Methane Code Red

by Ed Averill, a retired engineer, adamant climate activist. And Oregonian.

Foreword:

I believe the message we got from UN Secretary General, Antonio Guterres on August 9 is something extremely important. My impression is that many of the scientists that contributed to the message also believe that, and are ever more switching from scientists to activists with prayers tha people will hear. How can we live through very frequent climate/weather drama without knowing how important it is. How can we not know that the planet will keep getting worse, if we don't start treating it better. We know that fossil fuels are what we did wrong. We also have made it harder for every living thing to help repair the problem.

But why is it that we've come to points like this and get handed the message, and most of us put it in the waste basket and walk away?

I don't know. I can't walk away without screaming. Here's my scream: Not only did Exxon know, and not only do all the fossil fuel vendors know, and now gzillions of scientists know. But, there's no excuse for people regulating the very industries destroying the place from not knowing. Please get the message!

Here is my message that this doesn't have to go down in flames. There are people who do get the message. When the scientists tell us what the path should be to get some safety room, we should say; "Thank you sir/madam, I will try to do it."

This is my interpretation of Antonio Guterres' message, with some explanation:

In Oregon our legislators recently passed HB 2021 which calls for steady growth in clean energy from regulated public utilities. Perhaps it is not widely recognized that the basic commitments in this bill were decided and released by an energy utility 3 months before the 2021 session opened in Salem. This could indicate the onset of an encouraging trend toward self-regulation for the common good, assuring long term investment commitments for investor-owned utilities.

Natural Gas can contribute in similar ways by targeting IPCC science with their skill sets after leaving methane behind. We will return to this in our concluding remarks after describing the problems and opportunities we are confronting.

On August 9, 2021, the UN released the 6th major climate assessment[1]and it was declared by the [2]UN Secretary General, Antonio Guterres to be **"Code Red for Humanity "**. "The alarm bells are deafening, and the evidence is irrefutable: greenhouse-gas emissions from fossil-fuel burning and deforestation are **choking our planet and putting billions of people at immediate risk. Methane spills across the planet.** Global heating is affecting every region on Earth, with **many of the changes becoming ever harder to reverse"**

1 **AR6 Climate Change 2021:** https://www.ipcc.ch/report/ar6/wg1/
2 **IPCC Climate Report 'Code Red for Humanity':** https://www.un.org/press/en/2021/sgsm20847.doc.htm

A Brief Statement of Climate Change:

The problem of climate change is one of capturing too much of the heat of the earth's sunlight instead of bouncing it into space. The primary cause of the problem has been putting too many greenhouse gasses in our atmosphere, which allow the light in, but not out. The primary source of these greenhouse gases has been fossil fuels. At the moment, about ¾ of the extra heat capture is due to CO2. About ¼ of the excess heat is from methane. (Note, this is not the CO2 that results from burning methane, but leaked, raw, methane. The amount of methane in the atmosphere looks like this:

How bad is the situation?:

"The internationally agreed threshold of 1.5°C temperature increase is perilously close. We are at imminent risk of hitting 1.5°C in the near term (ballpark 2030 to 2035). The only way to prevent exceeding this threshold is by **urgently stepping up our efforts and pursuing the most ambitious path.**"

There is dramatic increase of releases of methane, much tied to the oil and gas industries, of both factory farming, and the release of arctic methane from permafrost.

One quarter of all current global warming of the planet is attributed to fossil methane. In order to keep below 1.5 degrees C, it would be necessary to remove both **half of the leaked fossil methane[3],** and **half of the emitted carbon dioxide.** Otherwise we will hit 2 degrees C in the mid 2030s or even in the next 5 years.

Consider that the massively bad weather we are now confronting has changed dramatically from the time we were at about 1 degree C above industrialization. We are now at about 1.25 degrees. We don't want to see more than the next 0.25 degrees (reaching 1.5 degrees), definitely not 0.75 degrees (reaching 2.0 degrees).

Most of these background items I moved to an Appendix. Here's one for context [4] There have been major decreases in phytoplankton, thus reducing a whole chain of higher organisms supporting ocean ecosystems. The phytoplankton has been one of the major sources of oxygen from consumed and sequestered CO2.
The result is

1. lessened ability to defend against CO2 and
2. a decreasing amount of O2 in the water,
3. some of which used to be supplied to the air, as well.

