Case #8. Green, Blue and Pink Hydrogen Seek Government Funding and Support

Hydrogen in the UK

In August 2021, the UK government published its first hydrogen strategy, aimed at helping to slash carbon emissions from a range of industries, the 12th country to release a hydrogen strategy. It called for 5gw of low-carbon hydrogen-production capacity by 2030—enough for around 2% of current energy demand. In April the government doubled that goal.

The strategy implied that UK taxpayers could subsidize the production of "low carbon" hydrogen to make it as cheap as natural gas. In order to persuade UK companies to switch away from fossil fuels, the UK government launched a dialogue with companies in target industries on how to bridge the gap between the high costs of producing low carbon hydrogen and an affordable purchase price for industries currently reliant on cheaper fossil fuels. The UK government will set a standard for low carbon hydrogen and subsidize projects that emit less than a set level of carbon dioxide per unit of hydrogen.

One key question posed by the **UK Department for Business, Energy and Industrial Strategy** is whether subsidies should be met out of general taxation or via surcharges on household energy bills.

Some energy experts view hydrogen as a key means to decarbonize industrial sectors such as aviation for which there are few other easy climate solutions. But environmental experts and academics have warned hydrogen is being "overhyped," particularly the potential of what is known as "blue hydrogen," a production method, which uses natural gas as a feedstock and carbon capture utilization and storage (CCUS) technology to sequester carbon.

The UK government goal is sufficient blue hydrogen production capacity by 2030 to power as many as 3 million homes a year, although the electricity will be used in target industrial sectors. The UK government says it will take a "twin track approach to supporting multiple technologies including 'green' electrolytic and 'blue' carbon capture-enabled hydrogen production."

Green vs. Blue Hydrogen

(Appendix A outlines the differences between green and blue hydrogen.)

The debate over green vs. blue hydrogen is worldwide, **but also includes other "colored" hydrogen, e.g., "pink" hydrogen from nuclear power.**

In the UK, the **Nuclear Industry Council (NIC)** and **Nuclear Industry Association (NIA)** published a roadmap outlining how the UK could co-locate electrolysis at 12-13GW (gigawatts 1 billion watts) of nuclear reactors. This commitment could enable the production of 75TWh (75 trillion (terawatt) hours) of "pink" hydrogen by 2050, the bodies claim. The groups are calling for more R&D funding, higher carbon pricing and new financing models to help bring the cost of "pink" hydrogen down to a parity with fossil-based hydrogen, which currently represents more than 95% of global annual production. **Hydrogen generated from fossil fuels, usually natural**

gas, is seen as blue hydrogen, and is supported by the oil and gas industry. The oil and gas industry is a powerful lobbyist in the UK, EU and USA.

Other groups with a vested interest in hydrogen include the **UK Hydrogen and Fuel Cell Association**, has also published a roadmap this month, detailing a potential trajectory for the sector through to 2050. The roadmap has been backed by business giants including Rolls Royce and ITM Power and explores how the UK could target 80GW (gigawatts) of green hydrogen capacity by 2050. For this target to be met, the roadmap states, the **UK Treasury** must overcome historic issues with prioritizing other industrial sectors over green hydrogen. The roadmap also states the **UK Government** must also develop short-term targets backed with adequate funding.

At the present time, "green hydrogen" produced from the electrolysis of water using renewable energy from wind and solar, is favored in the EU. Its strongest advocate is **Hydrogen Europe**, a trade association representing 260+ mostly small and medium-sized companies (see for example, https://www.battolysersystems.com/;https://www.sunfire.de/en/;https://www.itm-power.com/) and 27 national associations dedicated to "propelling global carbon neutrality by accelerating European hydrogen industry." (Its primary lobbying target is the **European Commission** and the **EC Directorate-General for Energy** responsible for EU energy policy formulation and implementation.) Naturally, the solar and wind power industries are supportive of green hydrogen, but at present they are primarily focused on building their capabilities for delivery of power to electric utilities in the short term, not for the generation of green hydrogen. See the two trade associations: **SolarPowerEurope** (solarpowereurope.org) and **WindEurope,** formerly The European Wind Energy Association (windeurope.org).

A recent U.S. academic study in the **Energy Science & Engineering** journal claimed blue hydrogen emits more across its entire supply chain than simply burning natural gas.

