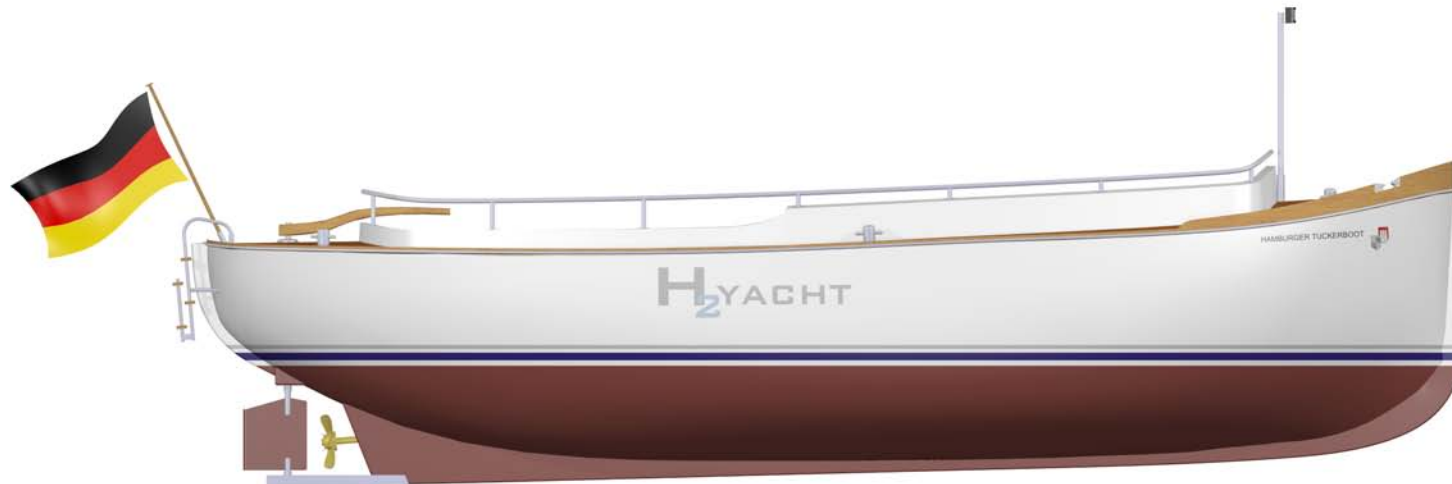


FC-Systems on Board of Watercrafts – An Early Market? (Part 2)



Finn Vogler (Germanischer Lloyd) and Dr. Walter Pelka (H2Yacht GmbH)

International Conference and Trade Fair on Hydrogen and Fuel Cell Technologies,

H2Expo 2006, 25.-26.October, CCH Congress Centre, Hamburg

O B E R V A T I N G S T A T T
Germanischer Lloyd



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„I should like to see that,“ observed the sailor



« Mais enfin, mon cher Cyrus, tout ce mouvement industriel et commercial auquel vous prédez une progression constante, est-ce qu'il ne court pas le danger d'être absolument arrêté tôt ou tard ?

– Cependant j'insiste, reprit Gédéon Spilett. Vous ne niez pas qu'un jour le charbon sera entièrement consommé ?

"And what will they burn instead of coal?"

"Water," replied Harding.

"Water!" cried Pencroft, "water as fuel for steamers and engines! water to heat water!"

"Yes, but water decomposed into its primitive elements," replied Cyrus Harding, "and decomposed doubtless, by electricity, which will then have become a powerful and manageable force, for all great discoveries, by some inexplicable laws, appear to agree and become complete at the same time.

Yes, my friends, I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable. Some day the coal-rooms of steamers and the tenders of locomotives will, instead of coal, be stored with these two condensed gases, which will burn in the furnaces with enormous calorific power.

There is, therefore, nothing to fear. As long as the earth is inhabited it will supply the wants of its inhabitants, and there will be no want of either light or heat as long as the productions of the vegetable, mineral or animal kingdoms do not fail us. I believe, then, that when the deposits of coal are exhausted we shall heat and warm ourselves with water. Water will be the coal of the future."

