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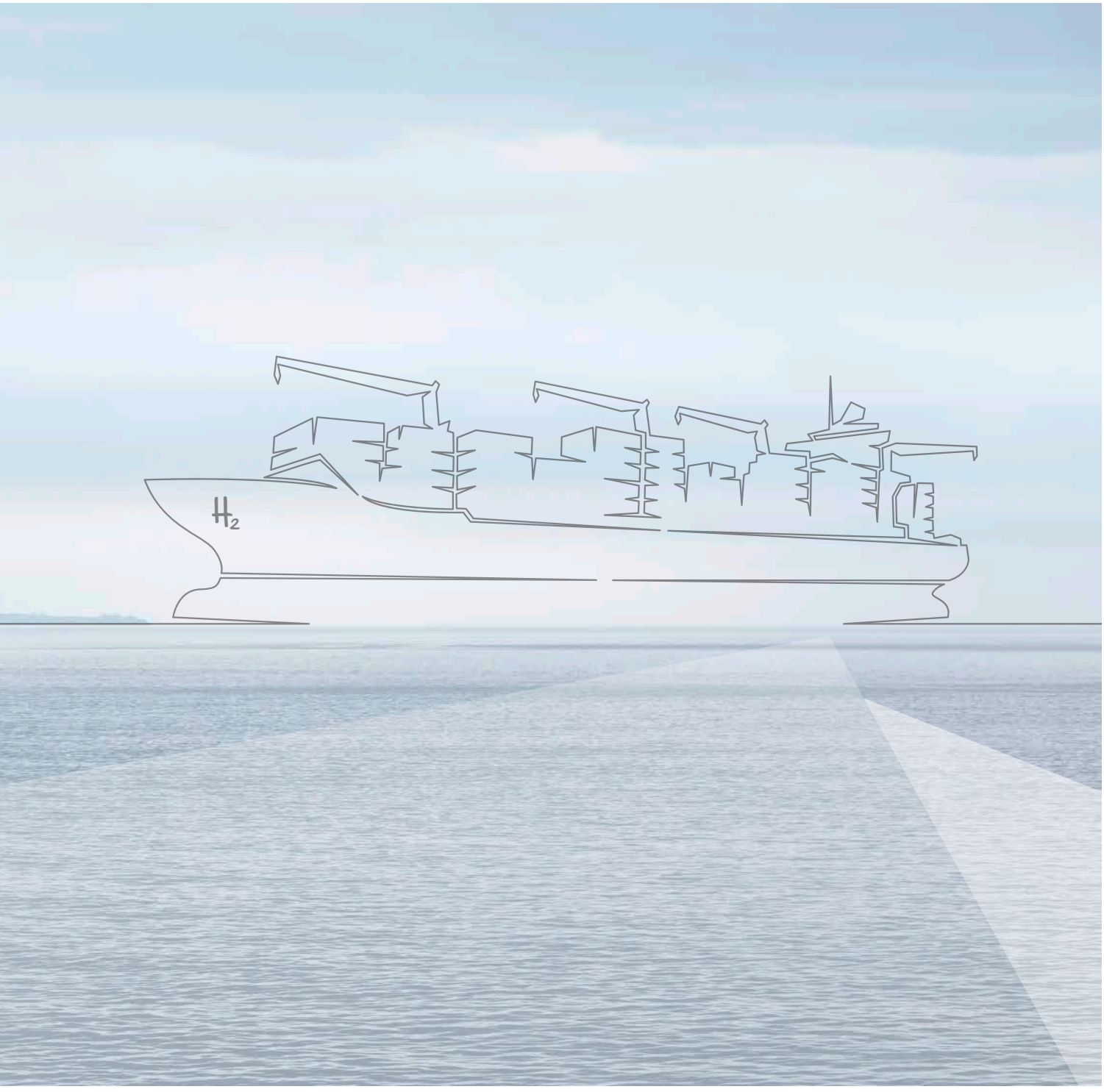
Emission-Free Shipping

NAVIGATING TOWARDS ZERO EMISSIONS



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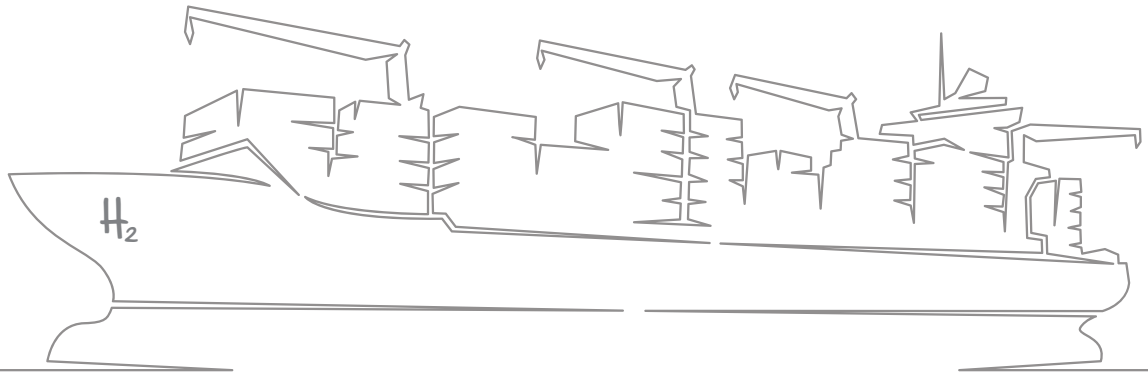

