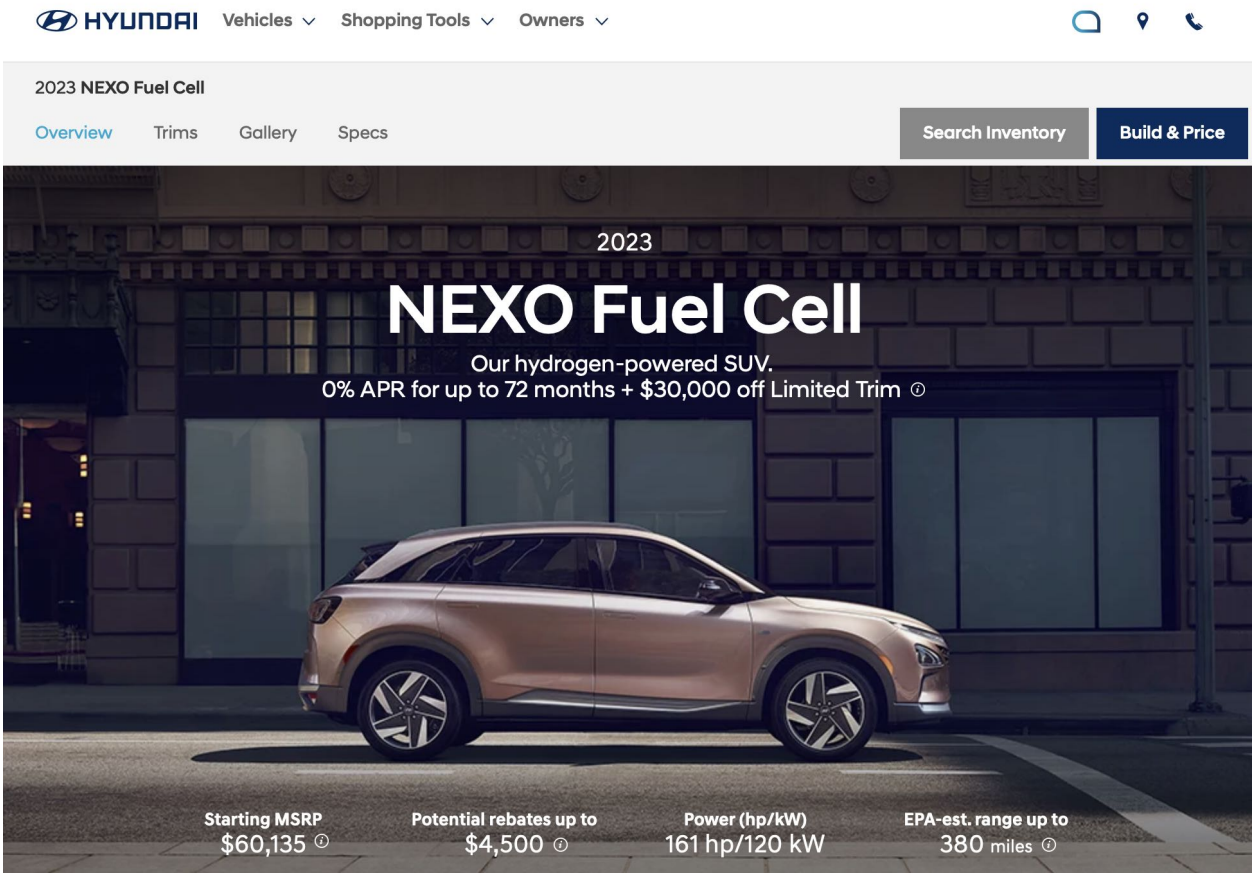
FUTURE of Clean Energy is Hydrogen

Solar panels capture energy from the sun, but are not useful at night. Battery systems are required. Lithium batteries cause fires and create much environmental damage. Wind turbines harness energy from the wind, but these 500' monstrosities are not suitable for all locations.

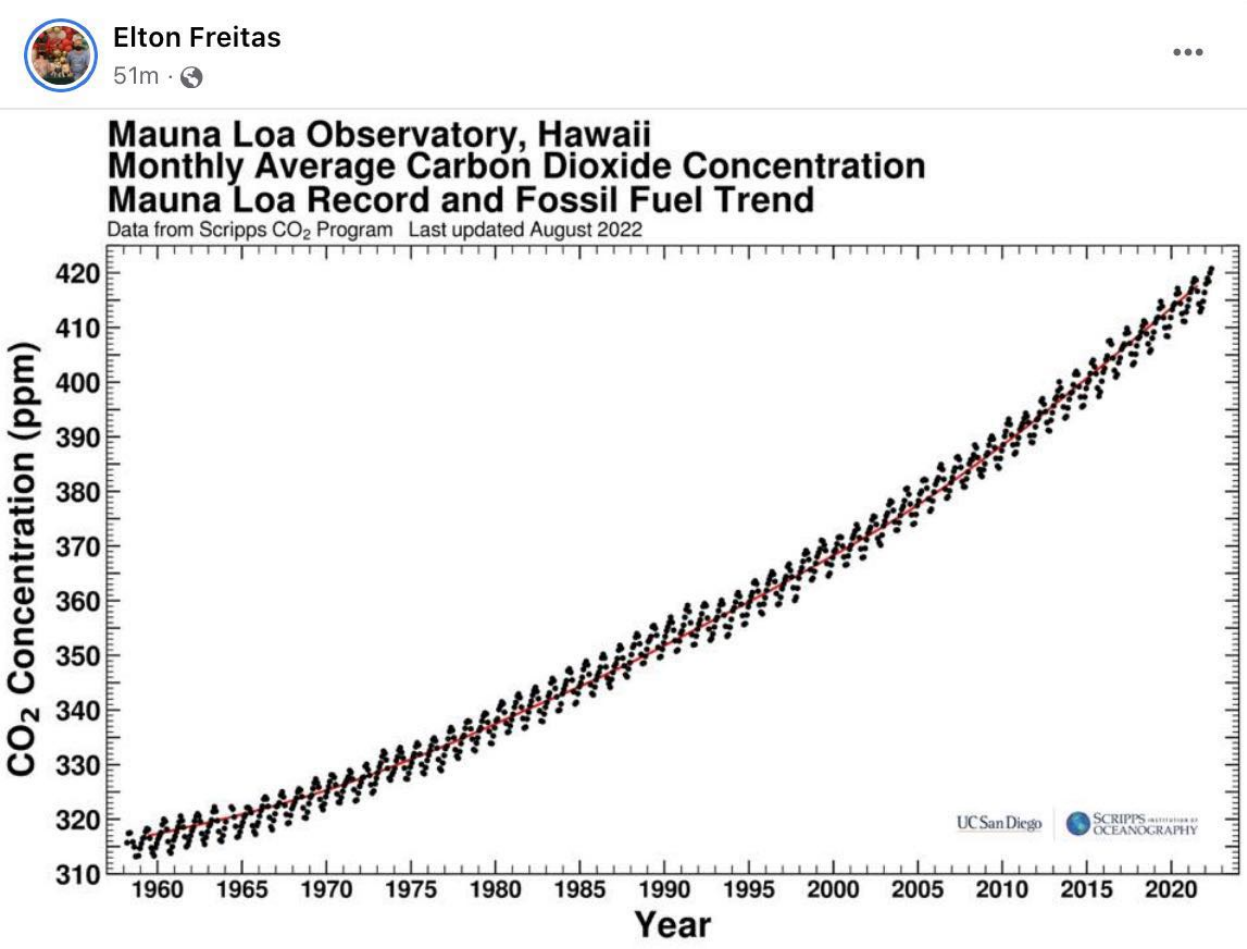
InfoImagination, directed by Scott Goold, began advocating use of hydrogen (H2) as an alternative fuel beginning in 2012. Technology and processes have evolved. H2 is more viable than ever today.

In a crisis, fuel cell engines can power household items, such as cell phone chargers, small refrigerators to keep medications cool or medical devices.

Fuel cell vehicles are the future! See all the uses as shown in the enclosed packet.



H is for Hydrogen. H is for Hawai’i



EXACTLY!!! Zero emissions — but how do we get that electricity to our islands or mainland? Use this geothermal energy to produce HYDROGEN — ship H around the islands as we do gas & oil today. We would not need to IMPORT fuel, and fuel is our most expensive import. $$$ would STAY in Hawai’i. Get it now? Go H. H is for Hawai'i !!! This is how we make Hawai'i more affordable for all.

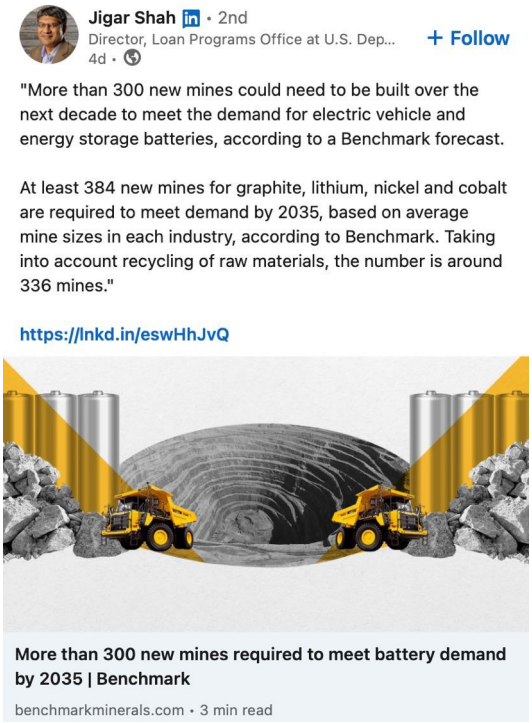
This packet of information shows ALL the potential uses for hydrogen. The challenge is extracting hydrogen from nature. We can use renewable energy, such as geothermal, wind or solar to extract hydrogen. Then use hydrogen to power our vehicles, homes and businesses.

