

# Watt's Happening? #262

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## Energy Storage Revolution

*renewables anytime, anywhere*



*As renewable energies become more and more widespread and less and less expensive, new ways of storing that cheap energy are coming on-line. Energy storage solutions in batteries and as green hydrogen (left) are rapidly being deployed world wide.*

In the last issue of Watt's Happening? "Solar: the quiet revolution" we saw how our energy world is changing quickly, very quickly, and solar is leading the charge: two billion watts of solar are being installed worldwide every day. In less than 20 years, solar is on track to become the world's largest source of primary energy (not just electricity). We are experiencing an energy revolution!

This is good news. Electrifying everything as quickly as possible, and supplying that electricity from clean sources like solar, is perhaps the most important single step we can take toward halting climate change.

But how do you store that solar energy so we can keep the lights when the sun isn't shining?

### **BATTERIES to the rescue**

Guess what: if you don't have somewhere to store it, you can have too much solar energy on a grid!

The solar-rich grids of Spain, Portugal, Germany, France, California and Texas have all experienced negative wholesale power prices for solar. On nice sunny days, their solar intensive grids have produced more solar than they can use, so the value of that energy has dropped to below zero dollars per watt!

You might think that this puts a limit on how much solar a grid can take. Not so. Batteries are the quick fix: store that excess energy when prices are dirt cheap (during a sunny day), then feed it back into the grid when demand is high and prices are up (later that evening).

Batteries lend themselves to mass production and rapid price declines, just like solar panels. The Rocky Mountain Institute calculates that the cost of a kilowatt-hour of battery storage has fallen by 99% over the last 30 years, and that steep decline continues today.

Batteries are working. California first saw negative prices on their grid in 2017, when they had some 19GW (one gigawatt = one billion watts) of solar. Since then they have doubled their solar because they now have 10GW of storage. There are times when batteries have been the largest source of energy on their grid. Texas is moving even faster in this direction.

### **SUNTRAIN**

Build a solar farm near a railway line. Install mass-produced battery rail cars on a 100-car train, charge them up with the almost free solar energy, and you can deliver 3 GW of energy to anywhere that has a rail terminal.

The U.S. Planetary Technologies sees this as an alternative to building expensive and controversial high-voltage transmission lines. A couple of trains a day (electric trains of course) could provide a large grid's energy import needs, quickly and easily, on demand. Batteries on wheels!

SunTrain is an example of the innovation that is possible (and needed) when you have massive quantities of cheap renewable energy distributed across the land coupled with a rapidly growing demand for electricity.

### **GREEN HYDROGEN**

Water. It's made of hydrogen and oxygen. Pass a direct electric current through it, a process called electrolysis, and the hydrogen and water separate

out: two parts hydrogen to one part oxygen. Use renewable electricity, and you get "green" hydrogen. This can be used as a way to store plentiful solar energy for longer periods of time than batteries offer. But state of the art electrolyzers, designed to be super efficient to use as little energy as possible, are expensive, and that makes green hydrogen expensive.

Things change when energy, like solar, becomes so plentiful and cheap. Use low-tech electrolyzers and put them next to a simple solar farm that generates only direct current (solar panels generate direct current which has to be converted to alternating current by an expensive gadget called an inverter to feed solar power into the grid). Electrolysis needs only direct current, so no inverter is needed, eliminating a huge expense for the solar farm.

### **CHEAP, CLEAN FUEL TOO!**

Now you are getting inexpensive green hydrogen using electricity from an inexpensive solar farm. Green hydrogen then becomes a cheap high-energy liquid or gaseous fuel that can replace propane, natural gas, LNG and gasoline, but with no nasty carbon emitted when burned. When burned, hydrogen simply re-unites with the oxygen in the air to make water again, while releasing a lot of heat energy.

Or you can get your electricity back simply by re-uniting the hydrogen and oxygen in a fuel cell.

When you begin to think of energy as plentiful and essentially free, like solar is becoming (at least at certain times of the day), all kinds of interesting and very important innovations begin to appear. This new way of thinking could be just what we need to solve the climate crisis.