Fighting back with all we can:
With all these growing consequences we need a way to fight back. Methane is an important answer. Methane as a fuel contributes nothing that green energy cannot do better for. But by stepping aside, it can hit hard with the magic of Methane Half-Life!

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3 Mitigation Pathways Compatible with 1.5°C
https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

4 Phytoplankton Population Drops 40 Percent Since 1950: https://www.scientificamerican.com/article/phytoplankton-population/

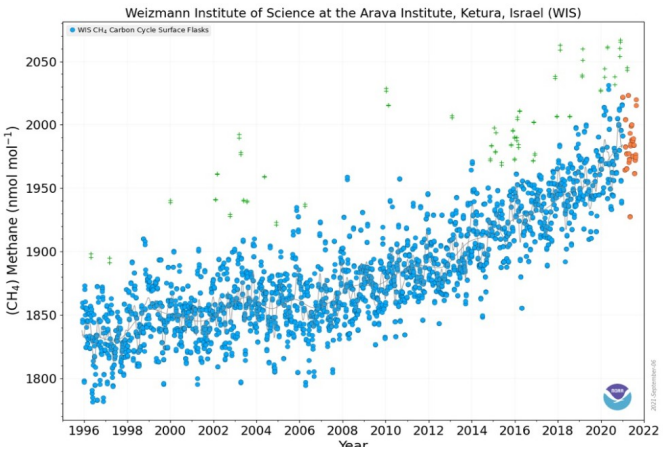
Getting the message:
This message wasn't heard well as people got their mail from the IPCC, even though it was highlighted. **"Code Red"**

Part of why Oregon failed to hear the message is that **we have treated Governor Browns executive order as the source of all definition of our climate plan.** This is an important part of why any such instructions should be tied to our changing understandings of the science.

To rub that point in, we have learned that climate change **HAS** fallen off a **Tipping Point. We need to bring best available science to tipping points,** so we must understand our rules in the context of needing to address newly understood issues well enough to bring **best available science to every one that comes along.**

Short Term Greenhouse Gas – A special magic.
[5] **In a new move, scientists emphasized how cutting airborne levels of methane — a powerful but short-lived gas that has soared to record levels — could help curb short-term warming.** Lots of methane the atmosphere comes from leaks of natural gas from oil and gas well – both in production and abandoned wells, which are major sources. Thats bad news.

The importance of methane being a short-term greenhouse gas is realize we can take advantage of it's half-life, which happens to be 11 years for methane in our air. That's the good news. We haven't had much opportunity to see casual representations of its half life because we always get shown [Fig 1]. Just concentration levels and the rate of leakage of methane has been (1) great and (2) ever-increasing. Thus when you look at the concentration of methane on a graph, it looks a lot like the CO2 Keeling Curve because current additions overpower current decay.



But, if we tackle methane correctly, we will be blessed with a great surprise relief. [In Figure 2.] If we were to quit using and leaking and otherwise emitting methane overnight, and then watch the graph, it would be a curve that drops quickly at the beginning, though slowing as it gets closer and closer to zero. [This is important enough for some more word walk thru of how it gives us a saving opportunity of importance.]

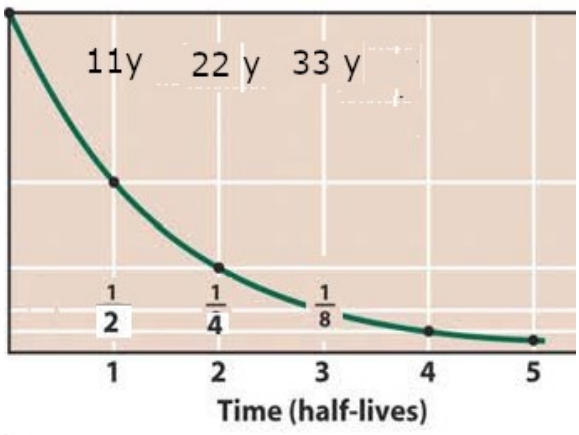


Figure 2: Showing the first few half-lives of methane's decay

5 **'Code red': UN scientists warn of worsening global wa**
https://apnews.com/article/asia-pacific-latin-america-mid
1d89d5183583718ad4ad311fa2ee7d83

Our key opportunity to control methane sources is to stop it at the source, and thereby enable the methane in the atmosphere to only expose the decay of it's half life to naturally reduce its forced heating. This rate of "cooling" is quite amazing compared to CO2 capture.