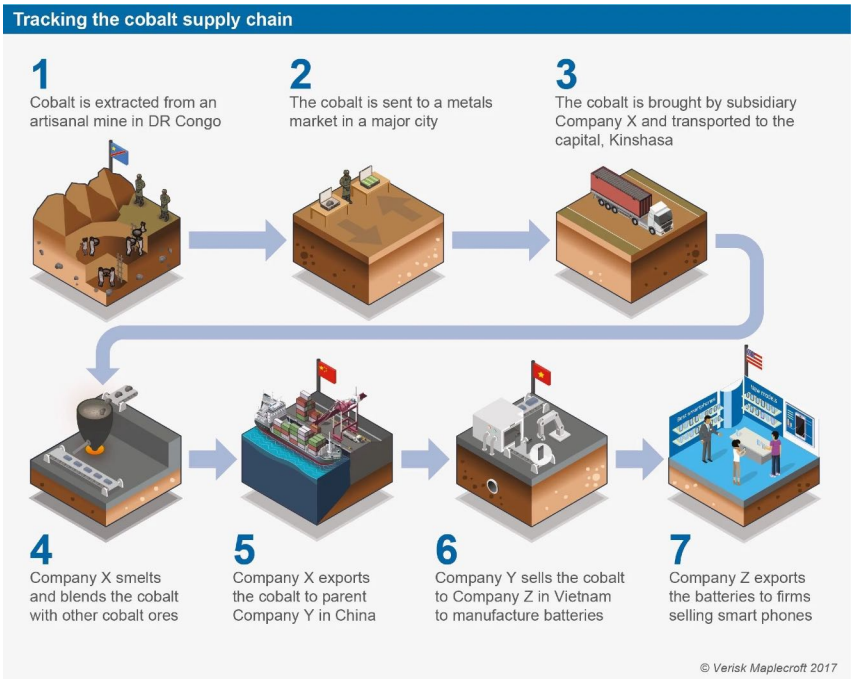
LITHIM and COBALT MINING ENVIRONMENTALLY DESTRUCTIVE

“More than 300 new mines could need to be built over the next decade to meet the demand for electric vehicle and energy storage batteries, according to a Benchmark forecast.

At least 384 new mines for graphite, lithium, nickel and cobalt are required to meet demand by 2035, based on average mine sizes in each industry, according to Benchmark. Taking into account recycling of raw materials, the number is around 336 mines.”

This is a Lithium leach field. This is what your Electric Car batteries are made of. It is so neuro-toxic that a bird landing on this stuff dies in minutes. Take a guess what it does to your nervous system?
Pat yourself on the back for saving the environment.





SAFETY, STORAGE AND FACTS ABOUT H2

BLUE PLANET ALLIANCE

Blue Planet Alliance: Henk Rogers

Hydrogen is probably the safest of all fuels to handle and move around. It's the lightest element in the universe, so any of it that gets released flies upward so fast that it's pretty much impossible to ignite. Pure hydrogen cannot be ignited. You could fire a bullet through a hydrogen tank and it would not ignite.

One way to move hydrogen is by using a tanker (like we move LNG around the planet). One would be stationed in Honolulu offloading while the other would be on the Big Island being loaded. As HNL nears empty, BI heads to HNL and replaces it. Other way is a pipe. It's ten times cheaper to lay down a hydrogen pipe than an electric cable.

Germany is building offshore wind and making hydrogen on an island in the Baltic then piping the hydrogen to the mainland because it's much cheaper that way.

We bring in oil from Russia, Libya and Venezuela. Shipping H2 from the Big Island to Oahu is a piece of cake by comparison.

The most powerful force in the world: Will Power

Henk Rogers, Founder
Blue Planet Alliance
777 United Nations Plaza, Suite 3E
New York, NY 10017
henk@blueplanetalliance.org

Blue Planet Research: Vincent Paul Ponthieux

Hydrogen as we usually know it is one of the diatomic ones like Oxygen, Nitrogen, etc. So two atoms form a molecule in that case (H2). Single monatomic hydrogen atoms can exist as an atomic bond such as in some acids like hydrochloric acid (HCL).

As far as your concern about leakage, it is not really valid. We have many excellent materials for containing hydrogen. Stainless steel, nylon and other polymers as well are excellent materials for storing and transporting hydrogen.

And you are right about liquid hydrogen for bulk transport. It also makes sense for trucking vs gaseous hydrogen if you already have liquid available. Liquefaction is well known as a process and companies like *Air Liquide* have been doing it for 40 years or more and are the world leaders in the technology.

Hydrogen is just a flammable gas but it is one of the safest if not the safest flammable gas that we have. You handle it with the same respect as any flammable gas.

But as Henk pointed out, the buoyancy and lack of significant radiant heat (no Carbon) make it quite safe. It's 14 times lighter than air so if it escapes it goes up at 45 mph.

Hope this helps! Feel free to ask me anything about H2.

Aloha,

Vincent Paul Ponthieux
Director & CTO

BLUE PLANET RESEARCH
71-1645 Mamalahoa Hwy. Box 2
Kailua Kona, HI. 96740

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paul@blueplanetresearch.us

Hydrogen Power for Kaua'i and America

Originally submitted to community officials in June 2012. Imagine where we would be had Americans launched a "hydrogen project" then. Using wind & solar power, we could extract hydrogen from fresh water, salt water or other sources. This would SAVE local residents millions of dollars we current spend to import diesel and coal. Using hydrogen ends the destructive pollution that most scientists believe contributes to global warming and extreme climate change. How much longer can we delay? The time to step into the H-future is now.

Aloha County Councilors and Community Leaders:
I've attached a packet for your review. Residents of Kaua'i spend about $100 million per year to purchase fuel off-island for generation of electricity. This money leaves the island — ensuring residents continue to struggle financially.

Hydrogen could be produced on Kaua'i using the Garden Island's abundance of water. While hydrogen production would not be free, it would be less expensive than purchasing diesel off-island and money would remain on Kaua'i. Economic multiplier tied to this additional pool of funds would lead to marked increase in standard of living for residents. Over ten years, we estimate such an investment would have a positive impact of greater than a billion dollars.

Imagine a billion dollars remaining in Kauai's local economy rather than leaving! I have enclosed six additional pages to this cover. The first, from KIUC, highlights development plans through 2023. KIUC plans Hydro, Solar and Biomass production. Hydrogen isn't mentioned.

Second page highlights KIUC's revenue model, showing fuel costs at 51.6 percent of total revenue. Linking this figure to the third page shows Kaua'i residents currently pay about $94,000,000 per year to purchase fuel, primarily diesel, from off-island sources. This page also shows residential cost of electricity is about $0.434/KW. Rates in New Mexico, by comparison, run $0.129/KW.

Rates on Kaua'i are about 3.5 times higher than rates for families on mainland. Fourth page highlights Honda's work on fuel cells. Hydrogen can be converted from water using solar or wind energy. These vehicles can use their fuel cell engines to power other appliances, such as refrigerators or medical devices in time of emergency.

Fifth page highlights work by Nissan. The Leaf can also power other items— revolutionary disaster planning. Using fuel cell technology and hydrogen, a personal vehicle can supply power to a home. On Kaua'i such application could be used to power community centers, hospitals, first-responders and other relief centers during a hurricane, tsunami or "great deluge" as we experienced last March.

Final page focuses on Southern California's efforts to ship and distribute hydrogen. We have mastered the technology related to this fuel source. We have harnessed an efficient and abundant energy source.

Time is here; time is now. By 2023 Kaua'i could be a world leader in energy generation. This will be a model for developing nations – hopefully, for the United States. We must move away from coal and non-renewables. By-product from hydrogen fuel cells is water vapor. Extracting hydrogen from H2O creates oxygen. This is win-win-win.

The public is seeking leaders for such a bold, enlightened initiative. Leaders who push this now will establish legacies similar to President Kennedy for initiating our jump into space. America is losing the science race. This has always been America's edge!

Mahalo!

Scott Goold
Providing answers and solutions to complex challenges

COOPERATIVE TECHNOLOGY

Renewable Update

In 2011, renewable generation resources accounted for 11 percent of KIUC's generation mix. With the goal of becoming 50-percent renewable by 2023, KIUC has upcoming projects that will move the co-op toward that goal.

The McBryde project at Port Allen will provide an estimated 6 megawatts of solar power once online. The AES solar project in Poipu will bring an additional 3 MW of solar to the renewable generation mix when complete. In 2013, KIUC anticipates bringing an additional 12 MW of solar online with the joint KIUC-HCDC project in Anahola, and is hopeful for another 6.7 MW of biomass from green energy in Koloa.

KIUC is continuing to move forward in its vision to provide hydroelectric power to the Kaua'i community. After earlier identifying eight potential sites, Free Flow Power, the KIUC consultant charged with the initial evaluation and development of hydropower resources, is nearing completion of its preliminary engineering proposals.

Numerous meetings with state, county and federal agencies, as well as landowners and community interests, are resulting in projects that are economically and environmentally viable. It is expected that meetings will be held mid-year to continue conversations with the community at large.

Once site control issues and community input is provided, it is anticipated studies can begin to address environmental permitting requirements.

When developed, hydroelectric power will further reduce Kaua'i's dependence on fossil fuels, enable KIUC to attain its goal of 50-percent renewable generation by 2023 and provide low-cost energy sustainability, over time reducing the cost to ratepayers.

KIUC Renewable Portfolio Summary Toward the Goal of 50% Renewable

Existing resources:	**Type**	**MW**	**GWh**	**% Total**
KIUC Waiahi, Lihue	Hydro	1.3	7.9	1.8%
McBryde, Wainiha & Kalaheo	Hydro	4.8	22.1	5.0%
Gay & Robinson, Olokele	Hydro	1.0	5.1	1.2%
ADC/KAA, Waimea & Kekaha	Hydro	1.5	5.7	1.3%
Kapaa Solar LLC, Kapaa	Solar	1.0	1.8	0.4%
Customer sited solar	Solar	4.0	7.0	1.6%
Total		13.6	49.6	11.3%
Signed PPAs:				
McBryde, Port Allen	Solar	6.0	12.1	2.7%
AES, Poipu	Solar	3.0	6.0	1.4%
MP2, Lawai	Solar	0.3	0.6	0.1%
KIUC-HCDC, Anahola	Solar	12.0	22.6	5.1%
Green Energy, Koloa	Biomass	6.7	51.2	11.6%
Total		28.0	92.5	21.0%
Under development/study:				
KIUC, TBD	Solar	9.0	17.0	3.8%
Puu Opae, Kekaha	Hydro	8.3	43.0	9.7%
Menehune Ditch, Kekaha	Hydro	1.5	6.5	1.5%
DHHL, Anahola	Hydro	0.3	1.3	0.3%
EKWUC, Kalepa	Hydro	3.7	18.5	4.2%
G&R Olokele	Hydro	6.0	20.5	4.6%
Total		30.1	102.3	23.2%
Total resources identified		71.7	244.5	55.4%

