ICELANDIC HYDROGEN

Creating Iceland's Hydrogen Economy: Case-studies from Iceland

Scotland's Hydrogen Future

Building a Sustainable Economy through Hydrogen and Renewable Energy

Victoria Quay, Edinburgh 15 September 2009

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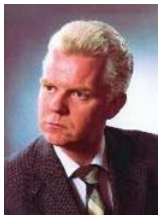
Overview

- *The H_2-Background in Iceland*
  - *The Formation of Icelandic New Energy*
  - *ECTOS*
  - *SMART-H_2*
  - *Introduction of Icelandic Hydrogen*
- *Hydrogen Vehicle Demonstration*
- *Elding: Marine Fuel Cell Auxilary System*

The H_2-Background in Iceland

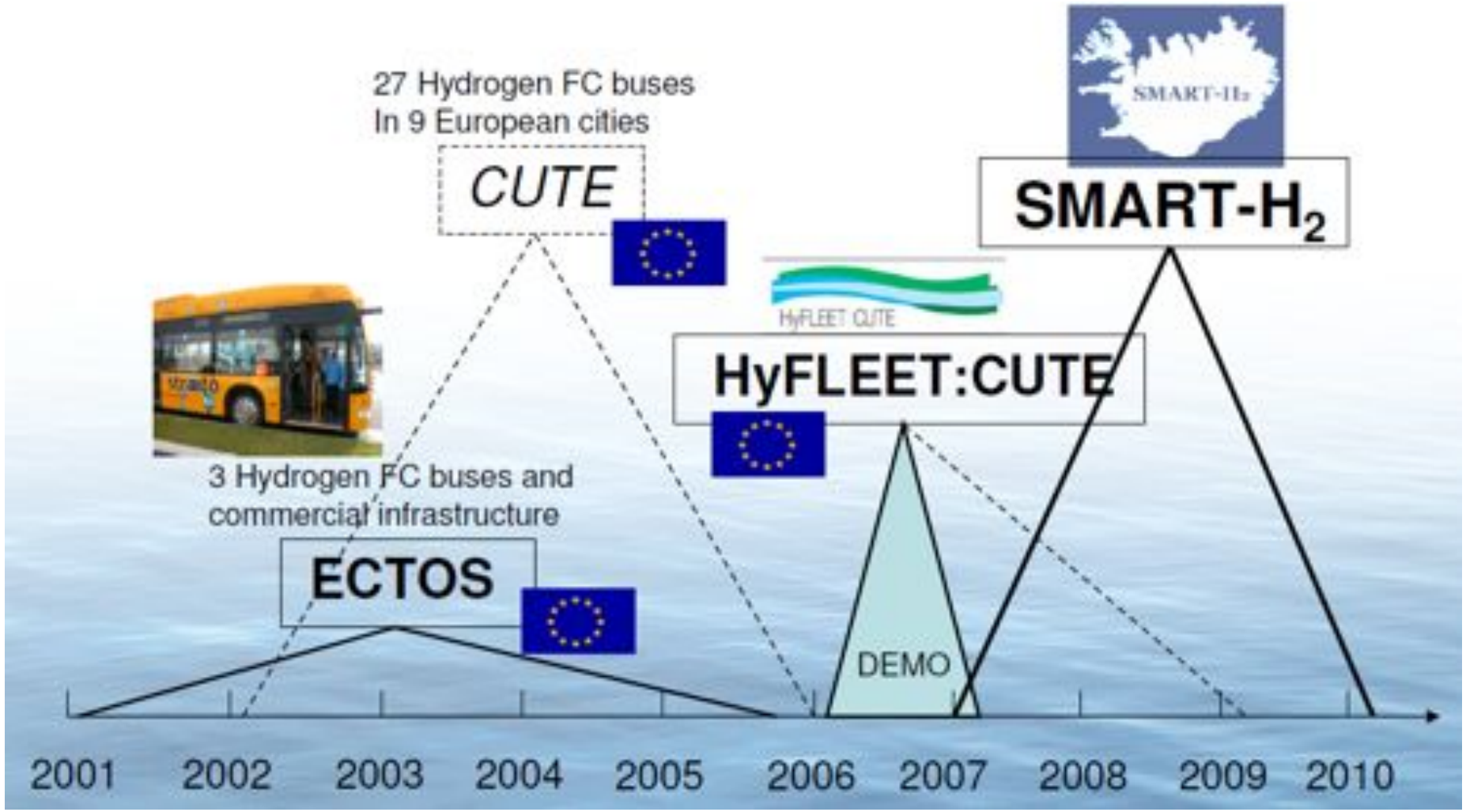
- *Prof. Bragi Arnason - University of Iceland*
  - *Over 30 years of research*