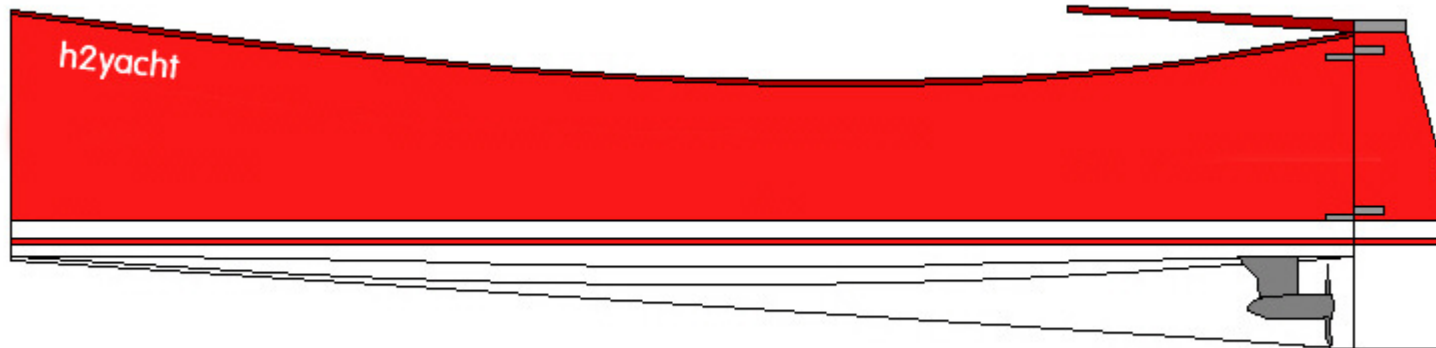
"I should like to see that," observed the sailor.

H2Yacht: “Using tomorrow’s technology today”

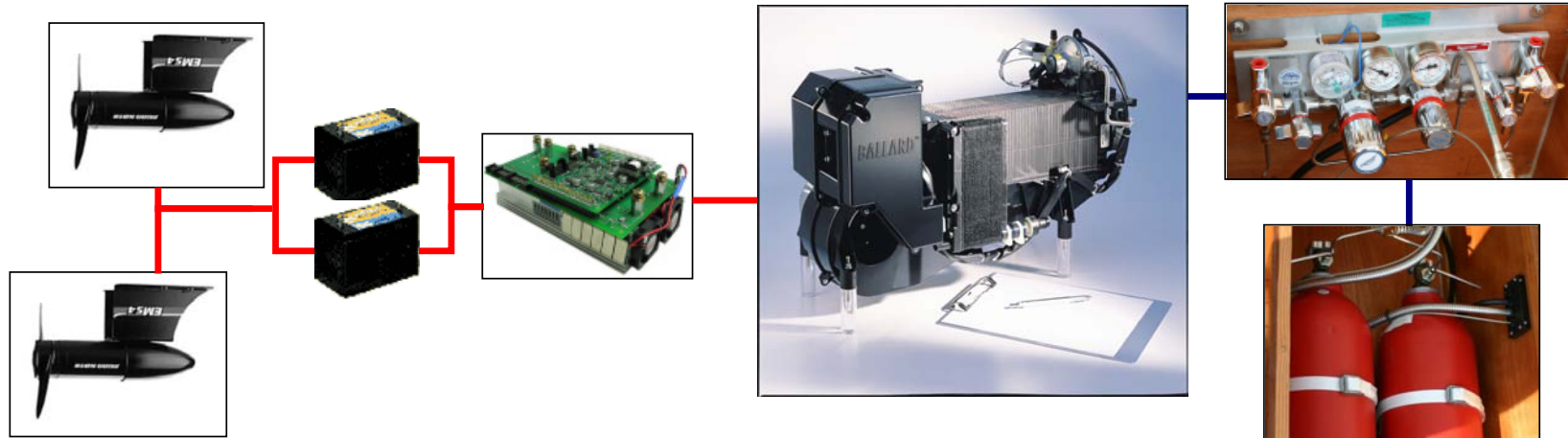
- H2Yacht was founded in 2004
- H2Yacht is a pioneer in the development and use of innovative, environmentally friendly energy supply and drive systems for the marine sector.
- In 2004, H2Yacht developed “H2Yacht”, a motorboat powered by hydrogen fuel cells which has been undergoing tests on the Elbe and its tributaries since the beginning of 2005 as a much-noted and successful prototype.
- H2Yacht GmbH is based in Hamburg-Cranz.