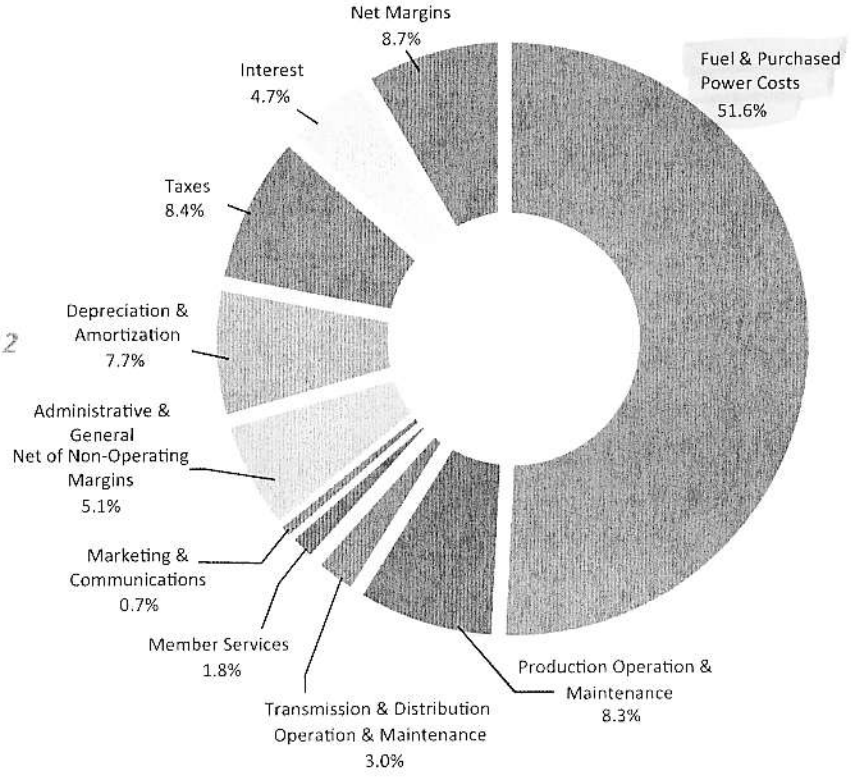
	Renewable GWh	**Sales GWh**	**Sales %**
2015 projection (pre-hydro)	161.0	461.1	34.9%
2020 projection (including 24.3 MW hydro)	244.5	495.7	49.3%

By Karissa Jonas, CFO

Statement of Operations

For the period 01/01/2012 – 02/29/2012

Percentage of Total Revenue



We are pleased to report that the KIUC results of operations through February 29, 2012, are favorable. However, year-to-date electricity use on the island is 2-percent lower than last year. Despite the reduction in sales volume, KIUC is still doing everything it can, while maintaining safety and reliability, to reduce costs in various areas to operate efficiently and effectively and continue to maintain a strong financial position. Revenues, expenses and net margins totaled $29.6 million, $27.0 million and $2.6 million, respectively, for the two-month period ending February 29, 2012.

As is the case for all electric utilities, the cost of power generation is the largest expense, totaling $17.7 million, or 59.9 percent of revenues. Fuel costs are the largest component of power generation, totaling $15.2 million, or 51.6 percent of revenues, and representing 86.1 percent of the cost of power generation. The remaining $2.5 million, or 8.3 percent of revenues and 13.9 percent of the cost of power generation, represents the cost of operating and maintaining the generating units.

The cost of operating and maintaining the electric lines totaled $0.9 million, or 3.0 percent of total revenues. The cost of servicing our members totaled $0.5 million, or 1.8 percent of revenues. The cost of keeping our members informed totaled $0.2 million, or 0.7 percent of revenues. Administrative and general costs—which include legislative and regulatory expenses, engineering, executive, human resources, safety and facilities, information services, financial and corporate services, and board of director expenses—totaled $1.6 million, or 5.3 percent of revenues.

Being very capital intensive, depreciation and amortization of the utility plant costs $2.3 million, or 7.7 percent of revenues. Although not subject to federal income taxes, state and local taxes amounted to $2.5 million, or 8.4 percent of revenues. Interest on long-term debt, at a favorable sub-5-percent interest rate, totaled $1.4 million, or 4.7 percent of revenues. Non-operating net margins added $0.1 million to overall net margins. Revenues less total expenses equal margins of $2.6 million, or 8.7 percent of revenues. Margins are allocated to consumer members and paid when appropriate.

Every year, KIUC is required by law to provide our ratepayers annual fuel mix and average electric cost information.

HRS [§269-16.4] annual fuel mix disclosure.

(a) Beginning June 1, 2004, and every June 1 thereafter, each retail supplier of electricity shall disclose fuel mix information by generation category to its existing and new retail electricity customers for the prior calendar year.

(b) Beginning June 1, 2004, and every June 1 thereafter, each retail supplier of electricity shall state the average retail price of electricity (per kilowatt-hour) for each rate class of service for the prior calendar year. The average retail price of electricity for each rate class of service shall be determined by dividing the total electric revenues for each rate class of service by the total kilowatt-hours sold to each respective rate class.

(c) The disclosure required by this section shall be:

(1) Printed either on the customer's bill or as a bill insert; provided that this disclosure requirement shall not result in increased costs to ratepayers; and

(2) Posted and updated on the suppliers Internet website, if any.

(d) As used in this section, the term "fuel mix" means the electricity sold to retail electricity customers expressed in terms of percentage contribution by generation category. The total fuel mix included in each disclosure shall total 100 percent. [L 2003, c 147, §2]

REVENUE

51.6%

Rate Class of Service	Schedule	2007	2008	2009	2010	2011
Residential	D	$58,823,116	$67,521,772	$48,759,892	$58,599,648	$69,031,915
General Lighting Service	G	$23,967,162	$27,098,626	$18,738,834	$22,536,553	$26,468,791
General Lighting Service	J	$20,935,075	$23,757,990	$15,861,517	$18,708,703	$21,485,166
Large Power	P	$39,318,452	$48,260,251	$32,715,713	$38,937,220	$46,579,473
Large Power	L	$18,208,673	$20,939,501	$11,999,215	$14,896,041	$17,238,659
Streetlight	SL	$1,286,933	$1,457,504	$1,160,789	$1,381,050	$1,573,722
Irrigation		$344,452	$415,411	$264,087	$35,886	$33,626
Total Revenue		**$162,883,863**	**$189,451,055**	**$129,500,047**	**$155,095,101**	**$182,411,352**

KWH SALES

-894m-

Rate Class of Service	Schedule	2007	2008	2009	2010	2011
Residential	D	165,177,370	160,479,367	161,946,254	159,425,808	159,071,128
General Lighting Service	G	64,311,197	61,762,667	58,775,630	59,481,202	59,790,431
General Lighting Service	J	60,600,629	57,561,387	54,387,913	53,235,877	51,859,338
Large Power	P	116,805,413	118,083,102	114,413,017	114,521,985	116,823,510
Large Power	L	55,893,565	52,082,601	42,638,562	44,990,571	44,379,446
Streetlight	SL	2,643,480	2,637,376	2,702,271	2,729,677	2,716,421
Irrigation		1,464,135	1,184,017	1,409,589	148,199	104,788
Total KWH Sold		**466,895,789**	**453,790,517**	**436,273,236**	**434,533,319**	**434,745,062**

AVERAGE RETAIL PRICE*

NM 0.129

Rate Class of Service	Schedule	2007	2008	2009	2010	2011
Residential	D	$0.356	$0.421	$0.301	$0.368	$0.434
General Lighting Service	G	$0.373	$0.439	$0.319	$0.379	$0.443
General Lighting Service	J	$0.345	$0.413	$0.292	$0.351	$0.414
Large Power	P	$0.337	$0.409	$0.286	$0.340	$0.399
Large Power	L	$0.326	$0.402	$0.281	$0.331	$0.388
Streetlight	SL	$0.487	$0.553	$0.430	$0.506	$0.579
Irrigation		$0.235	$0.351	$0.187	$0.242	$0.321

**All-in cost including customer charge, applicable demand charges and surcharges.*

Fuel Mix Generation*	2007	2008	2009	2010	2011
Biomass	1,400,362	1,095,193	2,219,370	0	0
Fossil Fuel	461,001,302	437,828,184	417,228,747	417,117,412	409,392,106
Hydro	26,300,465	36,253,752	36,364,756	35,640,977	40,573,700
Photovoltaic	522,769	3,924,000	5,023,000	6,221,983	9,885,319
Total	**489,224,897**	**479,101,129**	**460,835,873**	**458,980,371**	**459,851,125**

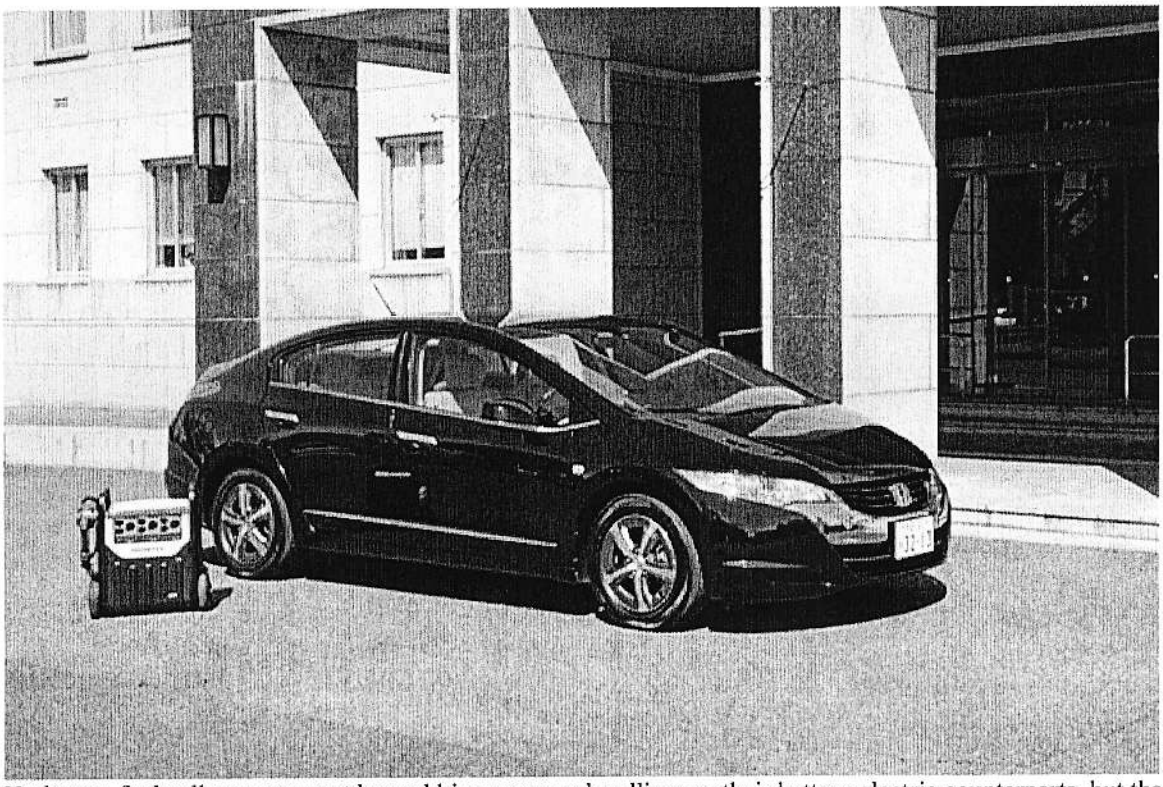
** Gross Generation kWh*

Fuel Mix Percentage	2007	2008	2009	2010	2011
Biomass	0.3%	0.2%	0.5%	0.0%	0.0%
Fossil Fuel	94.2%	91.4%	90.5%	90.9%	89.0%
Hydro	5.4%	7.6%	7.9%	7.8%	8.8%
Photovoltaic	0.1%	0.8%	1.1%	1.4%	2.1%0
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Honda Turns Their Fuel Cell Sedan Into A Solar Powered Generator

By Keith Barry
April 9, 2012
http://www.wired.com/autopia/2012/04/honda-turns-their-fuel-cell-sedan-into-a-solar-powered-generator/

Honda has equipped their FCX Clarity fuel cell electric vehicle with electrical outlets and built a new solar-powered hydrogen fueling system. Together, they turn the FCX Clarity into a zero emissions generator that's powered by the sun and water.