- *1990: Meeting between the University of Iceland, and Hamburg Electricitaets Werke*
- *1997: Ministry of Industry and Commerce appoints a committee on "Domestic Fuel Production"*
- *1998: Negotiations between Icelandic and European partners*
- *1999: Formation of Icelandic New Energy and a memorandum from the Government of Iceland deciding to aim for a hydrogen energy economy*

Icelandic New Energy

INE's - Key Projects



SMART-H_2

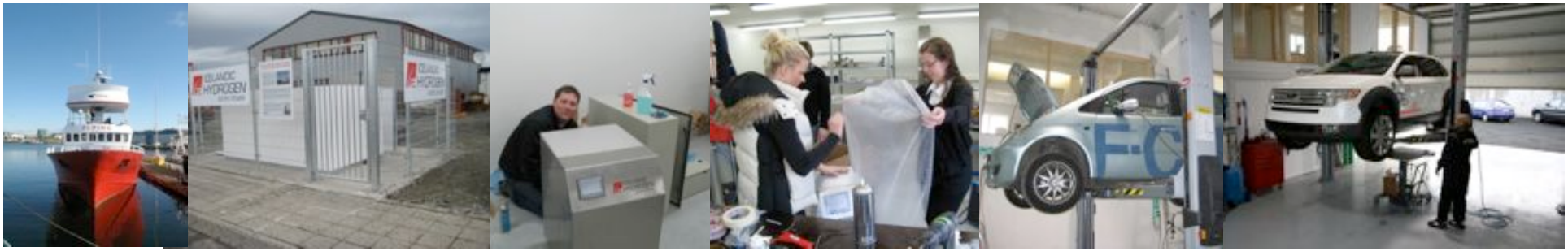
Sustainable Marine & Road Transport - H_2 in Iceland

- Goal:
  - Demonstration of a fleet of hydrogen cars 20-40 cars
    - Various engine types (ICE´s/FC´s), and from different vehicle producers
  - Demonstration of an auxiliary boat engine
    - Demonstration of a 10-40 kW FC auxiliary engine on board an Icelandic boat
  - Testing of infrastructure for different users and increasing the availability of hydrogen within Reykjavik/Iceland

Icelandic New Energy Ltd

Icelandic Hydrogen

- ***Founded in 2007***
  - ***The first private company in Iceland focusing solely on Hydrogen and renewable energy***
- ***Main activities:***
  - ***Hydrogen electrolysers and gas generators***
  - ***H_2-System integration (Refueling stations)***
  - ***Servicing all of the hydrogen vehicles in Iceland***



The H_2-Vehicle Demonstration

- ***Within the SMART-H_2 project, the goal is to get 20-40 hydrogen vehicles to Iceland***
- ***Try out the different vehicles concepts, learn about the different technology***
- ***Get customer feedback***
  - ***Until today, about 16 vehicles have been tested***
  - ***More to come soon ...***

The H_2-Vehicle Demonstration

- ***Various vehicle types from different Manufactures and Partners***
  - ***Daimler A-Class***
  - ***Toyota Prius (Retrofitted)***
  - ***Ford Focus***
  - ***Ford Edge***
  - ***Ford Explorer***

The H_2-Vehicle Demonstration

- ***Different Power-Train Concepts***
  - ***Pure Battery vehicles***
    - ***First vehicles arriving in Iceland***
  - ***Hybrid***
    - ***Fuel Cell and Battery***
    - ***ICE and Battery***
  - ***Plug-In Hybrid***
    - ***Enables the first 50..100 km to be driven on batteries***

The H_2-Vehicle Demonstration

- ***The service and monitoring of the vehicles***
  - ***Different service work between different types of vehicles and related partner***
  - ***In general, a very high availability of the vehicles***
  - ***The few failures are in most cases related to balance of plant and/or components unrelated to H_2***