Design of Research Vessel

Length (Hull):	5,40 m
Length (Over all):	5,80 m
Beam (Over all):	2,01 m
Displacement (0/5Pers.):	450/800kg
Draft (0/5Pers.):	0,40/0,47m



Fuel cell drive system of „H2Yacht“



Hydrogen Storage: Steel-Pressure-Tubes, 200bar, 2 x 20l
Pressure Reduction: 200bar -> 8bar
Fuel Cell: Ballard Nexa, 24V/1200W
Cooling-System Air/Air
Buffer Batteries: 24V/108Ah
Propulsion: 2 Minn-Kota EM54, 2 x 672W



Performance



Experience so far:

Travel Speed: 4kn (approx. 8km/h)
Reach: 30 nm (approx. 50km)

Operation: >400h

System Reliability: High (approx. 100%)

Handling: Easy, like
conventional combustion
engine

Fun-Factor: Great =>
silent
no vibrations
no emissions

„H2Yacht“ cruising at Cranz on the River Este



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Why do we really need an Early Market?

- In the past, applications of the innovative fuel cell technology have been largely confined to individual demonstration projects, research vehicles, and record attempts using special vehicles designed and built specifically for the purpose.
- Without an early market there will never be a real break-through of the Hydrogen fuel cell technology, fuel cells will stay in the laboratories and record vehicles for ever
- There will be no serious development targeting real life and consumers, fuel cells will be an exotic toy
- No series, no mass production, no long term reliability, high price, no service, ...

What are the main obstacles for a wide spread use of fuel cells today?

Environment and boundary conditions

- No hydrogen supply network
- No unique selling point
- Price of fuel cell and fuel

But also fuel cell industry internal reasons

- No „ready for implementation“ System available
- No „consumer ready“ System available
- Lack of peripheral reliable special components
- Afraid to face the „real world“ demanding customer?

What would be a precondition for the existence and development of such a market?

- Purchase should make sense for the customer
- A visible, obvious advantage

And of course the usual „hygiene factors“:

- Safety
- Long term reliability
- Usability
- Acceptable price-performance-ratio

Preferably:

- A unique selling point!

Are small watercrafts an early market?

- We believe: YES

Proof:

- H2Yacht is investing a lot of time, money, know-how in the development of a new generation of hydrogen fuel cell driven watercrafts:
 - A Series Product
 - Consumer ready
 - Affordable
 - „Buyable“

Environmental boundary conditions

- Rising energy costs, dwindling supplies of the conventional energy resources oil and coal, CO₂ emissions, climate change – all these are issues that will give rise to fundamental changes in water sports in the decades ahead.
- Of all alternative drive systems available today, the fuel cell is the only suitably powerful and realistic option (except sailing, of course).

BUT: environmental protection is not the final selling point for the private customer.

There is, however, a unique selling point

- Motorboats with combustion engines are banned on many rivers and lakes, especially those in attractive natural and scenic settings offering a high standard of recreation and leisure.
- Of 543 lakes in Germany that are used for recreational purpose, there are only 38 (7%) with permits for combustion engines.
- Even if we leave out the smaller lakes, on which an electric drive with battery power could make sense, there is a huge potential for long range electrical drives powered by fuel cells
- The alternatives for the customer are simple:
 - Buy a sail boat or rowing boat
 - Carry extreme battery capacities (weight!)
 - Stay ashore

There other important arguments

- A fuel cell system is not only totally free from emissions, but also extremely smooth and quiet – no noise, no vibrations (except „good vibrations“ from the users, of course)
- This makes a significant contribution to environmental protection and nature conservation when using such waters ...
- ... and enabling those on board to enjoy an unspoiled leisure experience of nature

