

HyLOG: Demonstration of a Fuel Cell Range Extender for Zero Emission Material Handling Application

Ewald Wahlmüller

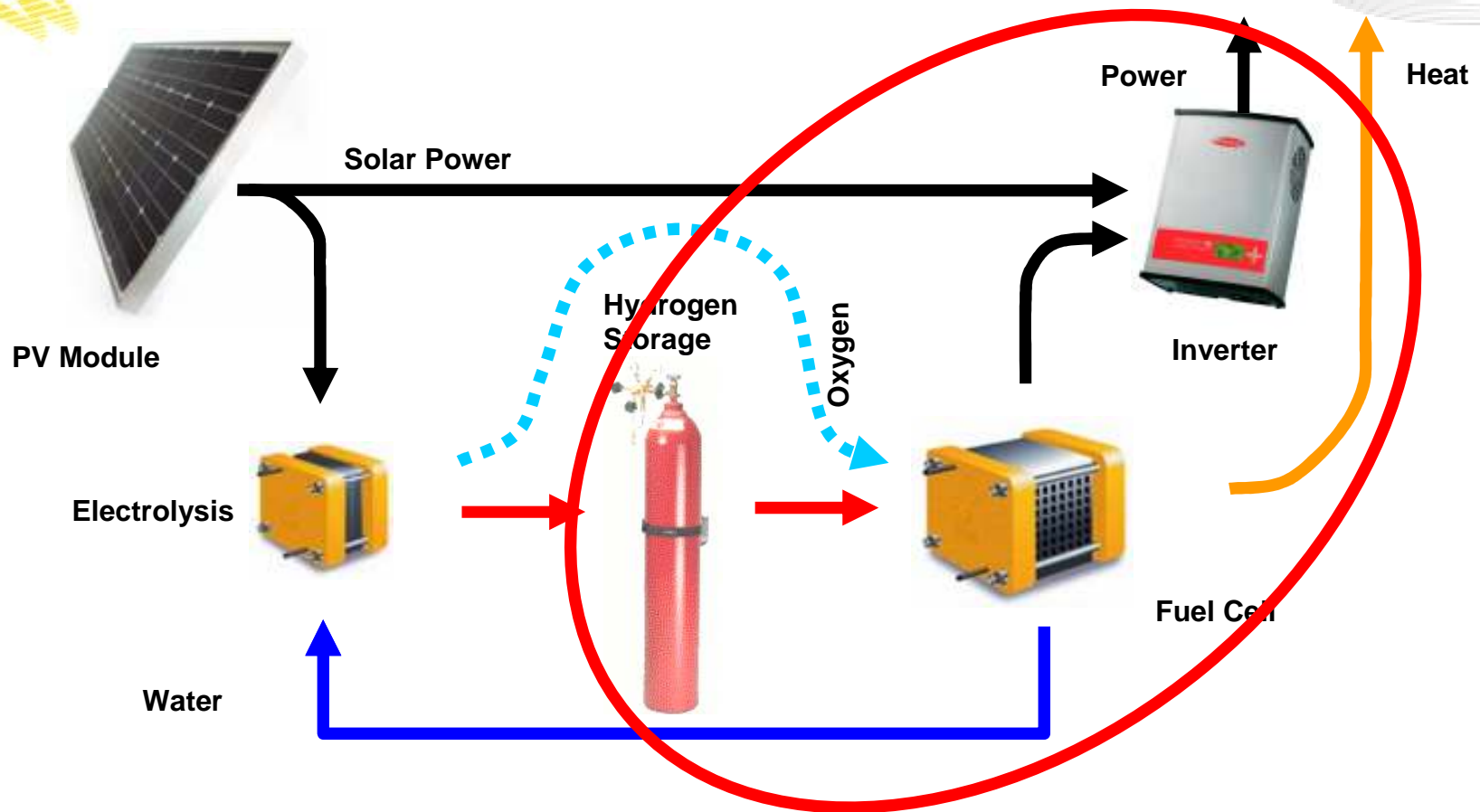
Hybrid and electric vehicles, energy storage technologies
and control systems

National and international R&D-projects, research institutions and funding programs

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- The Fronius Energy Cell & Applications
- Roadmap Market Entry
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- Summary

Vision "Solar Powered Energy Cell"