Hydrogen fuel cell cars may not be grabbing as many headlines as their battery electric counterparts, but that doesn't mean Honda hasn't stopped work on the FCX Clarity. More than four years after the fuel cell car's debut, Honda modified the car to feature a box of power outlets (the little wheeled unit near the car's back tire) that lets the car function as a 9kW generator.

As part of the same project, Honda also installed a new hydrogen fueling station at a government building in Saitama, Japan that creates hydrogen from water and solar power. It's a test of a system that, if successful, could allow the FCX Clarity to either drive or act as a generator with absolutely no tailpipe emissions.

While most hydrogen fueling stations rely on hydrogen that's either been reformed elsewhere from natural gas, Honda's test system in Saitama uses a high pressure water electrolysis system to produce hydrogen. The electricity to power this particular system comes from a mix of grid power and solar power, which together can create 1.5 kg or hydrogen in 24 hours — enough to run the FCX Clarity for 90 miles.

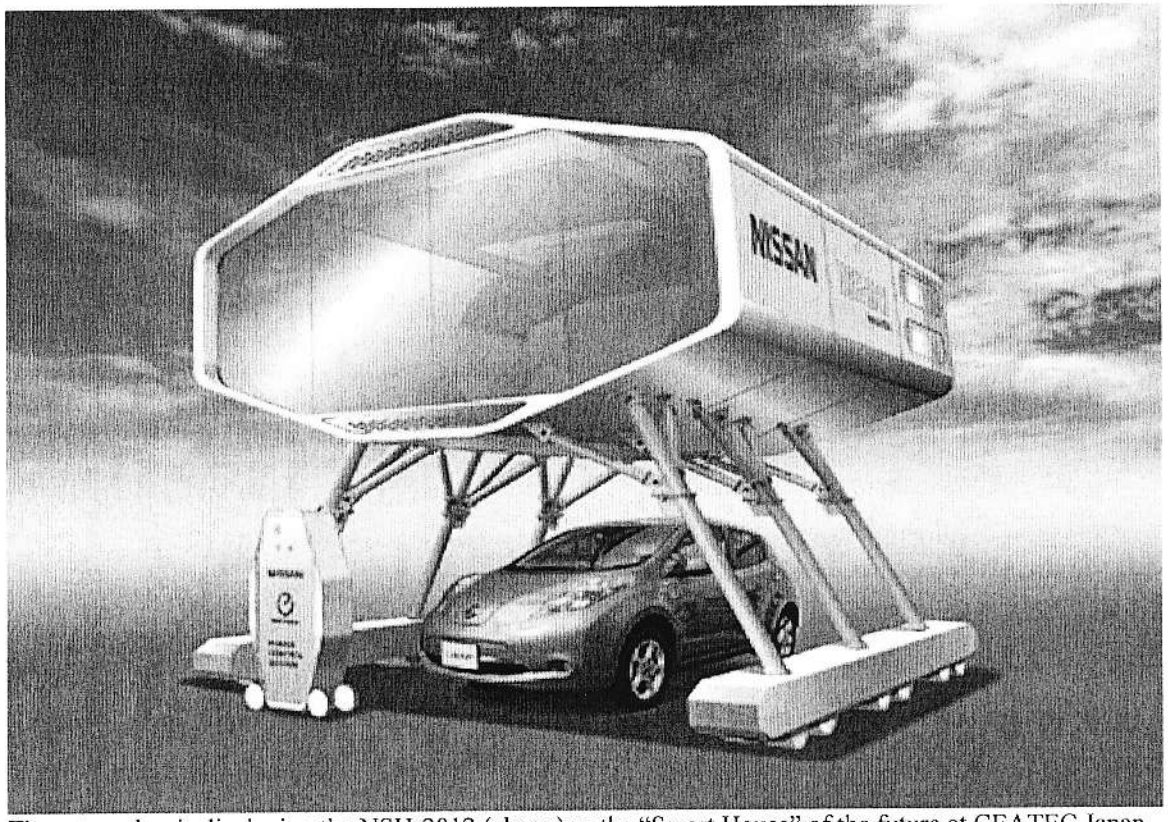
In the aftermath of last year's devastating tsunami and Fukushima nuclear accident, we've seen an increasing number of Japanese carmakers turning their EVs into portable generators. Though the FCX Clarity is the first hydrogen powered car to be used as a generator, it joins the Nissan's Leaf To Home system and Mitubishi's MiEV Power Box as power supplies on wheels.

Honda didn't offer too many details about the system, which just began testing late last month. Right now the FCX Clarity is only functioning as an emergency power supply, but we wouldn't be surprised if hydrogen fuel cell cars were eventually tied into smart grid setups, where plugged-in cars could act as backup generators during times of heavy power demand.

Nissan Builds a Post-Fukushima Neighborhood Around the Leaf

By Keith Barry
October 5, 2011
http://www.wired.com/autopia/2011/10/nissan-builds-a-post-fukushima-neighborhood-around-the-leaf/

If you're worried about natural disasters and energy dependence, Nissan's got a car and a house to sell you in the most exclusive of communities.



The automaker is displaying the NSH-2012 (above) as the "Smart House" of the future at CEATEC Japan (Combined Exhibition of Advanced Technologies) 2011. It's the centerpiece of Nissan's Standalone Energy Community exhibit along with Smart Healthcare, Smart Cottage, Smart Rental Car and Smart Food Stand.

The house, inspired by both modern aircraft fuselage design and ancient Japanese homes, has a polyhedral structure that's resistant to disasters, and there's a Leaf EV at its heart.

Energy independence has taken on new significance and urgency in Japan since the Fukushima disaster, so each one of the buildings in the Energy Community relies on solar, fuel cell or wind power. Although the buildings are all designed to be self-sufficient, the Leaf is central to their existence as a community. Through the Leaf to Home charging system, the car acts as a battery backup if a solar system can't generate enough power on a rainy day — or worse.

"This home can maintain stable in-house power supply that is not affected by weather, and can rely on solar power and power stored in an EV's batteries if power is cut off during a disaster," the company said.

When all is going well, a smart-grid setup funnels energy to and from individual power generation stations — and to and from plugged-in Leafs for low-emission charging.

SoCal Gets a Hydrogen Station Unlike Any Other

By Chuck Squatriglia
May 10, 2011
http://www.wired.com/autopia/2011/05/socal-gets-a-hydrogen-station-unlike-any-other/

There are a few dozen fuel-cell vehicles roaming Southern California, and today the early adopters driving them got one more place to fill up. But the nation's newest hydrogen-fueling station is unlike any other in the United States.

The public station in Torrance is the first in the country supplied by an active hydrogen pipeline. This is significant, because most of the stations in the United States provide hydrogen that is delivered by truck.

The station is run by Shell on land leased from Toyota, which remains enamored with hydrogen. For all the love automakers and policymakers are showering on battery electric vehicles, several automakers remain firmly committed to hydrogen fuel cell technology. **Honda, Toyota and Mercedes-Benz promise to have mass-market hydrogen fuel cell vehicles in showrooms by 2015.**

"Fuel cell technology is viable and ready for the mass market," Chris Hostetter, Toyota vice president of strategic resources, said at this morning's grand opening. "Toyota plans to bring a fuel cell vehicle to market in 2015 or sooner, and as you see, we will not be alone in the marketplace. Building an extensive hydrogen re-fueling infrastructure is the critical next step in bringing these products to market."

The station, near several freeways and Los Angeles International Airport, is open to all. It can fuel as many as four vehicles simultaneously in less than five minutes and can dispense up to 100 kilograms of hydrogen in 12 hours. A Honda FCX Clarity holds 3.92 kilograms of the stuff, while the Mercedes-Benz F-Cell holds four.

The hydrogen will come from Air Products plants in Wilmington and Carson that serve several industrial sites, including the Exxon Mobil refinery in Torrance. The project was funded in part by the South Coast Air Quality Management District and the Department of Energy.

"This fueling station will be a tremendous model to show how effortless a pipeline supply of hydrogen can be to an automobile fueling station and other hydrogen fuel cell applications," said David J. Taylor, VP of energy business at Air Products. "This site will be a model to learn and expand pipeline-fed stations as opportunities arise."

Honda FCX Clarity driver Jon Spallino (pictured) was the station's first retail customer.

Toyota has said it has cut the cost of fuel cell vehicles more than 90 percent by using less platinum and other expensive materials. It plans to sell its first hydrogen vehicle for around $50,000.

Honda just unveiled its new hydrogen-powered car
Emits nothing but water vapor.
28 OCT 2015

Just when everyone's getting all excited about electric cars usurping their fossil fuel-guzzling counterparts, Honda has announced that its hydrogen-powered cars will go on sale in Japan as early as March 2016, with launches in Europe and the US to follow.

The five-seated sedan, called the FCV Clarity, can travel 700 km (434 miles) on a single charge. It's been priced at 7.66 million yen, or US$62,807, which puts it just in the affordability range for the average consumer, the Japanese automaker saying it expects to sell far more than the 72 units it sold of its previous-generation model, the FCX Clarity. "We want this car to be the trigger for the 'hydrogen society'," Honda operating officer, Toshihiro Mibe, told Reuters at the Tokyo Motor Show in Japan this week.

A Honda hydrogen-powered car is nothing new. Back in 2008, the FCX Clarity was leased to a handful of private buyers in California as part of a subsidized trial deal, but things didn't go so well that time around.

