

CALIFORNIA DREAMING

California's unique geography has meant that it's often been a hostage to smog. Could fuel cell technology be the answer?

Toyota, Kenworth, the Port of Los Angeles and the California Air Resources Board (CARB) have teamed up for an ambitious trial featuring trucks powered by fuel cells.

The vehicle is a Kenworth Class 8 model with twin Toyota T680 fuel cells mounted under the cab floor. The power electronics units which control it are mounted toward the front, with the battery pack and hydrogen storage behind, leading to the motor, transmission then on to the rear wheels.

Everything is designed to be packaged within the conventional chassis.

Ten of these will go into use, the first has already been delivered. It's all part of CARB's \$41 million Zero-and-Near-Zero Emission Freight Facilities Project (ZANZEFF), which moves freight around the Ports of Los Angeles and Long Beach, across the LA basin.

The trucks will be operated by Toyota Logistics Services (4), United Parcel Services (3), Total Transportation Services (2) and Southern Counties Express (1).



These trucks are using Neste MY Renewable Diesel, made from raw materials like waste products and industrial residues. The company has worked out (based on LCFS carbon intensity calculation methodology) it reduces greenhouse gas emissions by up to 80%



Altogether there are some 16,000 trucks working around the Los Angeles and Long Beach port complexes, which is North America's largest gateway for containerised cargo. That number is estimated to grow to 32,000 by 2030. Currently, more than 43,000 drayage trucks are in operation at ports across the US.

To overcome the issue of storage and hydrogen production, a tri-gen plant is scheduled for completion in 2020. It uses a carbonate fuel cell stack to convert bio-waste (from biogas) to hydrogen, then to electricity. It will also use some of the hydrogen created in the process to refuel the fuel cell vehicles.

Russ Koble from Toyota Motor North America explains, "Hydrogen is produced in a tri-gen system through a steam reforming process, but the

steam and heat needed for reforming are byproducts of the power generation process, so there is no need to burn fuel and no need to supply water, in fact it is a net water producer. The co-production of power with hydrogen provides an additional value stream that reduces the cost of the hydrogen. This, combined with the fact that the hydrogen is produced locally, avoiding transportation costs and emissions, makes it competitive with conventional large scale central steam reforming."

Two high capacity stations will be developed by Shell in Wilmington and Ontario, California. The new stations will join three additional stations in development located at Toyota facilities around Los Angeles to form an integrated, five-station heavy-duty hydrogen fueling network.



There are currently over 43,000 wagons serving US ports, by 2020 ten of them will be powered by fuel cells



The Clarity platform



Honda's fuel cell unit

Roble continues, "Together, they will provide multiple sources of hydrogen throughout the region, including over 1 ton of 100% renewable hydrogen per day at the heavy-duty station to be operated by Shell, enabling zero-emissions freight transport. Existing stations supplied by Air Liquide at Toyota Logistics Services in Long Beach and Toyota Technical Center in Gardena will serve as important research and development locations."

Once onboard, the fuel is stored at 10,000 psi. It sounds high but this is one of the features of hydrogen – low pressure storage just wouldn't give an acceptable range. These trucks have a target of 300 miles between refills, which equates to two days work on a typical delivery route.

Kenworth and Toyota have worked hard together to ensure safety, Roble confirms. "The hydrogen tanks have been extensively tested for durability,

repeated filing cycles and extreme conditions, such as fire. These tests have demonstrated that the tanks can safely support daily operating conditions and Heavy-Duty Fuel Cell Trucks will be able to safely perform cargo hauls in and around the ports of Los Angeles."

The proof of concept generates 560 hp (e) from the two Mirai fuel cell stacks and a 12kWh battery. Importantly, this is a relatively small battery to support class 8 load operations. Torque is sufficient to move a fully loaded truck at 80,000 lbs from a complete stop at 20% gradient.

The waste – water – is exhausted through a port below the vehicle.

A MOMENT OF CLARITY

It's not just the truck market showing an interest in fuel cells, and in particular California with its refueling infrastructure advancing all the time.

In April Honda Clarity fuel cell cars started appearing at Honda dealerships in the Los Angeles and Orange County

The sky's the limit



Debuting in April in Newbury Park, California, the Skai from Alaka'i Technologies is a novel flying machine described by its creators as an "electric vertical takeoff and landing (eVTOL) vehicle."

Engineered in collaboration with BMW's Designworks, it features six electric motors with a 400 mile, 4 hour flying range. Top speed is 118 MPH.

The first models will be piloted, but future models are set to have an autonomous option.

Up to 5 passengers can be accommodated, with an airframe parachute in case of in-flight power loss.



Alternatively the payload is 1,000 pounds.

Redundancy is designed into everything. As well as the rotors and fuel cells, there is a Triple Redundant Autopilot System.

The pilot interface is simplified, with fly-by-light fibre optics for EMI and lighting.

It's just started the FAA certification process.



areas, the San Francisco Bay Area, and in Sacramento.

Instead of selling them, Honda has chosen to lease at \$379 per month for 36 months with a \$2,878 down payment. As it's California, customers are eligible for a \$5,000 rebate.

Honda has invested heavily in California's hydrogen refueling network, spending more than \$14 million. There are now nearly 40 retail hydrogen stations across the state, and the company claims two thirds of its sales will be EVs of one

sort or another by the year 2030.

While fuel cells may or may not be the future, the CARB is also keeping its finger on the pulse of the present. In May it released the 2018 report into the use of alternative fuels by more conventional engines. Executive officer Richard Corey says, "Renewable and biodiesel, renewable natural gas, ethanol and electricity are all seeing growth under the Low Carbon Fuel Standard (LCFS). Californians have the widest variety of cleaner low-carbon vehicles available anywhere

in the country. The LCFS is catalysing investments in these cleaner alternative fuels, providing consumers with more choices, and reducing emissions of toxic pollutants and greenhouse gases. These are key reasons why other states and nations are establishing similar programs."

The report states that renewable liquid fuel displaced over 568 million gallons of diesel in 2018. From the start of the project in 2011 almost 3.3 billion gallons of petroleum diesel have been displaced by cleaner alternatives. ■