Fronius Energy Cell

**Available for
Pilot Projects**

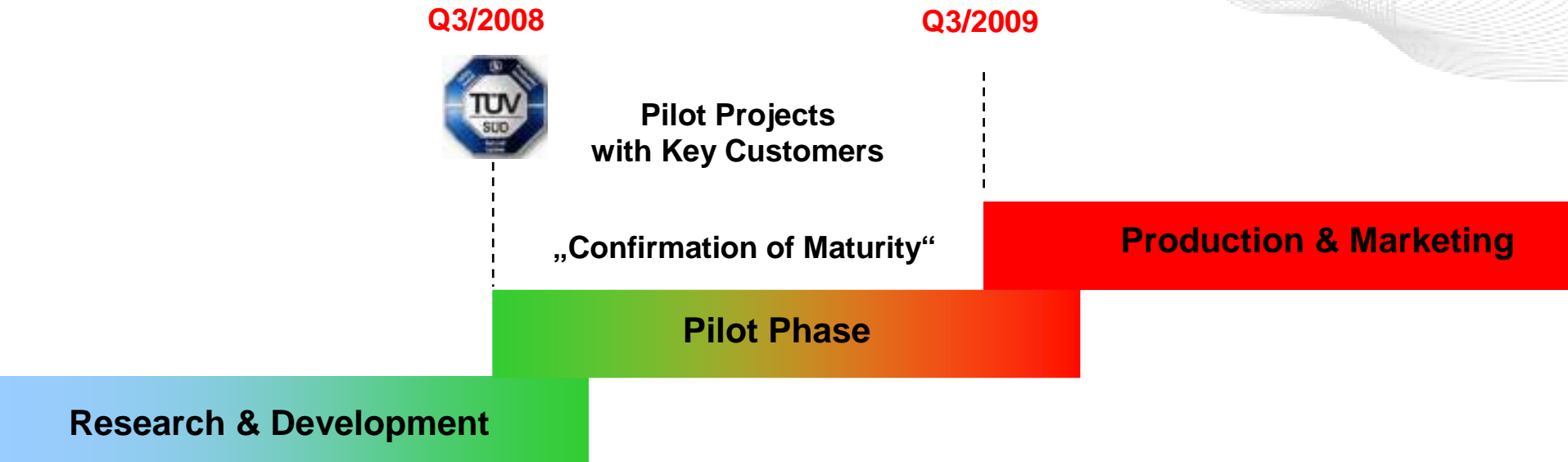


Power	4 kW	2 kW	1 kW
Voltage	48VDC		24VDC
IP Protection	IP20 (upgradable to IP54)		
Compliance			
Certification	EN62282-5-1:2007		
Fuel Supply	Hydrogen Storage Media 30 – 700 bar Hydrogen Gas Grid Electrolyser		
Applications	DC/AC Power Generator Mobile Applications		

- PEM fuel cell power generator
- High overall efficiency
- Silent operation
- Perfect safety strategy
- Easy to use and service, user-friendly
- Complete remote system monitoring