For one thing, the car cost 10 times more than it does now, and on top of that, it was 30 percent less powerful. The hydrogen fuel cell stack was also incredibly bulky, and the last thing you want to do is spend more than half a million dollars on a car you can barely fit into. "Until this point, fuel cells have been so large that they needed to be packaged elsewhere in the vehicle, like in Toyota's Mirai, which has its fuel cell stack in the centre of the vehicle, cutting into interior space," Nick Jaynes writes for Mashable.

The FCV Clarity, on the other hand, features a fuel cell stack that's 33 percent smaller, now taking up the same amount of room under the hood as a typical V-6 engine.

Hydrogen-powered cars work by having the fuel cell stack convert hydrogen into electricity, which powers an electric motor via a lithium-ion battery pack. "Essentially, think of it as an electric vehicle that can be refilled in 3 minutes and emits only water vapor out of its tailpipes," says Jaynes.

And therein lies the biggest hurdle in convincing drivers to join the "hydrogen society" – you're gonna need at least one hydrogen station in your local area to make buying one of these environmentally friendly vehicles in any way practical. Joann Muller reports at Forbes that companies like First Element and Air Liquide are installing some in Northeastern US and California, supported by government grants and loans from Toyota and Honda, but the rollout has so far been slow.

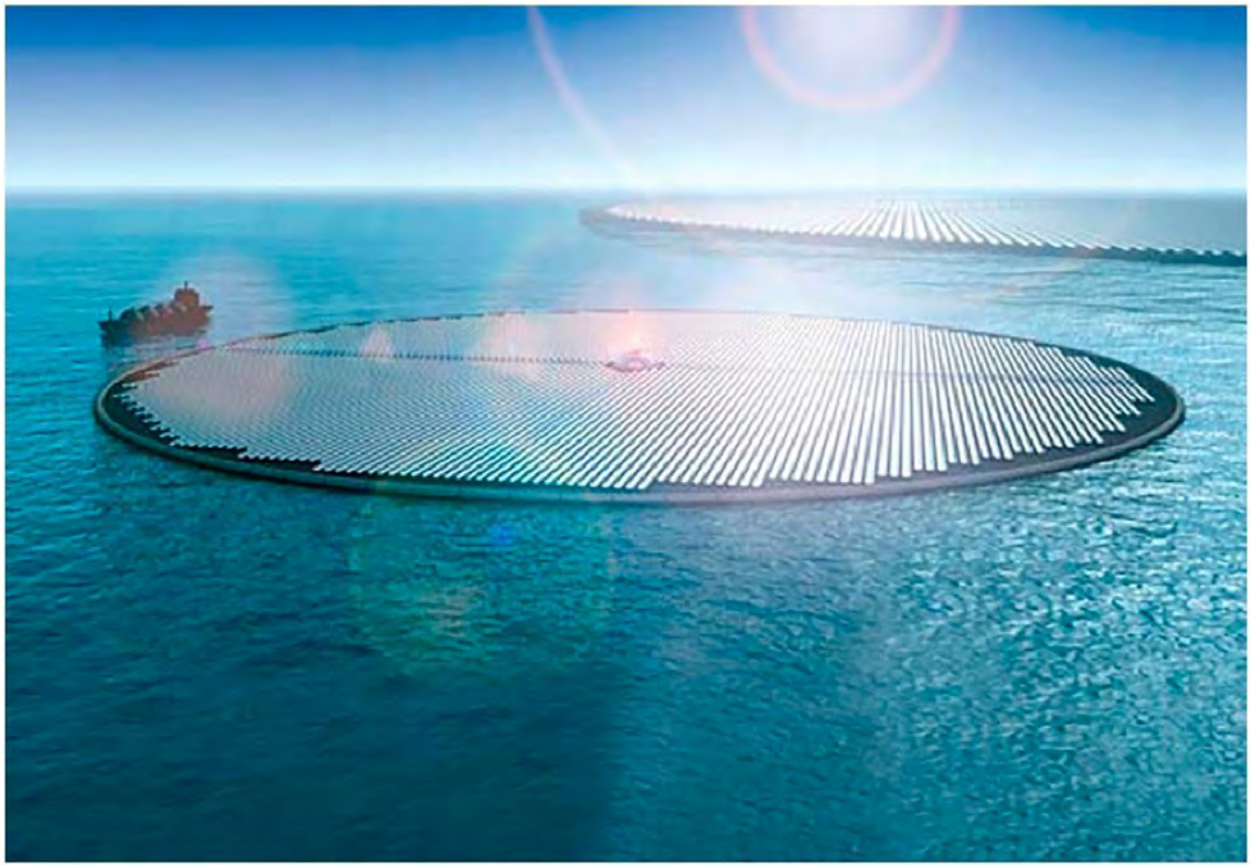
Not that Honda isn't aware of the challenges its drivers could face in finding places to charge – it's now developing a personal-use Smart Hydrogen Station, which is designed to be installed at home so you don't have to go looking for a re-up. "There's no word on when that might be available, but if it's affordable, it could be a huge breakthrough in speeding the adoption of fuel cell vehicles," says Muller.

It's exciting to see a car company go all-in on a vehicle that completely eliminates the need for toxic emissions. In a world where outdoor air pollution is killing more than 3 million people every year, with automobile exhaust being a significant part of the problem, alternatives like this are crucial. But only time will tell if there's truly a market for hydrogen cars out there.

"Compared to 10 years ago, I think fuel cell vehicles have developed significantly in terms of the technology," Honda president Takahiro Hachigo told Muller. "Ten years ago, we said fuel cells could not be driven in cold weather, for example, and that the hardware was too heavy. Today, fuel cells are equal to gasoline engine cars."

SOURCE: http://www.sciencealert.com/honda-just-unveiled-its-new-hydrogen-powered-car

Solar Powered Floating Islands Could Convert Hydrogen From Seawater To Produce Fuel



[ADDED June 21, 2019]

A team of researchers from Norway and Switzerland put forward a proposal for 'Solar Methanol Islands' that convert atmospheric carbon dioxide to fuel. The islands would have to be clustered together to create large-scale facilities.

If enough of these facilities were built, they could eventually offset the total global emissions from fossil fuels and thus help protect our climate from global warming. The researchers' proposal has been published in PNAS.

Rather than extracting CO2, we would convert sea water into hydrogen gas. This could power existing plants in our islands. No need for massive solar farms on our soil. Could be stationed in areas outside hurricane zones and rough ocean swells.

SOURCE: https://www.intelligentliving.co/floating-solar-islands/

This small island chain is leading the way on hydrogen power

By Hanna Ziady, CNN Business

Updated 10:46 AM ET, Fri March 13, 2020
https://www.cnn.com/2020/03/13/business/orkney-hydrogen-power/index.html

London (CNN Business)Too much clean energy. It's an unusual problem to have, and one that's spurred a group of islands off the northern coast of Scotland to become an unlikely pioneer in hydrogen power.

Orkney, better known for its breathtaking coastal scenery and some of Britain's oldest heritage sites than for its cutting edge approach to energy, has been quietly pioneering hydrogen technology.

Abundant rainfall, strong winds and powerful waves mean the island chain's entire electricity demand is already met through renewable resources. But in recent years, Orkney's grid couldn't handle the amount of power being generated from its ever expanding wind farms, Megan McNeill, Orkney projects manager at Community Energy Scotland, told CNN Business.

Wind turbines needed to be switched off on a daily basis, as power cables reached capacity, leaving clean energy unused.

Rather than waste the excess electricity, the islands decided to harness it. It was here that in 2017 the European Marine Energy Centre (EMEC), in a world first, used tidal energy to split water and make hydrogen — a process known as electrolysis.

That was just the beginning. The success of that project spurred collaboration between EMEC, Community Energy Scotland and others to do the same with excess wind energy. Surf 'n' Turf, a project funded by the Scottish government, combined excess electricity from tidal and wind turbines to create hydrogen, another world first.

Hydrogen is viewed as an important part of the transition to a cleaner future because it emits no carbon. It can also be stored and is seen as a potential replacement to natural gas.

But traditional hydrogen production relies almost entirely on fossil fuels and is responsible for 830 million tonnes of carbon dioxide emissions a year. That is equivalent to the CO2 emissions of the United Kingdom and Indonesia combined, according to the International Energy Agency.

Producing hydrogen power remains expensive, but Orkney's success in creating hydrogen using clean energy demonstrates that it can be done at scale. The islands are already using hydrogen to power vehicles and a local primary school. Now, Orkney is hoping to use hydrogen fuel cells to power a seagoing vessel able to transport both goods and passengers.

"We're hoping it can be the world first," said hydrogen manager at EMEC, Jon Clipshim, adding, "there is a race on."

— Jenny Marc contributed to this report.

New hydrogen-powered drone can fly for record-breaking 15-hour

BY ASHWINI SAKHARKAR [1]
SEPTEMBER 24, 2019

New hydrone Griflion H features a record-breaking 15-hour flight time

China's MMC drone company launched its new hydrogen-powered vertical take-off and landing drone – Griflion H – with the record-breaking 15-hour flight time. The Hydrone was launched last week at the InterGEO 2019 – the largest geoinformation fair in the world – held in Germany.

The Griffion H VTOL is powered by a patented high-efficiency metal bipolar plate hydrogen fuel battery with a maximum hydrogen storage capacity of 27L. It provides 15 hours of flight time when the drone is not loaded. And it can fly for 10 hours when carrying 3 kilograms (6.6 pounds) of payload, whereas according to the company, most drones in the market have a maximum 2-hour flight time.

It uses two rotors installed to each wing. The rotors are lifted off and then rotates forward through another rotor mounted at the rear wing. Along with extended flight time, Griflion H offers some more features include convenient operation, high security, wide-coverage, zero-emission, and low noise.

The VTOL is developed to provide different solutions for global customers in areas like surveying and mapping, rescue, security & protection, border scouting, and forest scouting. The company hasn't provided further details on its new Hydrone.

