The multi-sector fuel dilemma

Andrej Kormuth and Shane Jaftha of Bracewell share their thoughts on the appropriate structuring approach to renewables, highlighting the impact of the reliability of supply issue, energy storage and policy on fuel.

Confusion persists among industry stakeholders regarding the correct structuring approach to renewables. The truth is that renewables traverse sectors and is not a sector itself. Electrical power generated through sustainable means is a service, much like fossil fuel powered power stations. Green hydrogen, however, is a commodity (or fuel) play deserving of a different approach. Getting these distinctions right will be critical to the development of renewables for decades to come.

FUEL – RELIABILITY OF SUPPLY ISSUE

A topical point of discussion is the emergence of renewable energy as a replacement for the world's fossil fuel dependence. But, to say that, for example, solar or wind energy will replace fossil fuels is to misunderstand what fossil fuels are in relation to such renewable energy sources. Fossil fuel is exactly that – fuel.

Comparatively to solar and wind energy projects, the comparable "fuel" is the sun or wind. The result from both solar/wind power plants and fossil fuel-fired power plants is the same – electricity. Therefore, in the Middle East, the legal structuring for power plants utilising sun, wind or fossil fuel is very similar, if not almost identical. What differs in those projects is the way that "fuel" is treated and how reliable is the supply of that "fuel".

As a side note, it is worth remembering that the conversion of wind and sun energy into electrical energy is relatively old technology. For many years, the idea of converting solar radiation and wind energy into electrical energy, at scale, has preoccupied governments and private developers alike. This pre-occupation, however, precedes the notion of global warming as a result of carbon dioxide, methane and polluting gases emitted during the combustion of fossil fuels. Most might recall the original driver for the development of the so-called "renewable energy" was the fact that fossil fuels were finite and non-renewable – in other words, the world was concerned that it would run out of fossil fuels, a seemingly impossible worry to have in context of today's worldview.

This neatly introduces the issue of reliability of supply. What drove government sponsored development of solar and wind powered energy projects was the notion that fossil fuels would not, in the future, be reliably available, if not completely exhausted. Renewable energy was seen as the panacea to that scarcity problem. But, ironically, it is reliability of supply which is what renewables was intended to solve that plagues solar and wind power projects and prevents their mass development in replacement of fossil fuel fired power stations. Simply put, when the sun doesn't shine, whether day or night, or the wind doesn't blow, the capital investment made in solar or wind power plants sits unutilised or utilised at low efficiencies.

This drives the key structuring difference between conventional (fossil fuel) and renewables (solar/wind) electricity generation plants. While the conventional plant can generate electrical energy at any time up to its nameplate capacity, the renewables plant must wait for Mother Nature to deliver the necessary fuel i.e. sun or wind. Of course, wind and sun irradiation data for specific locations can help to manage the otherwise haphazard supply of solar/wind. But each day will include some low points in the generation cycle, such as during the night, meaning that renewables plants can never be run as true base-load conventional plants, delivering the same output on consistent and reliable basis, 24 hours a day. This is why conventional plant projects are structured on a dual-tariff basis, comprising the capacity charge, akin to rental of the available power capacity of the power plant, and energy charge, reflecting the variable costs of generating

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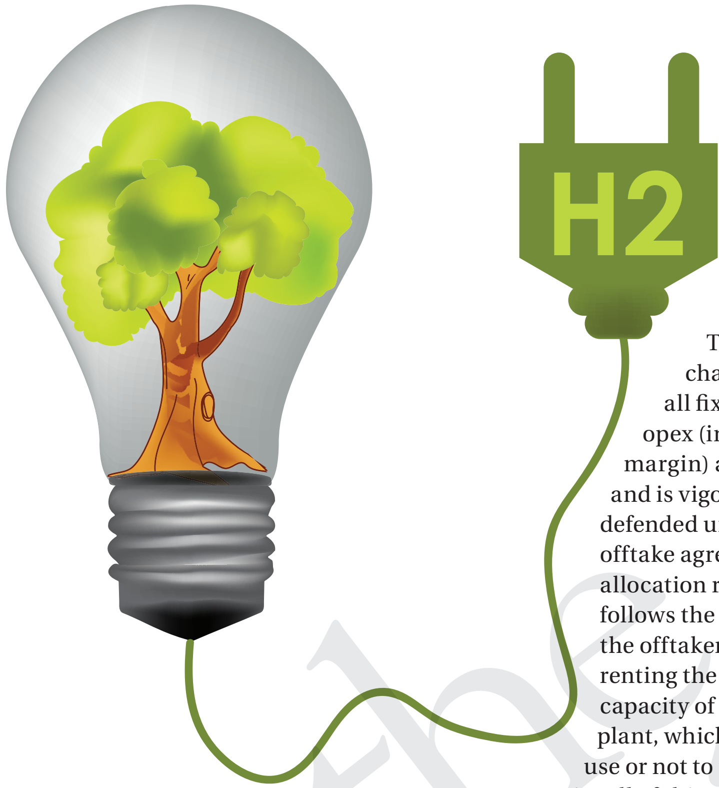

electrical energy pursuant to grid operator's dispatch instructions. The capacity charge is where all fixed capex and opex (including profit margin) are modelled and is vigorously defended under the offtake agreement's risk allocation regime. This follows the principle that the offtaker is essentially renting the generation capacity of the power plant, which it is free to use or not to use as it needs.

Again, all of this comes down to the certainty of supply of fuel, whether gas or heavy fuel (coal in other parts of the world), all of which is in abundance regionally and can be stored at site for immediate use.