Roadmap for Market Entry



The HyLOG project



HyLOG Tow Truck

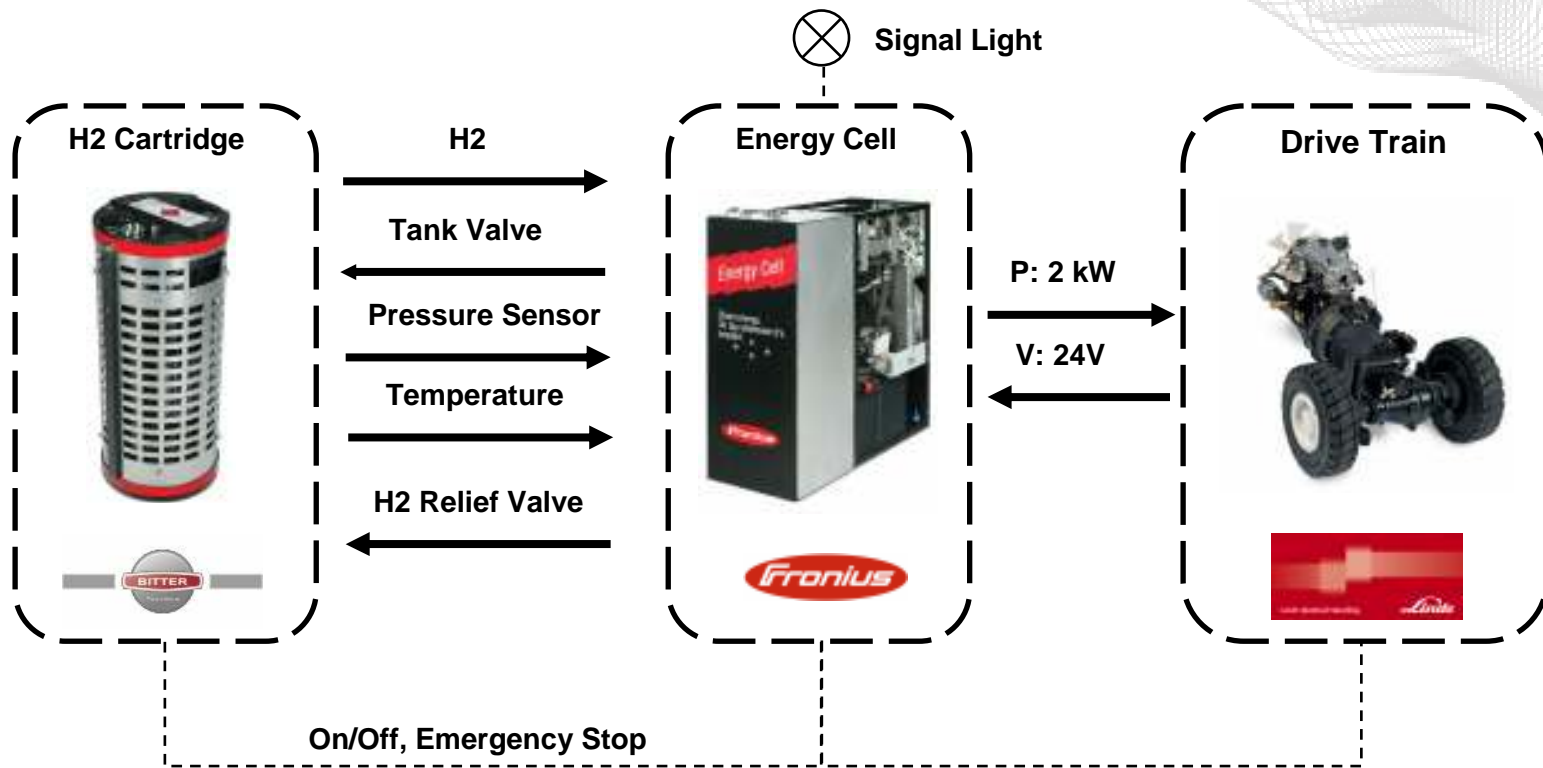
**with Energy Cell
26 lt. H2 Cartridge 350bar**

with Battery
500 Ah

Total Weight Vehicle [kg]	1005	1005
Total Weight Power Supply [kg]	150	380
Weight of Energy Storage [kg]	25	380
Amount of Energy [kWh]	11	9,6
Time to Refuel / Recharge [min]	<5	>500
System Voltage [VDC]	24	24
Power Socket 230V/50Hz	yes	no



HyLOG Power Train / Interfaces



Authority Approval

- **Product certification requirements (CE)**
 - HyLOG Tow Truck (98/37/EC machinery directive)
 - Fronius Energy Cell (EN62282-5-1:2007)
 - 350bar Hydrogen Cartridge (99/36/EC transportable pressure equipment directive (TPED) and 94/55/EC carriage of dangerous goods (ADR))
 - 350bar Hydrogen Refuelling Station (97/23/EC pressure equipment directive (PED))
 - Electrolyser HOGEN S40 (98/37/EC machinery directive and 94/9/EC ATEX directive)
- **Risk and safety analysis requirements**
 - Indoor operation of 5 HyLOG tow trucks
 - Installation and operation of 350bar H2 refuelling station (commissioning inspection and in-service inspection by authorised body required)
 - 350bar H2 cartridge filling and handling (in-service inspection by authorised body required)

H2 Technology / CO2 Reduction Potential Estimate

- Annual traction power: 17.000 kWh/a
 - (E-Forklift: 48V, 600Ah, 1 x battery recharging per shift (battery exchange required), 3 shifts/day, 49 weeks/year, 5 days per week)
- E-Forklift: Grid Electricity 25.758 kWh/a, CO₂ 16.021 kg/a
 - (Wh efficiency of lead acid battery 66%, CO₂ of EU grid electricity mix 0,622 kg/kWh)
- ICE Forklift: Diesel 11.565 l/a, CO₂ 30.646 kg/a
 - (Diesel ICE, 15% drive cycle efficiency, Diesel Fuel 9,8 kWh/l, 2650 g/l CO₂)

Quelle CO2 Daten:

- 1) Dem Leitfaden "Klima schützen - Kosten senken" des LfU
- 2) Der Datenbank GEMIS in der Version 4.2