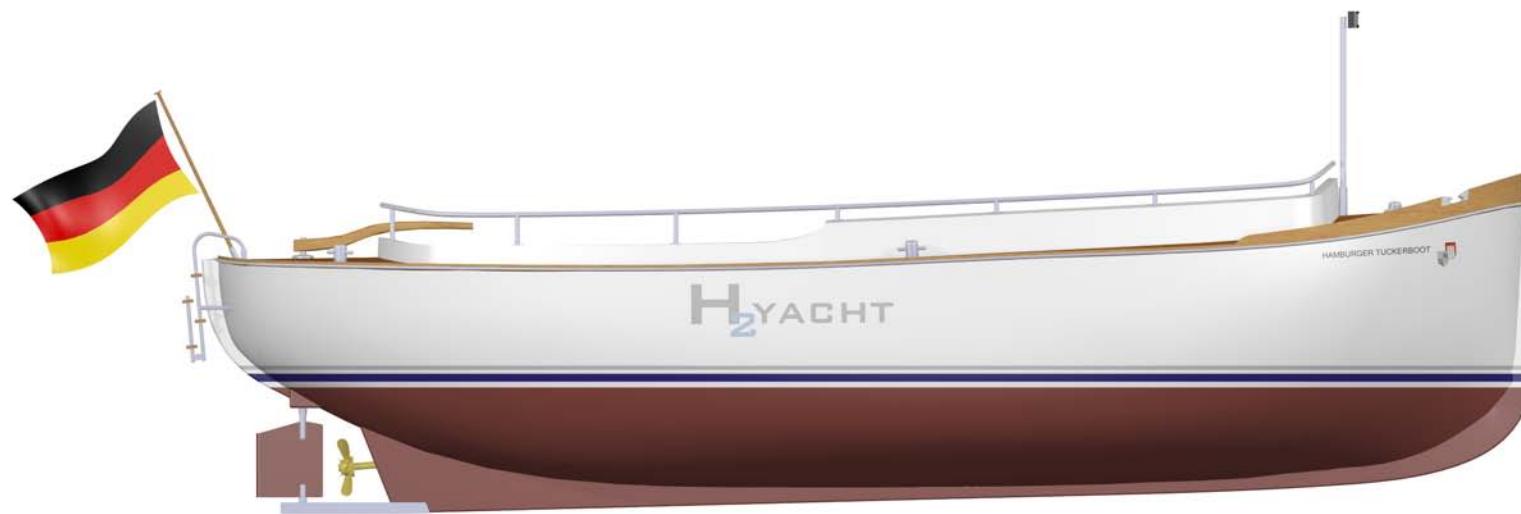
The usual main obstacle doesn't hurt

- Many fuel cell driven public transport buses prove, that mobile applications are successful as long as there is no need for a supply network
- Like for a hydrogen bus, for small watercrafts on a lake a single point supply is meaningful
- The hydrogen logistics for a single point supply can be managed
- With a small fleet of fuel cell boats (5-6) even a small hydrogen supply station may be installed

The project

- H2Yacht is dedicated to make the hydrogen fuel cell technology available in the marine sector today in a safe, reliable and user friendly form that is fit for everyday use.
- The new “AMS H2Yacht 675” has been developed based on the experience with „H2Yacht“
- She has an overall length of 6.75 m and space on board for up to 8 persons.
- The fuel cell drive system will offer a power output of around 2.5 kW, giving the boat a speed of up to 5 knots (9 km/h).
- The supply of hydrogen carried is designed to make all-day excursions possible without refuelling.
- The first series-production boats will be handed over to their buyers as early as mid 2007.