The half-life for methane in our atmosphere is about
11 years. Ozone and ultraviolet light combine to remove the hydrogen from CH3 and add 2 Oxygen making it our old familiar CO2, which is about 100 times less potent. Engineers take "5 to 7 half-lives of decay" to be equivalent to effectively "decayed to zero".

So, putting the methane half-life picture next to now, we can see what would happen if all the gas taps were turned off tomorrow: The total heating would actually drop as the methane decreases according to its half-life. By targeting methane early we get early cooling to help keep us under 1.5 degrees C of rise! This savings grows until the methane is gone, after which we will be stuck at the level of heating in the CO2.

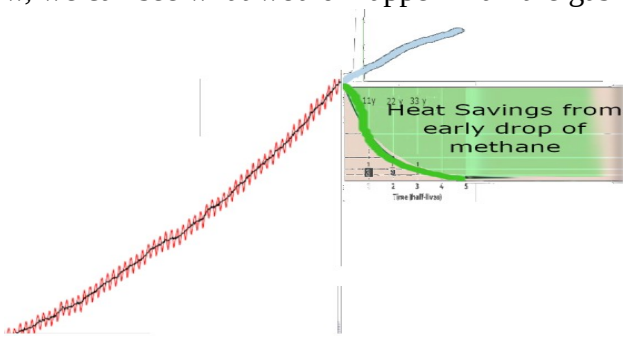


Figure 3: Allowing the sum of CO2 and Methane to be added then turning off the leakage of Methane.

[6]**New space-based monitoring of greenhouse gases** has started and will strengthen during the next year. We will be able to track methane better starting in 2022. [Reference to Satelites info]

This way of getting a quick easing of the overheating is a big opportunity.

Beyond Methane.

There are good solutions for building heating, cooking, etc., that are not carbon fuels. Much of the solutions have to do with moving to electrification. See the Appendix for some discussions about them.

What's the big deal?

1. We are in the process of losing all frozen water around the world. While we anticipated this tipping point was approaching, it wasn't expected to hit so soon, or so fast.
2. Everywhere that there has been standing snow and ice, the bright whiteness ("albedo") of the surface returned about 80% to 90% of the sun's heat to outer space. As that has moved to dirty snow, then to uncovered dirt, and over water, to depths of water, that reflection percentage gets as low as 5%.

This has the effect of adding more greenhouse gasses to the atmosphere. It amplifies the greenhouse warming problem, and will continue amplifying it until all the ice has turned to water.

6 **Control methane to slow global warming — fast:** https://www.nature.com/articles/d41586-021-02287-y

In order to compensate for that, we would need to not only stop emitting greenhouse gases, but to put them to lower levels than they before the industrial revolution – until the ice returns because of a cooling earth. That might be done by growing massive massive new forests on land and kelp forests in the oceans.

In Conclusion.

Methane has it's greatest use at the moment by going out of use. When it does that, it gives a powerful leverage to reduction in greenhouse gases. It also exposes new opportunities that should be seriously considered for similar use to methane. And Green Hydrogen should feel very comfortable with the methane industry.

This issue is of such high leverage that it deserves to be treated with extremely high urgency. Please understand what an urgent change in direction this should be for the world.

Appendix

Other things to think about.

Social Cost of Carbon:

Some ask what yet another ton of carbon in the atmosphere is worth on a dollar basis because people think investments will be made on linear time-money assumptions. In simple cases, if the next ton of carbon is just one of many, and we haven't yet hit tipping points, we might figure out the cost of reversing that small effect. If, however, it is the one that erases the last ice on the planet, and such an event will cause other tipping points to follow like dominoes, with the possibility little life will be left, **then no monetary accounting will determine the value of that ton of carbon**, as there will (maybe after a slow eventuality) nobody left to care.