H2 Technology / CO2 Reduction Potential Estimate

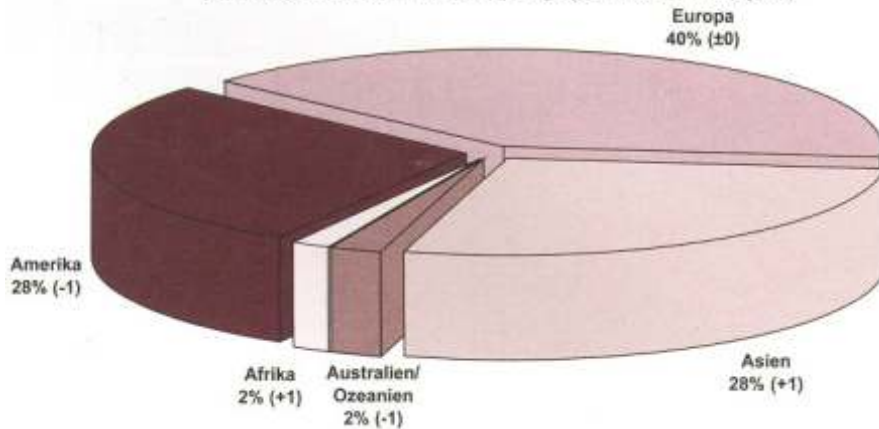
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 - (Diesel ICE, 15% drive cycle efficiency, Diesel Fuel 9,8 kWh/l, 2650 g/l CO₂)
- FC Forklift, fossile H₂ refuelled: 12.614 m³/a, CO₂ 9.480 kg/a
 - (efficiency reforming 85% -> 44.444 kWh/a natural gas, CO₂ of H₂ logistics neglected, CO₂ natural gas 2,15 kg/m³, 10,08 kWh/m³, electric system efficiency fuel cell 45%)
- FC Forklift, solar H₂ refuelled: 12.614 m³/a, CO₂ 0.0 kg/a
 - (efficiency electrolysis 60% -> 62.965 kWh/a solar electricity, CO₂ solar electricity 0 kg/m³, electric system efficiency fuel cell 45%)

Quelle CO₂ Daten:

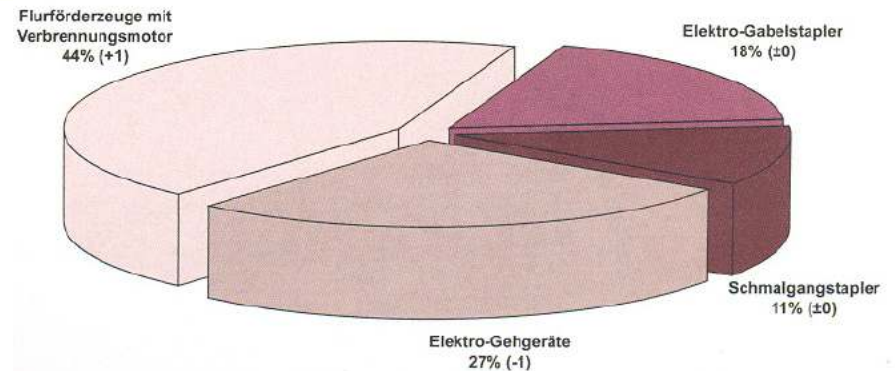
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Market Potential Material Handling 2006 (Worldwide: 855.000 Units/a)

Weltweite Flurförderzeug-Lieferungen 2006:
Prozentuale Aufteilung nach Kontinenten
(Klammerwerte: Veränderungen gegenüber dem Vorjahr)



Bauarten der Flurförderzeuge
Prozentuale Aufteilung der Weltproduktion 2006
(Klammerwerte: Veränderungen gegenüber dem Vorjahr)



Source: Fachmagazin dhf Intralogistik 12/2007

Summary

- The Fronius Energy Cell is ready for Pilot Applications
- Hydrogen is a safe and environmental friendly energy carrier
- Material handling is a large and existing electric vehicle market
- Hydrogen enables fast refuelling
- Fuel cells provide high availability and constant performance
- The HyLOG Project provides a reference for enhanced market entry

HyLOG Awards



Energy Globe Award
Upper Austria 2007
Austria 2007
World 2007
Nominee Klimaschutzpreis 2008



Österreichischer Staatspreis
for Energy Technology 2007



Eurosolar-
Austrian Solar Award 2007

contact

Dr. Ewald Wahlmüller

Fronius International GmbH

address: Günter Fronius Str. 1
 4600 Wels-Thalheim
 Austria

tel: +43-7242-2415100

fax: + 43-7242-2411447

web: www.fronius.com

email: wahlmueller.ewald@fronius.com



thank you for your attention !!!!!