelcell manufacturer
3. Industry funder; vehicle integrator; railyard demonstrator
4. Adviser on military applications; power-to-grid demonstrator
5. Hydrogen storage manufacturer
6. Refueling system
7. RailPower Hybrid Technologies

1. Vehicle Projects LLC
2. Ballard Power Systems
3. BNSF* Railway Company
4. Defense Gen. & Rail Equipment Center (DGRC)
5. Dynetek Industries
6. University of Nevada – Reno
7. Manufacturer of Green Goat platform

*Burlington Northern Santa Fè

The (no more experimental) railcar 'NE-train'

East Japan Railway Company (JR-East) and Hitachi, Ltd. in the last years developed a diesel hybrid system. Commercial railcars with the developed diesel hybrid system have been put in service this year (2007).

	System	Configuration
(1)	Diesel hybrid system (developed)	
(2)	Fuel cell hybrid system (developing) TESTED!	

Critical points

Taking account of the commercial mission profile to be assumed by the railway and the technology state of art,critical points, besides costs, for hydrogen use in railway application are:

- the energy autonomy to assume for the mission,
- the reliability level required by the railway applications,
- Infrastructure issues that require safety approach with hydrogen storage system, in depot for refuelling and in running line in tunnel.

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