Comparatively, renewables power plant projects are structured on a single tariff basis, comprising the energy charge only, being the compensation paid against the actual electrical energy delivered. Because the developers are in this case entirely dependent on generating electrical energy for revenue, the grid operator is obliged to take all electrical energy that the renewable power plant can produce, regardless of demand. This follows the principle that "fuel" (i.e. wind or solar radiation) is not entirely predictable and has to be consumed to its maximum as and when available, regardless of the downstream need in the grid for the electrical energy that it produces. The grid operator then has to awkwardly balance the demand-supply position in the grid, an electrical engineer's equivalent of walking a tight rope, by dispatching and derating its baseload power plants (i.e. burning fossil fuel) because those are the power plants that can, predictably, be ratcheted up or down, if not shut off and restarted entirely.

Basically, fossil fuels comprise energy molecules that store energy. Therefore, to find true replacement for conventional (fossil fuel) plants one must find an equivalent "clean" fuel which can be stored and converted to electrical energy at will. This is not to be confused with battery storage (or other types of electrical storage schemes) which are designed to store the output of a power plant (i.e. electrical energy) as opposed to the input (i.e. fuel) for a power plant.

Viewed thus, it immediately becomes clear that thermal (fossil fuel) power plants touch three distinct sectors – (i) commodities market (i.e. oil and gas) which supplies the fuel, (ii) infrastructure development (i.e. the physical construction, operation and maintenance of the power plant which burns fossil fuel to deliver electrical energy), and (iii) service (i.e. delivery of electrical energy to end consumers). Renewable (solar/wind) power plants touch only the latter two sectors because there is no commodity (i.e. fuel) market involved in delivering solar or wind energy to the power plant.

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FUEL – ENERGY STORAGE

This is where hydrogen becomes an exciting proposition.

At its heart, hydrogen is a commodity, like fossil fuel. It is the product of other activities, whether of sustainable or fossil-based nature, run through some form of decoupling process such as electrolysis or steam methane reforming. That commodity is then delivered into mid-stream infrastructure (think of pipelines or liquefaction facilities that compress hydrogen into storable volumes, ready for ship, rail or potentially truck transportation), which either stores or transports (or both) that hydrogen via that infrastructure. That commodity then arrives down-stream at a new point of consumption, which may itself take numerous forms – industrial facilities burning hydrogen as fuel (this would include thermal power stations) or using it as chemical component in a larger process.

This is why hydrogen, like fossil fuel, cannot be viewed in isolation. The legal structuring must follow the context – hydrogen's upstream, midstream and downstream existence, all of which are fundamentally different in relation to risk profile and financing. To couple hydrogen with "renewable energy" is also misleading because it incorrectly allocates hydrogen squarely within the downstream lifecycle, without considering the entire value chain or how it is produced.

To return to the power plant context, hydrogen is a potential input replacement for thermal power plants. In the context of thermal power projects in the region, hydrogen powered projects may technically look identical to existing fossil fuel powered projects. This is, however, assuming that such power projects will be on the typical "energy conversion" basis, which is to say that the single offtaker of power also ensures the delivery of the input, i.e. hydrogen. Under this structuring, the power developer never takes ownership of the hydrogen supplied, but rather converts it into electrical energy at guaranteed performance efficiencies which is then delivered, on instruction, back to the offtaker.

FUEL - POLICY

So why aren't thermal power plants simply converted to burn hydrogen, instead of gas or heavy fuel? After all, hydrogen is the most abundant molecule in the universe, the combustion of which returns to earth as water. Its use is, therefore, clean and, unlike fossil fuel, renewable.

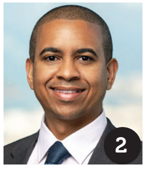
Most readers will most likely already know that the cost of producing hydrogen by means of electrolysis, powered by electrical energy generated through renewable means (i.e. wind or solar), costs multiples of what natural gas price fetches in the open market. So it is, in conclusion, prohibitively expensive.

But the same could have been said of electrical energy generated using photovoltaic modules, as opposed to gas burners and steam turbines, ten years ago. Fast forward to today, the actual cost of kWh generated by photovoltaic modules is less than burning gas. Many will point to technology development, economies of scale and mass production as the answer to that change, all of which is correct. However, to stop there would be to ignore the catalyst to human behaviour – incentivisation.

Remarkably few will now remember that all renewable (solar/wind) power plants were originally procured on government subsidy schemes, such as "feed-in tariff" and "contracts for difference". It was those government subsidies, i.e. the investment of public finances in an overpriced and inefficient product, that resulted in the break-neck speed evolution of technology and efficiency which ultimately cost equalised the current offering. This is where "renewables" transcends yet into another sector, government policy and legislation.

Hydrogen is an exciting proposition because it is the true replacement for fossil fuel. It is a commodity in the form of an energy molecule, subject to government policy and legislation. It is produced, much like oil and gas, using capital intensive means that require investment of private capital against the incentive to generate profit from end-user demand. However, because the end-user demand does not currently exist, or exists in very limited capacity, it will ultimately be on public institutions to generate the profit incentives that push private capital into gear. Positive moves in this regard are afoot in Saudi Arabia and couple of other GCC states.

But make no mistake, the hydrogen revolution is at this stage solely dependent on the government policy and legislative sector, which must commit scarce public resources for the development of the future. For the private sector, the first mover advantage will then be higher returns in the face of limited competition. As market participation increases, so too should price competition, which should in turn reduce policy incentives required to drive market participation. This will result in a self-propelling, multi-sectorial, evolution which will ultimately land renewable energy, across its entire value chain, in price parity with non-renewable energy…or so we hope.



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