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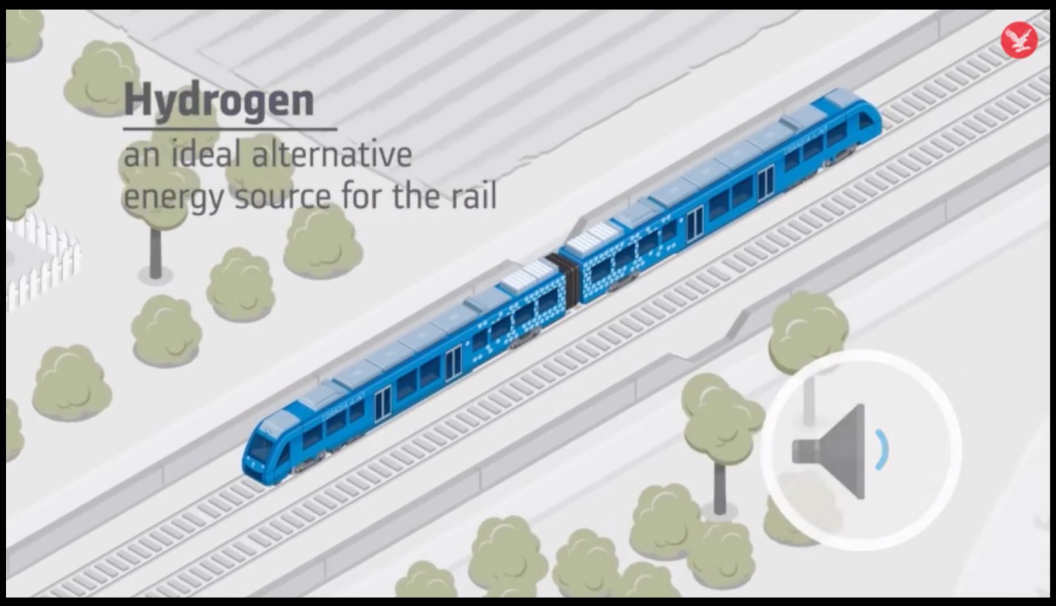
[1] https://www.inceptivemind.com/griflion-h-hydrogen-powered-drone-fly-15-hour/9264/



Germany unveils zero-emissions train that only emits steam

The world's first 'hydrail' can travel almost 500 miles per day at speeds of up to 87mph

Germany unveils zero-emissions train that only emits steam

The world's first 'hydrail' can travel almost 500 miles per day at speeds of up to 87mph

Tom Embury-Dennis @tomemburyd
Tuesday 1 November 2016 17:49

Germany is set to introduce the world's first zero-emission passenger train to be powered by hydrogen. The Coradia iLint only emits excess steam into the atmosphere, and provides an alternative to the country's 4,000 diesel trains.

Lower Saxony has already ordered 14 of them from French company Alstom, and more are likely to be seen around the country if they are judged a success, reports Die Welt. Testing is set to be carried out by the end of the year, before it opens up to the public in December 2017.

The train was first presented at Berlin's InnoTrans trade show in August, and it is set to be the first hydrogen-powered train to regularly ferry people over long distances. There's also interest in the train from the Netherlands, Denmark and Norway.

The iLint is powered by huge lithium ion batteries, and these get their energy from a hydrogen fuel tank on the roof of the train.

The hydrail can travel almost 500 miles per day at speeds of up to 87mph, and the only sound it gives off comes from the wheels and air resistance.

“Alstom is proud to launch a breakthrough innovation in the field of clean transportation," said Alstom CEO Henri Poupart-Lafarge, in a statement.

"It shows our ability to work in close collaboration with our customers and develop a train in only two years.”

Hydrogen power works when hydrogen is burned with oxygen to produce huge amounts of energy, with the only by-product being water.

NASA has used liquid hydrogen to propel its rockets into space since the 1970s.

https://www.independent.co.uk/news/world/europe/germany-unveils-zero-emissions-train-only-emits-steam-lower-saxony-hydrogen-powered-a7391581.html

iLint

The Coradia iLint is a version of the Coradia Lint 54 powered by a hydrogen fuel cell. Announced at InnoTrans 2016, the new model will be the world's first production hydrogen-powered trainset. The Coradia iLint is able to reach 140 kilometres per hour (87 mph) and travel 600–800 kilometres (370–500 mi) on a full tank of hydrogen.

It is assembled at Alstom's Salzgitter plant. It began rolling tests at 80 km/h (50 mph) in March 2017. On 16 September 2018, the first Coradia iLint entered service on the Buxtehude-Bremervörde-Bremerhaven-Cuxhaven line in Lower Saxony, Germany. A mobile hydrogen filling station refuels these trains, however, a stationary station is set to be built by 202 along with 14 more of these trains.

In 2019, Rhein-Main-Verkehrsverbund, the transit network serving the Frankfurt Rhine-Main region, ordered 27 iLint multiple-units to be delivered by December 2022. Each train will have 160 seats. The units will replace diesel trains currently plying the RB11 Frankfurt-Höchst – Bad Soden, RB12 Frankfurt – Königstein, RB15 Frankfurt – Bad Homburg – Brandoberndorf and RB16 Friedrichsdorf – Friedberg routes.

https://en.wikipedia.org/wiki/Alstom_Coradia_LINT

Secretive energy startup backed by Bill Gates achieves solar breakthrough

https://www.cnn.com/2019/11/19/business/heliogen-solar-energy-bill-gates/index.html

Heliogen said it is generating so much heat that its technology could eventually be used to create clean hydrogen at scale. That carbon-free hydrogen could then be turned into a fuel for trucks and airplanes.

November 19, 2019

Heliogen, a clean energy company that emerged from stealth mode on Tuesday, said it has discovered a way to use artificial intelligence and a field of mirrors to reflect so much sunlight that it generates extreme heat above 1,000 degrees Celsius.

"This is an existential issue for your children, for my children and our grandchildren."
BIOTECH BILLIONAIRE PATRICK SOON-SHIONG

Essentially, Heliogen created a solar oven — one capable of reaching temperatures that are roughly a quarter of what you'd find on the surface of the sun.

The breakthrough means that, for the first time, concentrated solar energy can be used to create the extreme heat required to make cement, steel, glass and other industrial processes. In other words, carbon-free sunlight can replace fossil fuels in a heavy carbon-emitting corner of the economy that has been untouched by the clean energy revolution.

"We are rolling out technology that can beat the price of fossil fuels and also not make the CO2 emissions," Bill Gross, Heliogen's founder and CEO, told CNN Business. "And that's really the holy grail."

Heliogen, which is also backed by billionaire Los Angeles Times owner Patrick Soon-Shiong, believes the patented technology will be able to dramatically reduce greenhouse gas emissions from industry. Cement, for example, accounts for 7% of global CO2 emissions, according to the International Energy Agency.

"Bill and the team have truly now harnessed the sun," Soon-Shiong, who also sits on the Heliogen board, told CNN Business. "The potential to humankind is enormous. ... The potential to business is unfathomable."

Unlike traditional solar power, which uses rooftop panels to capture the energy from the sun, Heliogen is improving on what's known as concentrated solar power. This technology, which uses mirrors to reflect the sun to a single point, is not new.

Concentrated solar has been used in the past to produce electricity and, in some limited fashion, to create heat for industry. It's even used in Oman to provide the power needed to drill for oil.
The problem is that in the past concentrated solar couldn't get temperatures hot enough to make cement and steel.

"You've ended up with technologies that can't really deliver super-heated systems," said Olav Junttila, a partner at Greentech Capital Advisors, a clean energy investment bank that has advised concentrated solar companies in the past.

Using artificial intelligence to solve the climate crisis

That means renewable energy has not yet disrupted industrial processes such as cement and steelmaking. And that's a problem because the world has an insatiable appetite for those materials. Cement, for instance, is used to make the concrete required to build homes, hospitals and schools. These industries are responsible for more than a fifth of global emissions, according to the EPA.

That's why the potential of Los Angeles-based Heliogen attracted investment from Gates, the Microsoft (MSFT) co-founder who recently surpassed Amazon (AMZN) CEO Jeff Bezos as the world's richest person.

"I'm pleased to have been an early backer of Bill Gross's novel solar concentration technology," Gates said in a statement. "Its capacity to achieve the high temperatures required for these processes is a promising development in the quest to one day replace fossil fuel."

While other concentrated solar companies attacked this temperature problem by adding steel to make the technology stiffer and sturdier, Heliogen and its team of scientists and engineers turned to artificial intelligence.

Heliogen uses computer vision software, automatic edge detection and other sophisticated technology to train a field of mirrors to reflect solar beams to one single spot.

"If you take a thousand mirrors and have them align exactly to a single point, you can achieve extremely, extremely high temperatures," Gross said, who added that Heliogen made its breakthrough on the first day it turned its plant on.

Heliogen said it is generating so much heat that its technology could eventually be used to create clean hydrogen at scale. That carbon-free hydrogen could then be turned into a fuel for trucks and airplanes.

"If you can make hydrogen that's green, that's a gamechanger," said Gross. "Long term, we want to be the green hydrogen company."

'No-brainer'

For now, Heliogen is squarely focused on solar. One problem with solar is that the sun doesn't always shine, yet industrial companies like cement makers have a constant need for heat. Heliogen said it would solve that issue by relying on storage systems that can hold the solar energy for rainy days.

Now that it has made this breakthrough, Heliogen will focus on demonstrating how the technology can be used in a large-scale application, such as making cement.

"We're in a race. We just want to scale as fast as possible," said Gross.

After the large-scale application, Soon-Shiong said Heliogen would likely be ready to go public.

In the meantime, Heliogen will require a healthy dose of capital to scale and it's working with investors on a private round of funding. Soon-Shiong signaled he plans to invest more in Heliogen. Heliogen declined to provide information on how much money it has raised so far.

"This is an existential issue for your children, for my children and our grandchildren," Soon-Shiong said.

Heliogen's biggest challenge will be convincing industrial companies using fossil fuels to make the investment required to switch over. Gross said the company has been talking to potential customers privately and plans to soon announce its first customers.

"If we go to a cement company and say we'll give you green heat, no CO2, but we'll also save you money, then it becomes a no-brainer," said Gross.

Its biggest selling point is the fact that, unlike fossil fuels like coal, oil and natural gas, sunlight is free. And Heliogen argues its technology is already economical against fossil fuels because of its reliance on AI.

"The only way to compete is to be extremely clever in how you use your materials. And by using software, we're able to do that," Gross said.

Why this space age airplane could change flying forever

Paul Sillers, CNN • Published 2nd October 2020

It looks like a spaceship, runs on fuel that up until a few years ago experts were calling "crazy," and has barely left the drawing board, but in the eyes of one of the world's leading aircraft manufacturers, it's undoubtedly the future.

Not even the distant future. Airbus hopes we'll be soaring into the skies on one of its radical new designs in just 15 years, leaving the days of jet engine pollution and flight-shaming far behind us.

The blended wing aircraft is one of a trinity of eco-friendly hydrogen-fueled models unveiled recently by Airbus as part of its ambitions to spearhead the decarbonization of the aviation industry.

It's a bold plan, and one that just a few short months ago might have seemed fanciful as demand for fossil fuel-powered air travel continued to rise, apparently immune to growing environmental concerns.

But the arrival of Covid-19 and its impact on aviation could've inadvertently cleared a flight path of opportunity for efforts to rethink the technology of getting the world up into the air.

Airbus has baptized its new program ZEROe. The designs revealed aren't prototypes but a starting point to explore the tech needed in order to start building the first climate-neutral commercial planes.