A senior policy adviser at **E3G, a climate think-tank**, (www.E3G.org) declared, "it is disappointing to see the (UK) government back blue (hydrogen)," calling it "a second rate solution to the climate emergency."

The chief scientist for **Greenpeace UK, (www.greenpeace.oorg.uk)** said the emphasis on blue hydrogen in the strategy "looks like a bad idea both environmentally and economically". Blue hydrogen critics often add the charge that producing natural gas releases methane, a particularly climate impacting gas. Greenpeace supports green hydrogen.

A McKinsey & Company report co-authored with **The Fuel Cell and Hydrogen Energy Association (FCHEA)** estimated that the hydrogen economy could generate $140 billion in annual revenue by 2030 and meet 14 percent of total American energy demand by 2050.

Blue hydrogen supporters view producing green hydrogen production to be too costly and too dependent on intermittent solar and wind power ("variable renewable energy (VRE) in industry

terminology) and incapable of generating sufficient quantities for all of the potential uses UK is considering.

For a detailed analysis of the relative cost structures of blue vs. green hydrogen, see

"Green or Blue Hydrogen: cost analysis uncovers which is best for the Hydrogen Economy" by Schalk Cloete, November 2020 https://energypost.eu/green-or-blue-hydrogen-cost-analysis-uncovers-which-is-best-for-the-hydrogen-economy/

Hydrogen in the U.S

In the U.S., infrastructure legislation introduced in August 2021 had $8 billion to creating regional hydrogen fueling hubs, a program endorsed by Members of Congress from natural gas producing states.

The natural gas industry, through the **Hydrogen Council**, an industry group founded in 2017 that includes BP, Shell, and other big oil and gas companies, has strongly lobbied for blue hydrogen in the UK, EU and Europe.

Over the past few years, the natural gas industry has begun heavily promoting hydrogen as a reliable, next-generation fuel to be used to power cars, heat homes and burn in power plants.

In the United States, Europe and elsewhere, the **Hydrogen Council** has also pointed to hydrogen as justification for continuing to build gas infrastructure like pipelines, saying that pipes that carry natural gas could in the future carry a cleaner blend of natural gas and hydrogen.

Electric utilities see hydrogen as complementary to wind or solar, which generate power only intermittently. Electric utilities are currently heavy users of fossil fuels to generate electricity.

Many experts agree that hydrogen could eventually play a role in energy storage or powering certain types of transportation — such as aircraft or long-haul trucks, where switching to battery-electric power may be challenging.

U.S. environmental groups have criticized the Biden Administration proposal. "It's not a climate action," said Jim Walsh, a senior energy policy analyst at **Food & Water Watch**, a Washington-based nonprofit group. "It's this is a fossil fuel subsidy with Congress acting like they're doing something on climate, while propping up the next chapter of the fossil fuel industry."

Resolving the Blue vs. Green vs. Pink Debate

To be truly emission free, hydrogen would ultimately need to be make using renewable energy, i.e., "green hydrogen." "Blue hydrogen" made from natural gas would be a transition fuel but would ultimately be a small contributor to the overall sustainable hydrogen economy.

The World Energy Council community shows that there is no silver bullet — neither green nor blue — for the UK or any other country's energy transition. Worse still, color prejudice can prematurely kill-off innovative energy solutions before their effectiveness can be tested.

With the hydrogen economy in an embryonic stage, governments, including the UK, face the classic chicken and egg conundrum — whether to focus on the demand-side (pull) or the supply-side (push) of the hydrogen equation.

The **World Energy Council (WEC)** has been instrumental in forming **Hydrogen Global**, "a community of hydrogen actors that aim to deliver impact around a shared commitment to consume, enable, and invest in blue and green hydrogen."
https://www.worldenergy.org/impact-communities/innovation/hydrogen-charter

The WEC is a nearly 100-year old non-profit organization that defines its mission as "We define, enable and accelerate successful energy transitions while maintaining a technology and resource neutral global perspective and through the widespread use of a flexible Transition Leadership Toolkit, insight, interactive events and dynamic platforms to delivery strategic moments of impact."

The WEC declared, "Companies and governments are pursuing hydrogen unilaterally, straining to reach a viable model on their own. Hydrogen Global assembles these scattered efforts to send a strong collective signal to the market. The Hydrogen Global charter will collect 100 participants to amass demand for clean hydrogen as a complement to electrification to decarbonise economies."