Many people are comforted by trying to assess the social cost of carbon. There are people who really want to know how much the carbon eraser costs for each ton of carbon in the atmosphere. Here is a reference to what may be the most complex accounting of this kind, **as it attempts to include tipping points.**[7] **Follow the footnote if you care.** **I want you to care if you can use that to show an IRP cannot afford that Social Cost of Carbon**

The Tipping Point of No permanent Ice on Earth

Heat Waves ("Domes") **and floods from jet stream behavior are a hot topic for both deaths and property damage:** Increasing wobbliness of the northern jet stream has produced massive heatwaves and floods in alternation, **sometimes killing hundreds and hundreds of people**. This problem comes from a tipping point that may be permanent, though there are geoengineering suggestions for trying to slow or reverse it. Paul Beckwith a Canadian climate scientist is very good at finding the tools and words to explain that the troughs and peaks represent displaced cold from the north or displaced heat from the south with associated moisture and flood possibilities.[8] Current heat waves produce "too hot" temperatures.[9] [Note to self: Keep the "Geoengineering" subject for later with Albedo.]

Losing all Natural Ice on Earth: The arctic climate has changed dramatically, resulting in the **rapid disappearance of much of the ice, both on permafrost and at sea.** Scientists say this change in the arctic is the cause of the wobbly or wavy pattern of the northern jet stream. It comes from the heating of the arctic – and now by the arctic.

The **change in albedo is dramatic**, [albedo is the reflective capability of surfaces. Bright white snow reflects about 80% to 90% of the light and heat of sunshine. Exposed land is lower reflectivity, and exposed water is all the way down to 5%.] and because that change in albedo **now increases the**

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7 David Roberts on The Social Cost of Carbon in the face of tipping points: https://www.worldbank.org/en/topic/climatechange/brief/short-lived-climate-pollutants

8 **Paul Beckwith showing wavy jet stream** with projections of cold from the north and heat from the south: https://youtu.be/eeYZOVu0uUU?t=302

9 How hot is too hot for the human body**?** https://www.technologyreview.com/2021/07/10/1028172/climate-change-human-body-extreme-heat-survival/

capture of heat for global warming of the northern latitudes, it would require **removal** of a much higher amount of heat to actually return the climate of the north to what it used to be.

We will be working to remove the higher rate of heating now occurring in the darker arctic's heat capture.
There is no natural pattern shorter than multiple lifetimes of current humans that would be expected to make such a repair. Unless there is an amazing human intervention well beyond (but absolutely including) elimination of emissions of greenhouse gases. It is clearly true [and should be footnoted] that the melting of the Arctic Ice is part of a world-wide loss of ice that will eventually remove all standing ice on the planet.
The result includes:

1. The wavy jet streams and the resulting sudden extreme changes in temperature where they wander.
2. The loss of ice mentioned above that represents
    1. a major source of stored and released water across summer seasons
    2. a loss of local temperature stability.
    3. a significant tipping up of global heat because the loss of ice will remove the protective heat reflection it has provided for thousands of years. Thus, the stable temperature for the earth will be notably higher.

Land effects of Heat Waves and Cold Waves and Flooding:

[10] H**eat waves** have been responsible for fires on the west coast of North America from the southern reaches of California to the regions of British Columbia. Lots of video and stories available. Siberia has had forest fires burning year-round for over 2 years now. These fires release major amounts of CO2 and put the lie to many carbon credits issued on what was believed to be sequestered carbon.

Flooding has been major in Europe, and eastern areas of North America.[11]

Ocean effects of Heat Waves and Cold Waves:

Tropical climate has also changed dramatically and will continue to do so as long as we continue to lose ice reflection where

1. areas in the tropical band that stretches either side of the equator risk changing into a new environment that will hit "the limit of human adaptation", the study warns
2. has moved temperatures near the equator **above what humans can tolerate without shelter,** while at the same time drying the soil and slowing the rivers such that water is growing scarce where it was not a few years ago, **resulting in "desertification"**.
3. [[12]] This added heat and dryness will make it more difficult to capture carbon with forests and other land plants.
4. [Extreme Temperature Change] in the water, the increase in temperatures has started **killing the ecosystems near the equator (**remember, the arctic ecosystem is replaced with

10 Heat Wave smothers much of West Coast in triple-degree temperatures
https://www.washingtonpost.com/nation/2021/07/10/heat-wave-california-arizona-nevada/
11 2021 European floods: https://en.wikipedia.org/wiki/2021_European_floods
12As Climate Warms, Plants Will Absorb Less CO_2, Study Finds
https://www.nytimes.com/2019/01/23/climate/plants-co2-climate-change.html

migrations from the south)**. We already were aware of the heavy damage to coral reefs, and therefore to the fish that were supported by those ecosystems**.