"How can you possibly emerge from the pandemic, with climate neutrality as a core long-term competitiveness factor?" Airbus's chief technology officer, Grazia Vittadini, asked rhetorically, during a briefing about the new plans.

"It would be impossible not to. Even well before the crisis, it has become an acknowledged and shared view that protecting climate and protecting our environment are key indispensable factors upon which we have to build the future of flight," she said.

Why hydrogen?

Airbus's plan to bring to market a zero-emission passenger aircraft by 2035 means it needs to start plotting a course in terms of technology in 2025. In fact it needs to plot several courses.

That's because no single technology can address the energy requirements to fuel the entire spectrum of aircraft types -- from flying taxis through to short-, medium- and long-range airplanes.

While having been recently more focused on electric aviation for small airplanes, Airbus has now pivoted towards hydrogen as a candidate for solving aviation's CO2 problems.

"Our experience with batteries shows us that battery technology is not moving at the pace we want," says Glenn Llewellyn, vice president of zero emission aircraft at Airbus. "This is where hydrogen comes in, it's got several thousand times more energy per kilogram than what batteries could have today."

Llewellyn says Airbus has already started talking hydrogen with airlines, energy companies and with airports, because "this kind of change really requires a teaming across industry and inside the aviation industry in order to make it happen."

Hydrogen has long been seen as a viable fuel by academics, but until now it's had little practical support.

Perhaps now, with batteries not quite cutting it, hydrogen's time has come.

"Eighteen months ago, when people talked about hydrogen in the aerospace industry, people thought you were slightly crazy," Iain Gray, director of aerospace at Cranfield University, tells CNN Travel.

"But now hydrogen has become something that everybody is seeing as a very significant solution to the zero carbon problems," says Gray. Cranfield has been supporting ZeroAvia -- a startup that received a £2.7m ($3.3 million) grant from the UK government to develop zero emission aviation technologies, achieving the world's first hydrogen fuel cell-powered flight of a commercial-grade aircraft at Cranfield Airport in September.

The three ZEROe concepts program include a 120-200 passenger turbofan with a range of 2,000+ nautical miles, capable of operating transcontinentally and powered by a modified gas-turbine engine running on hydrogen. The liquid hydrogen will be stored and distributed via tanks located behind the rear pressure bulkhead.

Then there's a 100-passenger airplane which uses a turboprop engine powered by hydrogen combustion in modified gas-turbine engines. It would be capable of traveling more than 1,000 nautical miles, making it a suitable option for short-haul trips.

However, the real conversation piece in the trio -- pictured at the top of of this article -- has a "blended-wing body," where the wings merge with the fuselage of the aircraft to produce a highly streamlined shape, like a "flying wing". This option shares its aeronautical DNA with Airbus's MAVERIC demonstrator aircraft ,which underwent flight tests last year to explore the energy-saving advantages of this futuristic type of airplane layout.

Looking like something out of Star Trek, Airbus's blended-wing hydrogen airplane could carry up to 200 passengers. Its unique configuration would facilitate a radical new type of cabin interior layout for passengers, while providing ample space for hydrogen storage.

How a hydrogen aircraft works

Hydrogen can be used in different ways to power airplanes: It can be combusted directly through modified gas turbines; it can be converted into electric energy, using fuel cells; and hydrogen combined with CO2 can be used to produce synthetic kerosene.

"For us, it's particularly important to combine the first two of these three elements -- having direct combustion of hydrogen through modified gas turbines, with an embedded electric motor, powered by fuel cells," says Airbus's Vittadini.

"To accelerate on this path, we already have in the pipeline a zero-emission demonstrator, which will be fundamental, especially to de-risk concepts such as refueling of such an aircraft and safe storage and distribution of hydrogen on board an aircraft," she adds.

Could existing jet engines run on hydrogen?

Since it's already been successfully proven that sustainable aviation fuel can be substituted into existing jet engines, the question now is whether hydrogen could also be a "drop in" fuel.

This is something that Rolls-Royce (which is not associated with the ZEROe program) has been looking at, having successfully tested its Trent engines with a hydrogen/kerosene blend in the past.

"Moving to 100% hydrogen would require adaptation to current gas turbine design," Alan Newby, director of aerospace technology and future programs at Rolls-Royce Civil Aerospace, tells CNN Travel.

But Newby also explains that the biggest challenge would be managing the flame temperature and stability in the combustion system. Then there is the question of adapting the fuel delivery and management system, notably for liquid hydrogen. Another caveat, he notes, is that one kilo of hydrogen has three times the energy of kerosene, but more importantly, it takes up five times the volume.

"So the answer is -- yes, it is possible but there would need to be a big focus on redesigning these elements of the current engine design as well as looking at the gas turbine as a complete tank-to-exhaust system and taking a more holistic, overall system level approach," says Newby.

How these concepts could change commercial aviation

The unveiling of the Airbus concepts symbolizes a milestone in terms of civil aerospace adopting hydrogen at the top tier of industry.

True, ongoing efforts with smaller aircraft and drones using hydrogen and hydrogen fuel cells are plentiful. However, Airbus's announcement signifies a major strategic shift for commercial aviation, whereby hydrogen could become the norm for short- and medium-haul flights for the 2030s and beyond.

"But there's no point in addressing a hydrogen airplane if you're not going to look at the system in which it operates," cautions Gray.

Aviation "needs to address the whole zero carbon issue in a holistic systems way, looking at airports, air traffic control, aircraft, and transport to and from airports," he explains.

Fortunately, the dialogue between stakeholders appears to be underway.

"This is going to create a massive change in the energy and aviation ecosystem," says Airbus's Glenn Llewellyn. "We've already started working with airlines, energy companies, and with airports because this kind of change really requires a teaming across industry and inside the aviation industry in order to make it happen."

This necessity for a holistic approach dovetails neatly with the aspiration among airport operators to reduce their own carbon footprint -- hydrogen could power many aspects of airport infrastructure.

For example, in 2015, Memphis International Airport carried out a two-year demonstration of the world's first zero-emissions, hydrogen fuel cell-powered ground support equipment, saving over 175,000 gallons of diesel fuel and 1,700 metric tons of CO2.

In a separate initiative at Toulouse-Blagnac Airport, a hydrogen production and distribution station is being installed for fueling hydrogen-powered buses.

What makes hydrogen a compelling fuel for airports is the fact that it can be produced on-site as well as from the airport's waste materials.

Finnish airport company Finavia is among those evaluating its practicality.

"We're looking at how we could use the waste streams at Finavia's airports, including the waste from glycol (the fluid used for de-icing airplanes) to generate hydrogen," says Henri Hansson, senior vice president of infrastructures and sustainability.

A significant leap towards eco-friendly air travel

Having a common fuel that airlines and airports alike can use is a total gamechanger for the industry.

The introduction of hydrogen airplanes and the extent of its environmental benefit will depend on the degree of uptake over coming years. Airbus's Vittadini says that "our estimation is that it will contribute by more than 50% along our journey to decarbonizing aviation."

There are, however, still many technological hurdles ahead in commercializing any type of sizable hydrogen airplane.

This is partly due to weight and size constraints, says Newby, but "also because the industry's reliability and safety requirements are set very high, which requires very high engineering maturity barriers to be achieved, particularly for passenger-carrying services."

And hydrogen-powered aviation is no silver bullet, he says. It will take a combination of different solutions, including sustainable aviation fuels, electric, hybrid and more efficient gas turbines, powering different missions, to help the industry reach its emissions goals.

"Timing-wise," says Newby, "small hydrogen-powered regional aircraft could potentially be available before the end of the decade."

What this means for fliers

Until Airbus settles on a configuration, it's too early to know what form the passenger cabin will take or what the on-board experience will look like.

But what can be reliably predicted is what it will feel like from a human sensibilities standpoint. Hydrogen could be the antidote to flight-shaming, if Airbus can get ZEROe off the ground.

Launching these concepts in the midst of a pandemic might even be a stroke of genius on Airbus's part, now that people have had time, while being cooped up, to reflect on the privilege of affordable aviation while acknowledging its impact on the planet.

"Covid, ironically, has reminded many people of what the world looks like when they're not seeing contrails and not hearing large jet engines," says Gray. "Flying, per se, is not the problem; carbon is the problem which we're trying to address."

"Flying has given individuals around the world great personal and professional travel opportunities, therefore the emphasis has got to be on solving the emissions and the carbon problems. Hydrogen is a gamechanger, and the industry is up for it."

Paul Sillers is an aviation journalist specializing in passenger experience and future air travel tech. Follow him at @paulsillers

RE: Response from Senator Schatz, July 26, 2019

Dear Dr. Scott Goold,

Thank you for contacting me regarding your support for using hydrogen as a source of renewable power.

I fully support the expansion and continued development of clean energy technologies that reduce our reliance on fossil fuels, create good paying jobs, and do not contribute to climate change. I am encouraged that **Hawaii County** is integrating **hydrogen-powered shuttle buses** into its public transit fleet. Demonstrations like this provide a proof of concept that alternative energy technologies like hydrogen fuel cells can support our energy security goals.

Thank you for your advocacy on this issue. Please be assured that I will continue to fight for legislation and funding for programs that will help our nation shift to a clean energy economy. Mahalo again for contacting me.

Sincerely,

BRIAN SCHATZ
U.S. Senator

Fast-Fill Hydrogen Fueling Station Enabling Zero Emission Transportation

University of Hawai‘i at Mānoa
Contact:Mitch Ewan, (808) 956-2337
Hydrogen Systems Program Manager, Hawaii Natural Energy Institute, SOEST
Rachel Orange, (808) 956-2329
Outreach Specialist, Hawaii Natural Energy Institute, SOEST

Short video about this project can be viewed here: http://youtu.be/JJKduL6qIOI

Posted: Jun 4, 2015

Electric vehicles fuel up with hydrogen at Marine Corps Base Hawaii. Credit: Mitch Ewan, HNEI.

Drivers can now self-fill vehicles with hydrogen at MCBH. Credit: Mitch Ewan, HNEI.

The Hawai‘i Natural Energy Institute (HNEI) has commissioned a “Fast-Fill” high-pressure hydrogen fueling station at the Marine Corps Base Hawai‘i (MCBH), Kaneohe Bay. This state-of-the-art station was developed to support a fleet of General Motors Equinox Fuel Cell Electric Vehicles (FCEV) leased by the Office of Naval Research for use by Marine Corps and Navy personnel on O‘ahu.

Operational since November 2014, this station was recently certified for unattended operation, allowing drivers to self-fill their cars just as they would do at any gasoline fueling station. Unattended operation will serve as a model for the installation of private stations throughout the state.

