Creating staying power for green energy

At Safe Hydrogen, LLC, we believe the simplest solution is usually the best one.

That's why we see hydrogen – the simplest of Earth's elements, the first atom to come spinning out of the Big Bang – as the ultimate solution to truly make the most of our renewable energy resources. To this day, renewable energy from wind and solar remains intermittent and frustratingly dependent

on fossil fuels. Even today's battery technology falls short of financial and performance goals. **Only with our emerging storage technology can storage become a clean, dependable,**

economically viable way to eliminate carbon from electricity generation.

The Energy Problem

The renewable energy industry faces a dirty dilemma: Behind every wind farm is a massive fossil fuel infrastructure to provide backup power when the skies are still.

To integrate this intermittent energy source, dispatchable plants of the same output must be ready to take over whenever wind production falls – as it does some 80% of the time – to keep the amount of generation constant. *These backup plants are usually powered by fossil fuels.*

In developing countries where new electricity infrastructure is being built, more wind means more fossil fuel plants with more CO_2 emissions contributing to global warming. So no matter how many wind farms we build, we will never achieve full renewable energy generation from wind.

The Storage Solution

To solve this problem, we need to store the energy harnessed from spinning wind turbines so we can use it when the wind isn't blowing. That way a wind farm can become a dispatchable plant controlled just like a fossil fuel plant.

With storage, a wind farm becomes a reliable, constant source of energy.

But Which Storage is Best?

Safe Hydrogen has developed a slurry technology that can store and produce hydrogen in a rechargeable manner.

Our process uses electricity from a wind farm to split water into hydrogen and oxygen, through electrolysis.

The hydrogen is stored in a magnesium slurry that can be safely stored on site or transported to where it is needed.

The slurry is heated to release the hydrogen to fuel gas turbines, which drive generators. Discharged slurry then goes back to be "recharged" at wind farms.



Only with our emerging technology, can storage become a clean, dependable, economically viable way to eliminate carbon from electricity generation.

The Cost Advantage

While a battery storage system might offer the potential to store energy in today's wind farm projects, this technology is inherently impractical because of its high cost. The installation price is far too much for the market to bear in the long run, especially in the developing world.

The key metric to calculate is the capital cost per kilowatt-hour. Battery technology typically costs \$500 per kilowatt-hour to build, versus about \$10 per kilowatt-hour for Safe Hydrogen's magnesium slurry technology.

In terms of the financial impact on consumers, this amounts to an estimated \$5 per kilowatt-hour consumed for a battery storage system, compared to just 10 cents per kilowatt-hour for magnesium slurry technology.

The Bottom Line

$$\label{eq:constraint} \begin{split} & \text{With the right storage solution,} \\ & \text{more wind farms can be built.} \\ & \text{Fossil fuel plants can be retired.} \\ & \text{Transportation can run on electricity or} \\ & \text{hydrogen from electricity. Buildings can} \\ & \text{be heated with electricity and hydrogen.} \\ & \text{CO}_2 \text{ emissions from the generation of} \end{split}$$

electricity can be a thing of the past.

Safe Hydrogen's slurry is proving to be the only storage technology with the costeffectiveness needed to give staying power to our renewable energy resources.





The chart above shows the current method of integrating a 500 megawatt (MW) wind farm. Because this is an intermittent generation source, energy from fossil fuel-powered plants must make up the difference in output when wind production declines at various times of the year. Under this scenario, with wind and fossil fuel each contributing about half the energy output, we will never get above 50% renewable generation – no matter how many wind farms we build.



The chart above shows the same 500 MW wind farm firmed by Safe Hydrogen's slurry storage technology. With 100,000 MWh of storage, the wind farm can be converted to a base load or a dispatchable plant that can be controlled just like a fossil fuel plant. The storage availability means the average annual output for the wind farm is about 150 MW. More importantly, the wind farm becomes a reliable, constant source of energy.

Wind Storage with Hydrogen Slurry