5. [Near Equator] It is being noticed that there is **a separation developing between the northern oceans and southern oceans** that lowers the resilience of those (now traveling) ecosystems because they can no longer interact or retreat across the equator in two direction to more temperate waters. Equatorial ecosystems will depend on migrating only north from above the equator, or only south from below the equator.
6. **[Temperate Waters for Kelp Forests] temperate waters were a major source of ecosystems that depended on kelp forests and similar patterns of large plant areas required for their major ecosystems. Many of these features are already migrated or missing, and research needs to continue on how to restore them.**

Is there value in saving methane ("Natural" gas) as a business for any length of time?

The chance for such a trend with methane-dependent utilities appears slim after the California Energy Commission report on the future of natural gas, April 2020. The unavoidable costs associated with maintaining aging infrastructure and the unpredictable cost of fuel seem unique to natural gas utilities as compared with energy supply from renewable electricity infrastructure. https://www.energy.ca.gov/sites/default/files/2021-06/CEC-500-2019-055-F.pdf Please note that any fuel as energy source, and especially one with the costs of greenhouse gases is never likely to compete well against non-fuel energy drawn directly out of nature's energy sources.

Future business in fluids supporting green energy jobs.

Even after electrification as a major strategy for greening our energy system, and eliminating carbon fuels entirely, there is a future in using liquid and gaseous fluids to store and transport energy in important uses, and that the Natural Gas industry would be capable of moving to the roles that would support these new needs.

This is very different from CO2, which could stay in the atmosphere for centuries UNLESS it is captured by something like plants, trees, phytoplankton (small ocean plants), etc. Because we have damaged our ecosystem SO MUCH, this ability to capture CO2 is very hobbled. It must be repaired and used heavily, but even when repaired, won't give us the fast half-life early relief of the methane.

Thus, we have a great opportunity to give our war against greenhouse gases a boost by concentrating on getting rid of all generation or leakage of methane – and quickly. The UN IPCC says get rid of at least half of it by 2030, but if you look at the half-life issue, it should motivate aggressive removal of all under human control.

Requirements for Oil and Gas and Coal reduction of use and emission control.
Since extraction of oil and gas come from mixed beds of both of them, efforts to extract oil also extract gas and visa versa. This may be unintended, but unavoidable. That gas must not be released into the atmosphere to be a greenhouse gas.

Because there are abandoned wells for both oil and gas, and those wells often leak methane, there is a need to prevent those leaks. The prevention can either be containment, or burning to reduce it to carbon dioxide, or shipping it through the pipelines for useful burning. In any case, leaked methane is a problem that must be avoided.

Opportunities for Geoengineering – And why those should be in addition to moving beyond carbon fuels.

There are many suggestions, and many of them may turn out to have utility, but when you look at the issues of geoengineering, there are two big issues:

1) **Opportunities**

The major opportunity we have discussed is restoring the problem of loss of ice, and therefor heat reflection.

2) **Risks**

Most proposals for geoengineering have put foreign chemicals into our ecosystem, and hoped the negative consequences won't be too bad.

Paul Beckwith's team's proposal for countering Melting ICE Tipping Point:

Paul is studying this subject with a team and other teams are doing so separately. The point of his activity is similar, but different to the Sulfer Dioxide (SO2) idea that others have proposed, but by using sprays of seawater, he believes he will get dramatic effect without putting acid into the air, which would have significant side effects.

The process creates a mist of seawater in the air over the ocean at sunset. Natural heat inversion after sundown produces an updraft that carries a carefully crafted seaspray into the high atmosphere, leaving small crystals of sea salt. In the morning sunlight, a new updraft brings moisture into this high atmosphere, which upon finding the specs of sea salt would form small – and therefore very brightly reflective drops in clouds.

The first point of this is to create more white clouds than nature does, typically, and thus reflecting sunlight back into space. This is a pretty well understood anti-greenhouse gas effect, but one that doesn't get talked about very much because it hasn't typically varied from a normal pattern. Thus, modeling it has seemed simple and unimportant until you think of changing the amount of clouds – and their whiteness (albedo) dramatically.