Said General Motors’ Hawai‘i Site Leader Chris Colquitt,

> “We have been really impressed with the fill speed and control algorithms of the hydrogen station at MCBH. It is exciting to experience consistent 4-minute 700 bar fills. I am confident the Department of Defense (DoD) drivers of the FCEVs will be delighted as well.”

The algorithms to control flow have done a really good job of ensuring tank temperature thresholds are maintained without stopping fills before completion. On top of all that, the station and site aesthetic came out really well."

Added HNEI Director Richard Rocheleau:

> "We are excited that the MCBH hydrogen station is now servicing Fast Fills by the drivers without an attendant – a first in Hawai‘i. We are also pleased that General Motors is satisfied with the performance of the station. We hope that our research efforts will help accelerate the deployment of hydrogen stations throughout Hawai‘i as it contributes to the DoD's energy goals."

The fuel cells in these vehicles work by using hydrogen to create electricity that is then used to power an electric motor. The only emission is water. Successful hydrogen fueling operations here will help identify zero emission sustainable transportation solutions. The development of fuel cell and hydrogen technology has been part of the U.S. Department of Energy (US DOE) portfolio since 1986. UH Mānoa and HNEI have been part of that program since its inception.

A major challenge for hydrogen production and dispensing stations is the cost of hydrogen at the nozzle. In this project, HNEI is conducting research to assess the technical performance and economic value of an electrolyzer-based hydrogen production system in a 350/700 bar Fast-Fill (under 5 minutes) fueling station. The technical analysis will include component efficiencies under various operating scenarios and the long-term durability of major components.

The economic analysis will determine the daily operating cost of the station and the overall cost benefits of producing hydrogen. The dual fill pressure capability will allow this station to service both light duty vehicles that have largely been designed to use high pressure (700 bar) hydrogen storage and larger fleet vehicles such as buses which usually are designed for lower pressure (350 bar).

The MCBH Fast-Fill hydrogen station is part of the Hawai‘i Hydrogen Power Park project established by HNEI to support the US DOE's Technology Validation Program. The initial funding from the US DOE Fuel Cell Technology Office was used to procure the electrolyzer and a low-pressure fueling capability.

Additional funding was received from the Office of Naval Research to expand the capability to include the 700 bar Fast Fill to support the Equinox FCEV demonstration at MCBH on O‘ahu. The State of Hawai‘i also provided funding that was used for project management and the installation of equipment.

The project has received funding support from the US DOE, the State of Hawai‘i and the Office of Naval Research.

The race to make diesel engines run on hydrogen

https://www.bbc.com/news/business-64248564

By Phil Mercer
BBC News, Sydney

It's a new hydrogen-diesel hybrid engine affectionately known as "baby number two" that could help to decarbonise some of Australia's heaviest industries.

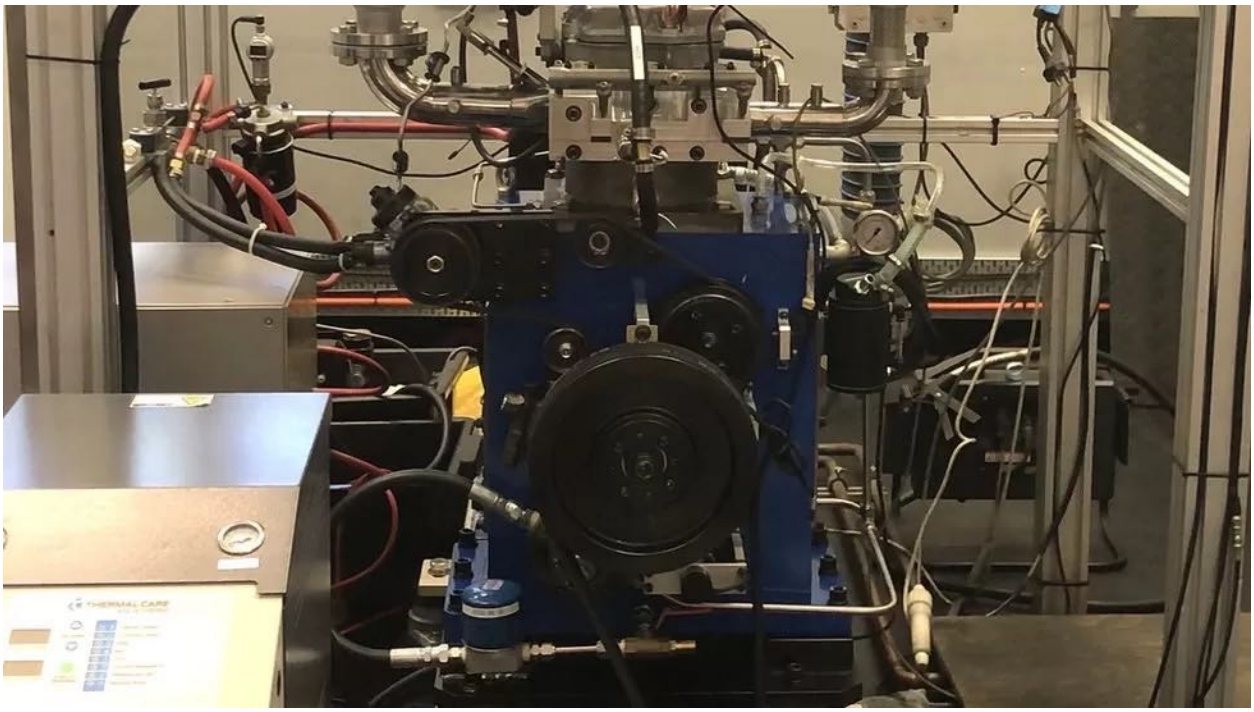
The test rig is large - it has its own room adjoining a lab and looks at first glance like many other large motors, but beneath its metallic skin could lie game-changing technology.

Engineers at the University of New South Wales (UNSW) say they have successfully modified a conventional diesel engine to use a mix of hydrogen and a small amount of diesel, claiming their patented technology has cut carbon dioxide (CO_2) emissions by more than 85%.

It's the work of Prof Shawn Kook and his team at the university's School of Mechanical and Manufacturing Engineering.

"The interest in converting an existing diesel engine into a clean-burning hydrogen engine is extremely high," Prof Kook tells the BBC at his laboratory in Sydney. Enquiries have come from Germany, South Africa, Brazil, Japan and China.

"We mount the hydrogen direct injection system into existing diesel engines, which can be applied to any conventional engine," he adds.



It's an ordinary diesel engine but runs on 90% hydrogen

What makes their system unique, according to Prof Kook, is the way it mixes the hydrogen and diesel and then introduces it to the engine cylinder for combustion.

Unlike fossil fuels, hydrogen does not produce CO2 when burnt, so it has long been seen as a greener fuel source.

About 90% of fuel in the UNSW hybrid diesel engine is hydrogen but it must be applied in a carefully calibrated way.

If the hydrogen is not introduced into the fuel mix at the right moment "it will create something that is explosive that will burn out the whole system," Prof Kook explains.

He says that studies have shown that controlling the mixture of hydrogen and air inside the cylinder of the engine can help negate harmful nitrogen oxide emissions, which have been an obstacle to the commercialisation of hydrogen motors.

The Sydney research team believes that any diesel trucks and power equipment in the mining, transportation and agriculture sectors could be retrofitted with the new hybrid system in just a couple of months.

Prof Kook doubts the hybrid would be of much interest in the car industry though, where electric and hybrid vehicles are already advanced and replacing diesel cars.

However, he says Australia's multibillion-dollar mining industry needs a solution for all its diesel-powered equipment as soon as possible.

"We have so many established diesel-powered generators, mega-trucks and underground machines. How do we decarbonise all those existing diesel engines? One way is to shut down everything and get new technology in, which will take decades," he says.

The plan is for the hybrid to run off a hydrogen-diesel mix or, in the absence of hydrogen, it can revert to diesel only.

Prof Kook hopes his new generation engine will become a commercial product within two years.

Tim Buckley, the director at Climate Energy Finance, a public interest think-tank in Sydney, believes the technology has the potential to "transform the Australian mining industry dramatically".

"There's always an element of scepticism in the work I do to evaluate what is hype and hope as opposed to reality. Having said that, this University of New South Wales breakthrough does appear to be pretty material. If they can pull it off it is a huge opportunity," he says.

The Australian team is in a global race to develop hybrid diesel-hydrogen engines. Engineers in other countries are working on their concepts and designs but the Sydney team believes it has an edge.

"I think we have a breakthrough compared to most other research groups in the world where we can actually achieve a higher percentage using hydrogen over diesel," explains Xinyu Liu, a UNSW PhD student from China.

"Emission-wise, CO2-wise we can achieve a higher reduction than the other methods. The concept has been proven using the previous small-scale engine. We are trying to implement this idea into a larger scale, which is more [applicable] to industry."

The bigger version, or the UNSW's "baby number two", has twice the volume of the original prototype and has the potential for a "massive reduction in CO2" emissions, according to Prof Kook.

The vision is laid out in a paper published in the International Journal of Hydrogen Energy.

https://www.sciencedirect.com/science/article/abs/pii/S0360319922036771?via%3Dihub

Much of the invention's impact on the environment will depend on where the hydrogen comes from.

While small amounts of hydrogen are being extracted directly from the ground, most hydrogen is manufactured, in a process that emits CO2.

Green hydrogen, produced by using electricity from renewable power to split water into hydrogen and oxygen molecules using an electrolyser, is seen as the answer. But the technology and the electricity needed is costly, so at the moment only a small amount of hydrogen is produced this way.

But the costs are likely to come down and with abundant sunshine and wind, Australia has a lot of potential to produce renewable electricity, which could one day be used to make more green hydrogen.

The Climate Council, an independent organisation, believes that sustainable hydrogen gives Australia the chance to end its reliance on fossil fuels.

"Australia is one of the world's largest coal exporters and the largest liquefied gas exporter," the Council wrote in a 2021 briefing. "Both are polluting fossil fuels, and Australia is paying a high cost for that with more severe and frequent extreme weather events like bushfires, heatwaves, and drought."

For now, the UNSW project remains in the nursery in the laboratory. Academic endeavour needs the financial heft of outside investment and the hands-on input and knowledge of a mining company or engine manufacturer.

"Our vision is to impact Australian mining, agriculture and construction industries first and then move out to the rest of the world to make a bigger impact," says Prof Kook.

Australia has some of the world's biggest resources companies and they have all committed to aggressive decarbonisation targets. Technology is the key.

"The idea of blending hydrogen and diesel together in an existing engine is something of a Holy Grail for decarbonising heavy industry and mining," adds Tim Buckley.

He has this existential question for the engineers at UNSW: "Can they actually deploy it in a commercial setting and replicate it outside the university?"