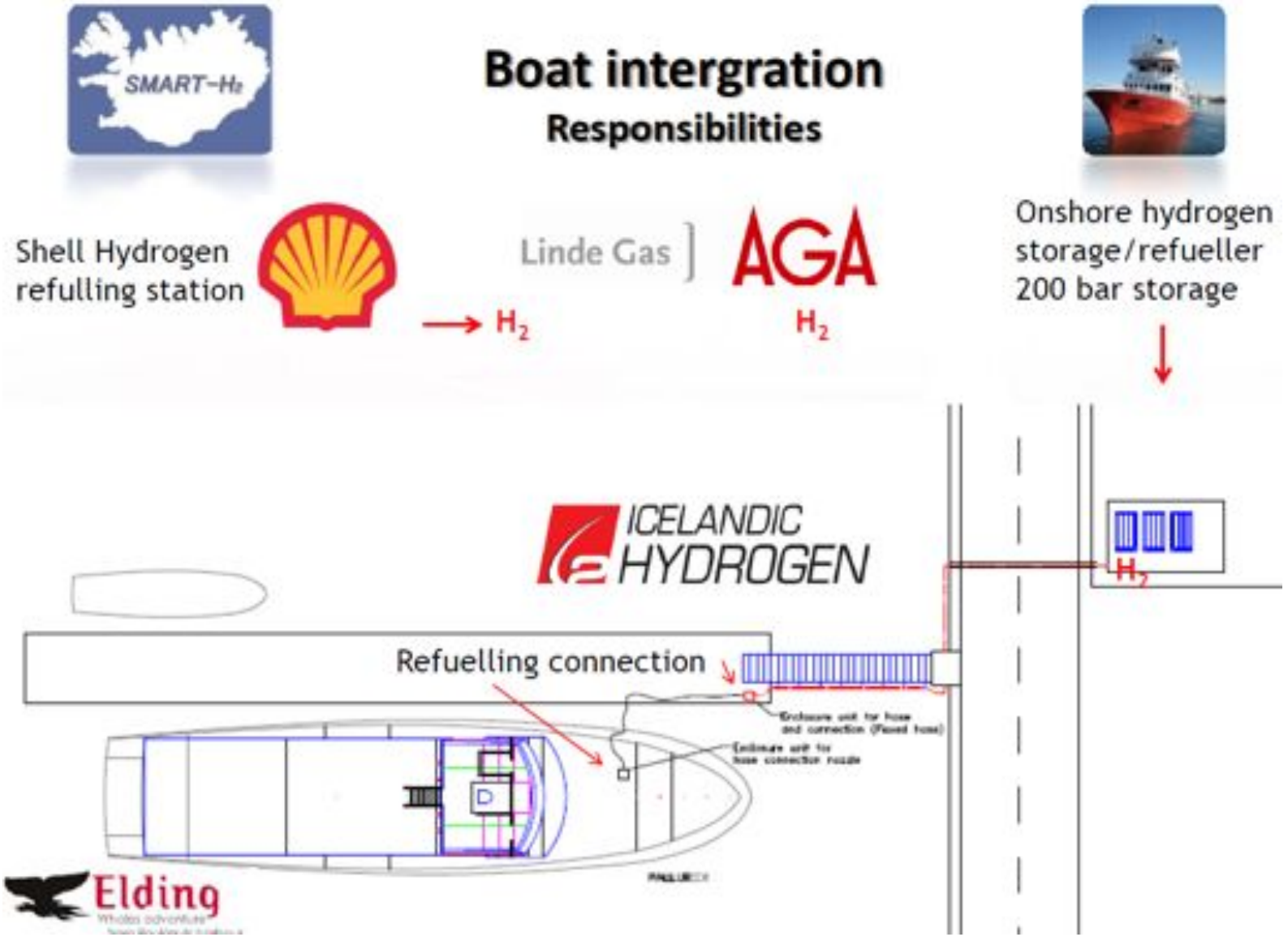
The H_2-Vehicle Demonstration

- ***The service and monitoring of the vehicles has provided excellent platform to build up the knowledge around the hydrogen technology***
- ***Working with different partners and being in contact with the people in the industry has given us great insight in future concepts***
- ***We very much believe in the future of HYDROGEN***

