Belize hydrogen energy storage

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The energy revolution is not a smooth progression. It is a movement comprised of shifts and phases where things speed up followed, sometimes, by slower progress. However, we have now reached a plateau. Continuing the deployment of proven technological solutions on a larger scale is not enough to overcome two major problems that stand in the way of a 100% renewable world.

Hydrogen could solve the problem of how to deal with intermittent renewable energy. Indeed, power to gas is currently the best solution for storing renewable energy on a large scale. Renewable electricity surpluses are used to produce hydrogen which can then be directly injected into the gas network: power to gas or be converted into electricity via a fuel cell. Used as an alternative or supplement to electric batteries, hydrogen thus makes the energy system more resilient. Power to gas moreover has the advantage of using gas infrastructure that has already been paid for and it becomes part of a circular economy system, where renewable electricity surpluses will be systematically transformed and reused.

As countries across the Central American and the Caribbean region continue the exciting process of expanding their capacity in solar and wind power generation, they will increasingly face two main renewable energy challenges. The first is the intermittent production of renewable energies, the problem is a familiar one. The production of renewable energies is variable, discontinuous and cannot be scheduled. It depends first and foremost on uncontrollable weather conditions, such as sunlight or the wind. Combined with this, we are still investigating how to store this electricity in large quantities for long periods of time.

Electric batteries can cover short-term needs, but how can we cover seasonal variations and use the solar energy produced in the summer, to cover needs in the winter? Like the rest of the world, Belize faces the challenge that solar and wind energy produce electricity only when there is sunlight and wind and even when there isn"t necessarily demand in the grid. A passing cloud can cause a sudden large drop in electricity flowing into the grid, or the wind could pick up in the middle of the night when everyone"s asleep and demand is low.

The second problem is decarbonization of all energy uses: transport, heating and industrial processes. Let us take the example of transport. It is 95% dependent on oil and the transportation sector is responsible for 23% of CO2 emissions worldwide. What fuels should be adopted? Should we focus all our efforts on electric vehicles, even though this would require huge investment? Consider that the size of the electricity grid of Belize would have to be doubled simply to convert 10% of the fleet to electricity.

But electrical grids, and the power demand they feed steady supply. What"s more, while a gas-fired power plant can raise or lower output to meet demand, as already noted, solar and wind plants generally can"t do that. To address these issues, the scientific community in the world is increasingly looking to energy storage. That"s because storage solves both issues. It collects energy when it"s not needed by the grid and then releases it to the grid when it"s needed. It also can be used to smooth out the fluctuating increases and decreases in

supply from solar and wind farms, thereby helping stabilize the grid.

Batteries, whether the chemical form we are used to in phones and computers, or alternative types, such as compressed air or pumped water storage, are one solution. However, as renewable energy begins to comprise a larger and larger share of the energy mix, many think that battery storage at such scale required for large grid-connected networks will be too expensive or will not have enough capacity. But there"s another solution: hydrogen produced by electrolysis. Hydrogen and the electrolysis process are particularly exciting for countries such as Belize that are located in sun-drenched regions.

Electrolysis is the process of running an electric current - in this case produced by renewable energy - through water to produce oxygen and hydrogen. The electrolysis system based on PEM (proton-exchange membrane) technology can efficiently transform the energy produced by wind and solar generating facilities into hydrogen. This is not only helpful for the renewable sector but also for industry, transportation, and power-to-gas solutions and networks.

The special property of the proton-exchange membrane is that it is permeable for protons, but not for gases such as hydrogen and oxygen. In an electrolytic process, the membrane carries out a number of functions, including that of a separator, preventing the gases produced by the process from mixing. In contrast to traditional alkali electrolysis, PEM electrolysis is ideally suited to be powered by the intermittent electricity produced by wind and solar power. Siemens has already successfully put several of these renewable energy-powered systems into continuous operation for customers in Europe, including a 5 MW system in Germany. Siemens is already in discussions with potential customers in our region regarding plants of up to 400 MW.

For national utilities, this process could use excess electricity produced by renewable energy to produce hydrogen that can be stored for months before being used as fuel in a power plant to produce electricity when required. But hydrogen"s versatility means it can do a lot more. It is relatively easy to transport, so it can be used in fuel cells to power vehicles, from cars to ships to trains. What is more, the hydrogen used in car and truck fuel cells doesn"t have to be transported to filling stations, allowing hydrogen to be produced safely and cleanly onsite. Using onsite renewable energy, the system would produce "green hydrogen" for the refueling of future fuel cell vehicles. This is an efficient and flexible solution for producing hydrogen.

Beyond its use as a fuel, hydrogen is an important material for industry, including pharmaceuticals and food manufacturing, while in the semiconductor industry, hydrogen serves as a carrier gas. Hydrogen also is an important input in the petrochemical industry, serving as a building block for many compounds, such as ammonia, methane and other hydrocarbons used in the production of plastics.

Significantly, the hydrogen currently used in these processes is produced using natural gas. Another exciting use of hydrogen produced with renewable energy, is to combine it with carbon dioxide to generate methane, which can be used as fuel for power generation. This results in a neutral CO2 balance, because when the methane is consumed it releases the same amount of CO2 that was previously fixed.

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