Yet hydrogen has so many of the right characteristics for fuelling the future that it seems only a matter of time before it makes its way into more areas of society – including maritime.

When hydrogen is cleaved from water, oxygen is the only by-product. And hydrogen fuel leaves only water when it is burned, completing the natural water cycle. Not only that, this is powerful stuff: “H₂ has a very high energy density, three times that of gasoline, and 150 times that of a lithium ion battery,” says Jon André Løkke, CEO of Nel Hydrogen, a global hydrogen company delivering solutions to produce, store and distribute hydrogen from renewable energy.

“H₂ solves many of the fundamental energy challenges,” he relates. For example, the time and distance gap between power generation and power consumption is resolved when hydrogen can be produced when power is available and stored or transported to the point of consumption. And when it is transported, weight is not an issue, as hydrogen is 14 times lighter than air, with an energy density higher than any other fuel.

Refuelling time issues are also being resolved by constantly evolving fast-fuelling systems for all transportation modes, ensuring improved asset utilisation.

Perhaps most importantly, hydrogen technology has become more accessible recently, and prices for the technology as well as the gas continue to fall, also helped by renewable energy becoming increasingly competitive.

“These are the two main drivers,” Løkke maintains. “Cheaper renewables mean cheaper hydrogen. With this, fossil parity has been achieved. Now we are working toward superiority.”

**Down to the water**

As for the potential for marine applications, Løkke is optimistic, though land-based transportation is still the core of their business. “We are involved in a number of projects related to marine applications, including a cruise line owner looking to convert to hydrogen,” he tells, “with dedicated systems for production, fuelling, and operations.”

The concept involves cruising alternately in the Arctic and Antarctic, traversing the Atlantic in between sailings. “A ship can make the trans-Atlantic run on a single fuelling, and Nel can produce the amount needed for this sailing in 36 hours.”
The challenge for marine, Løkke says, is how to apply available technology to marine applications. "There are no standard solutions, this is what we have to develop. For now each problem has to be addressed individually. In addition, you have the issue of permitting when there are passengers involved. This applies to both fuelling and sailing."

Growing up
Contrary to electrolysers, fuel cell technologies are still relatively immature and there are a lot of improvements to come. The cost will continue to drop dramatically and the operational robustness will improve, Løkke believes.

Nel is a partner in the Norwegian project ‘HYBRID-ship’, where the goal is to establish a knowledge base for longer journeys and operational times in larger vessels, based on battery and hydrogen technology. The target is to have a hydrogen hybrid ferry in operation by 2020. Among the partners are the yard Fiskerstrand, DNV GL, and The Norwegian Maritime Authority.

"The first vessel will be a milestone," says Løkke. "But once the first work is complete and the permitting is in place, we have established a basic framework and the other projects will follow more quickly."

More and more car manufacturers are offering hydrogen technology in production vehicles.

Regarding other uses, Løkke paints with a broad brush: "Fish farms need clean power, and they could find multiple applications, using every aspect of the electrolysis process."

He points out that ports will be the energy hubs of the future, and that ports themselves could use hydrogen to generate electricity for shore power to ships.

"Tank size will be reduced, and storage methods will in general be much more compact. I see more newbuild vessels based on hydrogen. Retrofitting would only be relevant where there is already an element of electric propulsion on board, like diesel electric. Probably ferries with travel time of more than 25 minutes and less time available to charge would be the earliest candidates."

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Also regulations need to get up to speed, he observes. "They are lagging behind the technology in the maritime sphere. Our job now is to educate the regulators."

Standardisation also presents a challenge. "The last thing we want to do is rush to set a standard. We don’t want to standardise on the wrong platform, as many industries have done."

For all the hurdles to be cleared, and the frustratingly slow pace of progress toward a hydrogen society, Løkke and Nel retain the resilient optimism of true pioneers. The closing line on their website tutorial is a jaunty wave goodbye to centuries of fossil dependence:

"Thanks for the ride, dinosaurs. We’ll take it from here!"

There are many drivers on the road to a hydrogen society, including the state of California, with its progressive legislation and support for technical innovations, championed not least by former governor Arnold Schwarzenegger. Norway’s hydrogen highway initiative HyNor is another prime mover, and UN sustainability goals increasingly support renewable hydrogen production.

But every cause needs a headliner, and Nikola Motors, with their hydrogen-electric semi-trucks, may be just the ticket. Nikola took the first name of Hungarian immigrant Nikola Tesla, George Westinghouse’s partner in the pioneering of alternating current electrical technology, better known as AC, in the late 1800s.

Nikola has rolled out two big rig models and has plans to build hydrogen fuelling stations across the US. They have also devised a leasing program for their trucks that includes fuel costs and maintenance, merging the sharing and sustainable economies in the most unlikely of arenas: long-haul trucking, the citadel of conservative, petroleum-driven transportation.

Buy a truck, get free fuel
Nikola plans to install solar farms to create hydrogen from electrolysis. They will convert solar energy to hydrogen using only energy and water, creating zero emission fuel, from production to consumption.

Based on the renewable fuel generation model, Nikola can promise buyers free hydrogen fuel for up to 1,000,000 miles. And with 1,200 miles between fill ups, Nikola’s sleek rigs beat diesel by up to 500 miles.

Add to this vastly improved uphill towing speed compared to diesel, and charging, rather than braking, on descents, and the Nikola package would seem irresistible to truck owners – if not drivers loyal to the roar of their mighty Macks, Peterbults, and White Freightliners. Maybe the 30-second 0-60 mph acceleration will help win over new converts?