In the end, one resolution of the blue vs. green debate may be for governments to promote both. By promoting blue hydrogen as a short term solution a ready supply of hydrogen will be created, stimulating demand and attracting much-needed investment in green hydrogen for the long-term.

ACTORS IN THE CASE

GOVERNMENT ACTORS

United Kingdom

UK Department for Business, Energy and Industrial Strategy

UK Treasury

EU

European Commission

EC Directorate-General for Energy

Hydrogen Europe

US

Biden Administration

HYDROGEN ADVOCATES

Nonpartisan Hydrogen Advocates

World Energy Council (WEC) and **Hydrogen Global**

Fuel Cell and Hydrogen Energy Association (FCHEA) in the US and UK

Blue Hydrogen Advocates

Oil and Gas Industry

Electric Utilities

Hydrogen Council

Pink Hydrogen Advocates

NUKES (Nuclear Industry Council (NIC) and **Nuclear Industry Association (NIA))**

Green Hydrogen Advocates

UK Hydrogen and Fuel Cell Association

SolarPowerEurope (solarpowereurope.org)

WindEurope, formerly The European Wind Energy Association (windeurope.org)

Other Green Hydrogen Advocates

Energy Science & Engineering journal article authors

E3G, a climate think-tank

Greenpeace UK

CASE QUESTIONS

1. **(8) With the actors double underlined above, draw a power diagram for the case following the examples shown in Exhibit 8.1, (Note a number of actors are eliminated to simplify your diagramming, including the pink hydrogen advocates)**

NOTE: You will need to show the interaction between the UK and EU government actors in your diagram

Please review "How to Structure an Easily Readable Power Diagram" before drawing your power diagram. Exhibits 8.1 is a good diagram that follows my advice in the "How to…" regarding centering the government agencies, bracketing by supporters and opponents of the focal company.

2. (4) Summarize what your power diagram tells you about the power situation the Blue and Green Hydrogen advocates face in the case in less than 150 words (Summary means summary! Do not simply repeat what is in your diagram. Summarize key elements, leading to a concluding statement about

position, positive or negative, of the Blue Hydrogen Advocates or the Green Hydrogen Advocates, i.e., a "summary" of your summary in power terms.)

3. (3) Referencing where appropriate to your foregoing power analysis, who do you think is likely to prevail—the Blue Hydrogen Advocates or the Green Hydrogen Advocates? (maximum 150 words)

Appendix A. The Hydrogen Rainbow

Green hydrogen is when the energy used to power electrolysis comes from renewable sources like wind, water or solar. when electricity is passed through a substance to force a chemical change — in this case, splitting H2O into hydrogen and oxygen.

Blue hydrogen is hydrogen produced from natural gas with a process of steam methane reforming, where natural gas is mixed with very hot steam and a catalyst. A chemical reaction occurs creating hydrogen and carbon monoxide. Water is added to that mixture, turning the carbon monoxide into carbon dioxide and more hydrogen. If the carbon dioxide emissions are then captured and stored underground, the process is considered carbon-neutral, and the resulting hydrogen is called "blue hydrogen."

Grey hydrogen is made from natural gas reforming like blue hydrogen, but without any efforts to capture carbon dioxide byproducts.

Pink (purple/red) hydrogen is hydrogen made with electrolysis powered by nuclear energy, which does not produce any carbon dioxide emissions. (Although nuclear energy creates radioactive waste which must be stored safely for thousands of years.)

Yellow hydrogen is hydrogen made with electrolysis from the energy grid. The carbon emissions vary greatly depending on the sources powering the grid.

Turquoise hydrogen is hydrogen produced from methane pyrolysis, or splitting methane into hydrogen and solid carbon with heat in reactors or blast furnaces. Turquoise hydrogen is still in its nascent stages of being commercialized, and its climate-conscious value depends on powering the pyrolysis with clean energy and storing the physical carbon.

White hydrogen is a routine byproduct of industrial processes

The color system is a bit simplistic and needs to be updated and made more specific, said Daryl Wilson, the executive director of the coalition of the Hydrogen Council, an organization of industry CEOs.

"The color scheme is not helpful in in the sense that it's not getting to the key point, which is what are the environmental attributes of the hydrogen being produced," Wilson told CNBC. "The key issue is there has to be a methodology for tracking and declaring the specific CO^2 intensity of whatever hydrogen you're working with."

https://www.cnbc.com/2022/01/06/what-is-green-hydrogen-vs-blue-hydrogen-and-why-it-matters.html