Secondarily, if these clouds are in air that is below freezing, they turn into very white snow clouds. So, in the arctic you can get both chilling, and snow from the same action. If the ground or water is chilled, adequately, there can be an accumulation of snow. Simply covering the permafrost and eventually, the ocean with white snow immediately repairs it's old albedo such that we no longer get excess heating from the loss of snow/ice cover.

The "Cloud Brightening" topic is important so that we understand that we **HAVE HIT THE FIRST BIG TIPPING POINT: Melting Ice.** Eliminating fossil greenhouse gases is part of recovery, but not sufficient. Something like Cloud Brightening might be part of getting a sufficient answer.

New life for "Natural Gas Utilities" supplying non-methane energy gases, and maybe ground source water.

There are significant reasons for why methane is a danger that negates its energy benefits. And, in the end, for many uses, the right answer is to move to electrification of both things that can be done with motors and batteries or grid power. One of these things is to take advantage of the important cleanliness efficiencies of electric HVAC.

HVAC can amplify heat energy by approximately a factor of 4x (twice as efficient as air sourced) using reverse air conditioning with ground sources stored energy. Ground sourcing summer air conditioning brings similar efficiency and few alternatives are able to be more cost effective.

Making high-efficiency heat pumps our national / state standard.
Natural Gas has required an industry to make wells and piping a common practice. In the process of electrifying building heating there is still a need for piping and liquids that should not be ignored.

Air source heat pumps are more efficient than using electricity directly for heating, and does include cooling in the mix. Using a heat reservoir drops the delta temperature by half reducing the energy requirement. Without the reservoir, the process wastes half of it's energy. This huge energy inefficiency should not be accepted. There is an extra cost for such wells, but the process of inserting these wells has been standardized in a way that makes them affordable. As with Electric Vehicles, an extra cost of purchase can be quickly amortized. If we standardize on a process that makes these wells the normal standard for both new construction and retrofits, we will gain huge benefits, and it can become a part of the business of what were Natural Gas utilities.

Supplying non-methane energy gases

However, using gases to store very large amounts of energy does have value as a highly efficient battery effect. Two specific examples seem worthy of the attention of people doing Natural Gas work in these times:

1. **Green Hydrogen** (Not Blue Hydrogen that depends on fossil fuel sources).
    1. The idea is that when Electric Utilities try to assure continuous supply of energy across dark weather and pauses of wind, they need storage of energy. Today, part of that storage is provided by underground storage of large amounts of methane – allowing Natural Gas turbines to be a supply of electricity during the green-energy droughts.
    2. By over-buying green energy supplies, and using electrolysis, H2 hydrogen can be produced for storage when the electricity supply does have excess energy. Such H2 can be compressed and stored. However it cannot be easily piped across any distance, and it's qualities don't match up well with turbines that currently use methane.

2. **Ammonia**
    1. Hydrogen can be morphed into other forms. Since the point of this essay is to move the world beyond methane, I simply say having more methane to leak is not my idea of a good direction. But, there are more possibilities.
    2. Ammonia has been suggested as a fuel, and is particularly being studied for use with current ships and their current engines. The idea that a non-carbon fuel is so easily used in existing machinery seems worth investigating. Ammonia, while a gas at standard atmospheric pressure, is easily compressed into a liquid with similar energy density to gasoline.
    3. Ammonia is poisonous if allowed to leak in high concentrations into the air, so it doesn't seem highly attractive to handle too freely, but it is much more easily contained in steel containers than even methane. And, it has been suggested that current "peaker turbines" meant for natural gas could continue their preventing the electric grid from running out of energy during the droughts of green sources.

    4. Stranding of methane infrastructure can be partially avoided, and long-term jobs can be saved by recognizing the value of gas-fed peaker plants used to stabilize the electricity grid. Hydrogen and ammonia-fed electric generators can stand in for natural gas turbines, with effectively zero carbon intensity from fuel. Hydrogen-driven gas turbine demonstrations have been accomplished with a technology readiness level of 7 as of last year. Ammonia-to-power is slightly lagging. https://www.powermag.com/worlds-first-integrated-hydrogen-power-to-power-demonstration-launched/