Hydrogen is considered one of the most promising options in the search for alternative shipping fuels. It could be used to generate emission-free electricity for propulsion, as well as for the on-board supply of energy. To discover how far this technology has come, and how green it is today, we talked to Jogchum Bruinsma, Application Manager Maritime Systems at PEM fuel cell manufacturer Nedstack.

Based in Arnhem, in the Netherlands, Nedstack Fuel Cell Technology BV is one of the leading providers in the field of industrial fuel cell technology. Their systems are based on polymer electrolyte fuel cells with proton exchange membranes (PEM). Energy-carrying hydrogen is located on one side of the extremely thin and electrically-isolating synthetic membrane. This reacts with a catalyst, usually platinum, which is applied to the membrane. This splits the hydrogen into protons and electrons. Protons pass through the membrane and migrate to the cathode on the air-filled side. As the protons migrate, electrons generated at the anode (on the hydrogen side) create a current and potential difference between the two electrodes. At the cathode, the hydrogen protons and electrons recombine with oxygen in the air to form pure water (H_2O).

Durability

PEM fuel cells are ideally suited for use in shipping: The technology is well-established, they operate at comparatively low temperatures, have a high power density in terms of both weight and volume, and they are durable, requiring little maintenance. Nedstack builds fuel cell stacks with a service life of over 24,000 hours and systems that last over 15 years. “If you consider an inland vessel with around 4,000 operating hours per year, that's six years before stack maintenance,” explains Bruinsma.

Scalable

The open-circuit voltage of a single PEM fuel cell is very small, less than one volt in practice. “However, it can generate a current of up to 250 amperes,” explains Bruinsma. By ‘stacking’ several fuel cells, Nedstack can generate up to 13 kW of power in a single, modular stack. This modularity has key advantages: units can be scaled as required, and are easily replaced when servicing is required.

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“The modularity and scalability of our system can be mapped very easily with the Bachmann M1 automation system,” confirms Jogchum Bruinsma. “The modular software structure of the M1 automation system makes it easy and efficient to create one piece of system software, and then to transfer it to our various systems.” He also appreciates the engineering environment and in particular the integrated scope function – “it enables us to view highly detailed logs, without additional measuring devices.” The flexibility and reliability of the hardware is also important for the Nedstack manager: “This gives us all the freedom we need during system setup and a high level of security.”

Big Potential

On the path towards emission-free shipping, Bruinsman currently envisages applications for port tugs, assembly boats and cruise ships: “The megawatt hours of energy required for on-board electricity generation and the continuous operation of auxiliary equipment can easily be generated by fuel cells.” At present, the required power levels make it difficult to achieve economic viability for ocean-going propulsion, “but, in inland shipping, a number of ships are being equipped with our technology,” explains Bruinsma. For example, Nedstack is supplying fuel cell technology for the Maas, a container vessel and for the Antonie, a dry cargo vessel. The first system was put into use in 2009 by the Dutch consortium ‘Fuel Cell Boat BV’. The project launched the first fuel cell boat ‘Nemo-H2’ for shipping company Lovers. Bachmann was already on board at the time, providing the ship’s entire control system.

Going Completely Green

The environmental footprint of the system, cradle-to-cradle, still requires fine-tuning. Hydrogen is still largely produced by steam reforming using a hydrocarbon, usually natural gas. It is considered ‘gray hydrogen’ and is generated using fossil fuels, so it’s still associated with high CO_2 emissions. A key development will be obtaining the electricity required for electrolysis from renewable energies such as wind or solar. “Once we have ‘green hydrogen’, the entire chain will become CO_2-emission-free. These developments are already in full swing.” says Bruinsma.

That is the explicit goal, but, according to the expert, people should not be deterred from starting to use fuel cells: “Even if hydrogen is still a gray area today, at least it doesn’t generate environmentally harmful emissions when providing electricity on board." And that is an important first step.

»Even if hydrogen is still a gray area today, at least it doesn’t generate environmentally harmful emissions when providing electricity on-board. That is an important first step to zero-emission power generation.«

Jogchum Bruinsma
Application Manager Maritime Systems at Nedstack

NEDSTACK FUEL CELL TECHNOLOGY BV

– Created in 1999 from a division of Dutch company AkzoNobel

– Around 50 employees at its headquarters in Arnhem, Netherlands

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