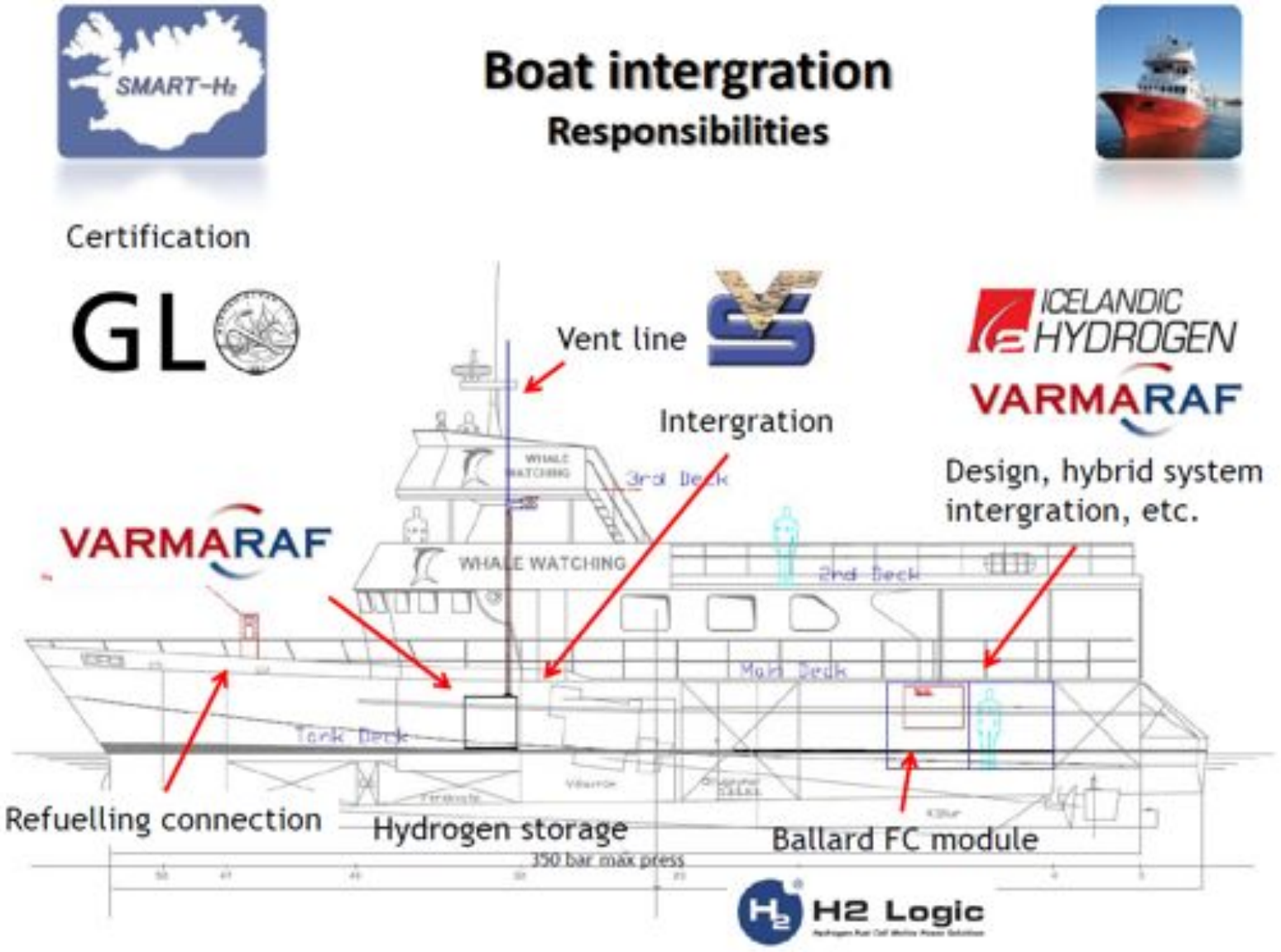
The ELDING Project

- ***The main objective is to demonstrate the fuel cell technology in Marine Environment***
- ***3-Year project***
- ***Based in Reykjavik, the Elding, is a 125-ton cruiser with a capacity of 150 passengers.***
- ***The Elding is a safe and extremely stable ship, originally built in Iceland as a rescue ship***

