UT LAW CLE THE UNIVERSITY OF TEXAS SCHOOL OF LAW

PRESENTED AT

2020 Hot Topics in Gas and Power Studio Webcast

December 11, 2020
Studio Webcast

HYDROGEN – HOW DOES IT FIT WITHIN CURRENT TRADING STRUCTURES?

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Energy markets worldwide are undergoing a rapid transformation. Where electricity generation and motor fuels had been staid for generations, within a relatively short period, we have witnessed a radical transformation in how we view energy in our lives. This trend shows no signs of slowing as countries and cultures globally shift to a lower carbon future.

Much of this transformation is occurring due to the retirement of coal, fuel oil and natural gas power generation facilities in favor of wind and solar power generation. While this trend continues to build, with global renewable power generation poised to surpass coal power generation by 202[ ],[1] a trend that is getting less attention is the shift to hydrogen as a power generation and motor fuel.

This paper will examine this trend from the perspective of the energy trading sector. We will first review how hydrogen compares to fossil fuels and renewable power generation, the basic elements of its use and current plans to use it worldwide. This paper will then shift to consider how hydrogen will fit into existing energy trading contract structures and issues that may arise from hydrogen that are different from issues experienced with other fuels.

I. Hydrogen As A Fuel

Hydrogen is a very attractive element to use for industrial purposes. It is the most abundant element in the universe,[2] incredibly abundant in the atmosphere, it bonds easily to a wide range of other elements and compounds,[3] and it is relatively easy to separate from molecules using electric, industrial or chemical processes.[4] Because it is part of a large number of carbon compounds, hydrogen is present in all animal and vegetable tissue.[5] Hydrogen has been used for decades to produce ammonia (when added to nitrogen, providing most of the fertilizer used globally), margarine (when added to unsaturated fats and oils), and methanol (when added to carbon dioxide).[6] It is commonly used as an industrial coolant because of its low density, low viscosity, and the highest specific heat and thermal conductivity of all gases.[7] Its affinity to bond with other elements is what makes it so attractive from a pollution standpoint, as when

[1] Add cite

[2] Hydrogen comprises approximately 75% of the baryonic mass in the universe. https://en.wikipedia.org/wiki/Hydrogen#:~:text=Hydrogen%20is%20the%20chemical%20element,75%25%20of%20all%20baryonic%20mass.

[3] This includes water, and in that form it covers more than 70% of the Earth. Id.

[4] *Id.*

[5] https://www.britannica.com/science/hydrogen.

[6] https://en.wikipedia.org/wiki/Hydrogen#:~:text=Hydrogen%20is%20the%20chemical%20element,75%25%20of%20all%20baryonic%20mass.

[7] *Id.*

it is released into the atmosphere it bonds with oxygen to form water and, if combusted, a small amount of nitrogen oxide.[8] However, its affinity to form bonds with other substances causes it to almost never exist in other than molecular form.[9]

Hydrogen is not a source of energy, as are fossil fuels, but is a very efficient carrier of energy.[10] The energy can be released in a combustion process but is even more efficient when used with a fuel cell.[11] A fuel cell used with an electric motor is two to three times more efficient than an internal combustion engine running on gasoline.[12]

Hydrogen has been contemplated as a motor fuel for decades, primarily because of its relatively dense energy content and its lack of polluting emissions.

Given the wide range of means by which hydrogen may be formed, there are presently three classifications of hydrogen based on the environmental attributes of its creation. Green hydrogen is produced using electricity generated entirely from renewable sources. Grey hydrogen is produced using fossil fuels. Blue hydrogen is produced using natural gas, potentially sourced from biogas, with the carbon emissions stored underground. Grey hydrogen is the cheapest to produce and forms 95% of present produced volumes,[13] and green hydrogen is not projected to be cost-competitive until 2045.[14] In a sign of the movement of hydrogen into the commodity mainstream, Platts began publishing a price assessment in December 2019 for the U.S. and Europe.[15]

There are a large number of projects that have recently been announced. These include San Diego Gas & Electric and Mitsubishi Power Americas separately planning green hydrogen storage facilities and the Intermountain Power Agency building a power generation plant using the Mitsubishi green hydrogen storage that would then be sold to the Los Angeles Department of Water and Power,[16] Australia building green hydrogen export hubs for trade with Korea and Japan,[17] JERA announcing it would co-fire its thermal plants with ammonia starting in 2040 and with hydrogen 2050,[18] Fortress Transportation and Infrastructure and GE Power announcing the Long Ridge Energy Terminal transitioning its 485-MW combined-cycle power plant in Ohio to run on a blend of natural gas and hydrogen by November 2021 and to burn 100% green hydrogen by 2030,[19] Lavo Hydrogen Technology Ltd. announcing the rollout in Australia of residential and commercial solar/fuel cell units using hydrogen for the energy storage,[20] the

[8] In Greek, "hydrogen" means "water former". *Id.* Because hydrogen has no carbon compounds it does not produce pollutants associated with carbon-based fuels such as fossil fuels. https://www.livescience.com/28466-hydrogen.html

[9] *Id.*

[10] *Id.*

[11] *Id.*

[12] https://afdc.energy.gov/fuels/hydrogen_basics.html.

[13] These CO2 emissions are equal to the combined annual CO2 emissions of the UK and Indonesia. Gas Daily, October 15, 2020.

[14] Gas Daily, September 2, 2020.

[15] Gas Daily, October 12, 2020.

[16] *Id.*

[17] *Id.*

[18] Gas Daily, October 12, 2020.

[19] Gas Daily, October 14, 2020.

[20] This system will be able to store approximately three times the energy of a Tesla Powerwall battery. EnergyWire, published by Environment & Energy Publishing, LLC, October 20,2020.

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First appeared as part of the conference materials for the
2020 Hot Topics in Gas and Power session
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