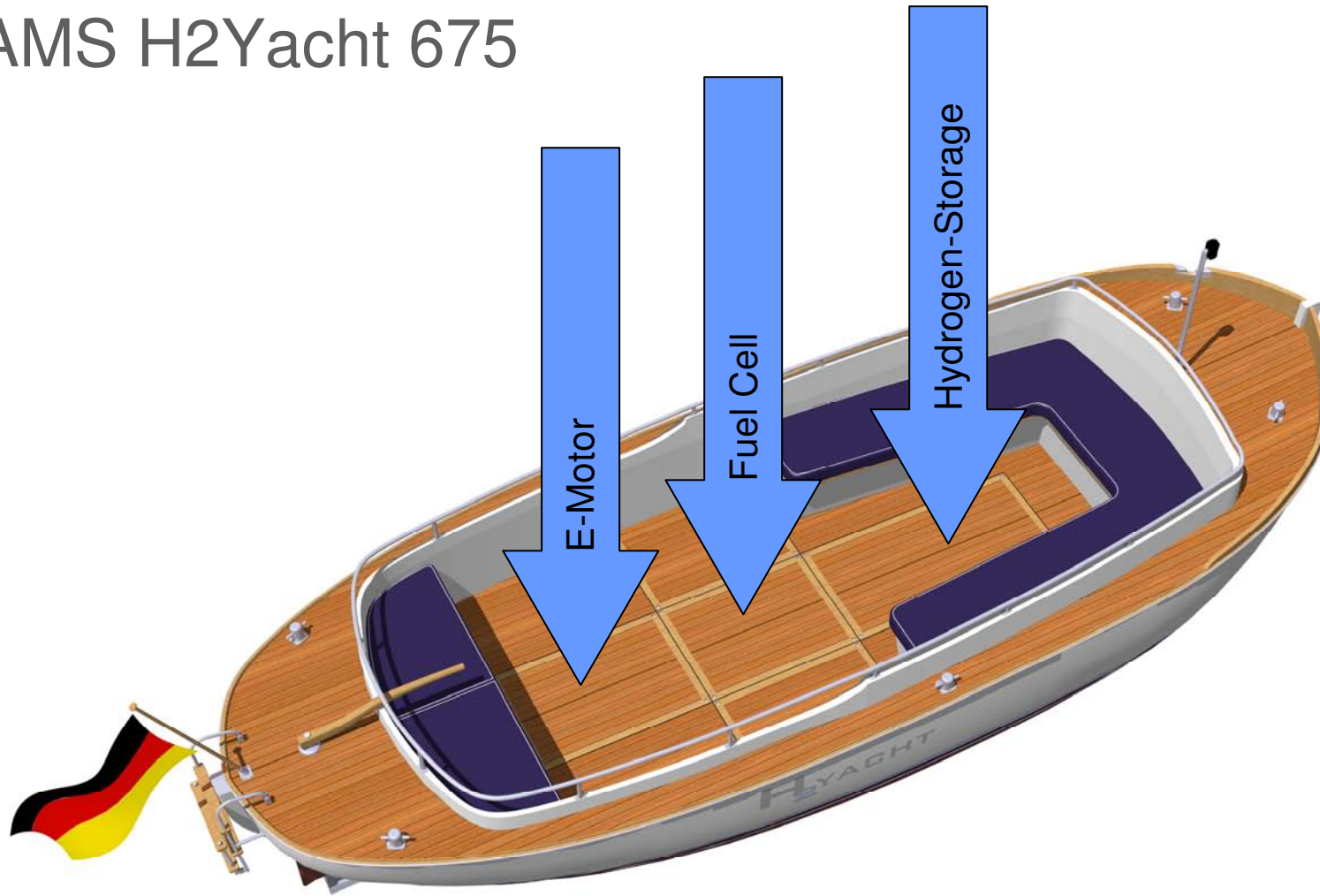
AMS H2Yacht 675



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AMS H2Yacht 675



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H2-power-train



Hydrogen Storage „Six-Pack“

- 6 x 10l Aluminium-Carbon-Composite tubes 300bar
- 2 x 1.4 kW hydrogen fuel cell system
- 180 Ah buffer batteries
- 2.2 kW electric motor

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Speed Control



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Special adapted 3-blade-bronze-propeller



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Project Partners



AMS Marine Yachten, Hamburg
Boat Yard, Hull and Conventional Equipment



Germanischer Lloyd
OPERATING 24/7

Germanischer Lloyd AG, Hamburg
Safety Aspects, Quality Control, Certification



Linde AG, Hamburg/Düsseldorf
Hydrogen Storage and Hydrogen Logistics



ZSW-BW, Ulm
Fuel Cell Systems



Supported by
Hamburg Innovation Foundation

Next steps

- The first series-production boats are planned be handed over to their buyers as early as mid 2007.
- We are prepared to accept YOUR order.