The Harbour Site - Layout



The Ship Layout and Partners



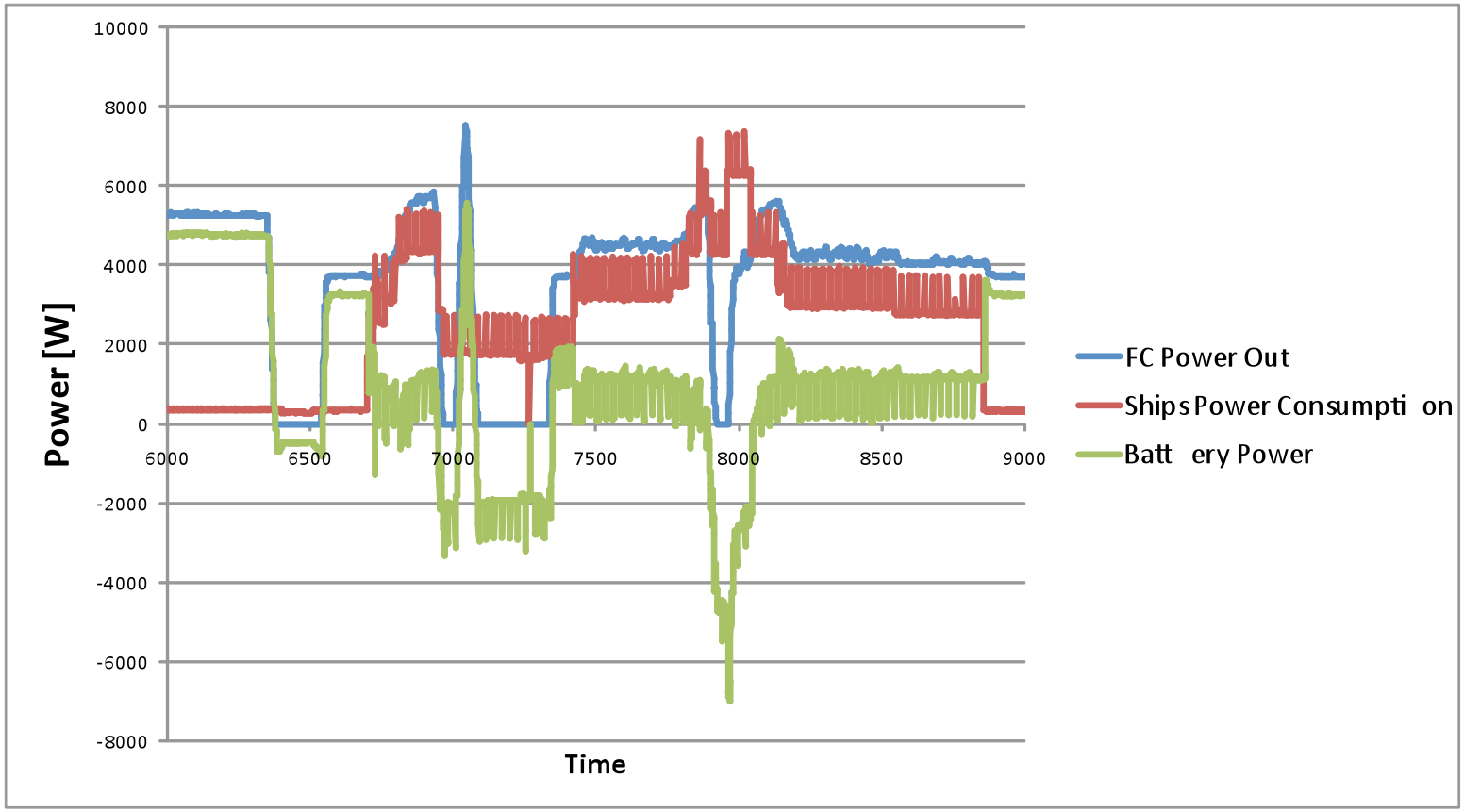
The certification

- ***Certified by GL***
  - ***In addition to normal hydrogen projects, every component has to be approved for marine application***
  - ***A independent safety chain takes car of the safety aspects***
  - ***Different modes of operation***
  - ***Lead to more expensive system than planned***
  - ***High cost in relation to the low power output***
  - ***GL has showed great commitment to the project***

The difficulties

- ***Under financed project***
  - ***Exceptionally difficult financial environment (budget in 2006/2007 ISK)!***
- ***Project planning / Partner readiness***
  - ***Gaps in responsibilities between project partners***
  - ***Different focus and commitment between partners***
- ***Certification***
  - ***Lead to more expensive system than planned***

The system behaviour



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Hallmar Halldórs - CEO of Icelandic Hydrogen

The relation to other applications

- ***Hydrogen fishing***
  - ***Difficult for larger trawlers and new design necessary***
  - ***Smaller boats – near coastal fishing possible***
- ***Ferries***
  - ***The range and size will decide on the potential***
  - ***Not a strong relation to the Icelandic environment***

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The Conclusion

- ***H_2-Vehicle demonstration***
  - ***Has been very successful in terms of technology availability***
  - ***High knowledge being built around the activities***
  - ***Quite positive customer acceptance***
  - ***Important to educate the user***
- ***Elding: Marine Fuel Cell Auxiliary System***
  - ***The first fuel cell system on a commercial sea-going ship***
  - ***Difficult realisation of the project mainly due to the financial environment***
  - ***There is no indication of problems related to the use of hydrogen on board ships***

High Tech – High Potential
Building up the future Energy Infrastructure

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The human factor
And the daliy operation