Electrify Everything

A Path to the Zero-Carbon Grid

In the developed world, most consumers get their power from the electricity grid. When it is connected to a grid, everything that runs on electricity is, in carbon/climate terms, only as clean as the grid. This has profound implications: As long as we are reducing carbon on the grid, every single electrical device is getting cleaner throughout its life.

Consider two home-heating systems, a natural-gas or oil furnace and a heat pump that runs on electricity. The fossil-fuel furnace's rate of carbon emissions is basically fixed by its design. It will emit the same level of carbon emissions per unit of heat throughout its, say, 20-year lifespan. Over the same 20 years, the power grid, from which the heat pump draws its electricity, will get cleaner – less coal, more renewables. That means the heat pump's carbon emissions per unit of heat will decline throughout its life. Its environmental performance improves as the grid improves. The same is true for autos. An internal-combustion engine vehicle will emit roughly the same level of carbon emissions per mile throughout its decades of life.

Electrification will decarbonize only if there is ample and affordable clean energy on the grid to feed the growing demand. If all buildings, vehicles, and industry were suddenly electrified via today's grid, emissions actually would increase in the short term. This is because, depending where you live, the electricity grid isn't that clean. More than a quarter of energy in the U.S. still comes from coal.

But the grid is not static. The electrify-everything movement is about anticipating and preparing for a clean-energy future. Appliances that households and businesses buy today will be around for the next 10 to 30 years. In that timeframe, the grid will become much cleaner.

Energy conservation must also grow. With the world population projected to reach 10 billion by 2050, resources required for the batteries and other technologies that make it possible to electrify everything will be limited. Fortunately, battery technology is advancing at light speed. Reducing energy consumption is first achieved by simply using less of a service, especially where that service itself is frivolous, wasteful, or not benefiting people. After all, the least polluting, least expensive megawatt-hour is the one that is not generated.

The Value of Distributed Microgrids

More than 40% of Americans live in a state with goals for 100% clean-energy, net-zero, or carbon-neutrality. Getting there will be complicated, given that utilities are tasked with ensuring accessible, reliable, affordable electricity to rate-payers. "Microgrids" can become a key part of achieving these seemingly incongruent goals and obligations.

A microgrid is a local energy grid with control capability: it can disconnect from the traditional grid and operate autonomously. A microgrid consists of energy generation and energy storage that can power a building, campus, or community when not connected to the conventional electric grid, e.g., in the event of a disaster.

Microgrids have obvious benefits in powering critical resources, such as hospitals, in the event of planned or unplanned outages of generation or transmission assets. In addition, renewable sources of generation, such as solar and wind, don't require transport of fossil fuel, which may be restricted during a disaster.

To understand how a microgrid works, first consider how the grid works. The grid connects homes, businesses, and other buildings to central power sources, enabling us to have – even expect – electric power 24x7 without fail. But this interconnectedness means that when part of the grid needs to be off-line for repairs – both planned and unplanned, i.e., disaster-caused – everyone is affected.

This is where microgrids can help. Microgrids generally operate while connected to the grid, but importantly, can break off and operate on independently using local energy generation in times of crisis, such as hurricanes. Microgrids can be powered by distributed renewable resources like solar, wind, or batteries, or by conventional generators.

As the grid uses more and more solar and wind, one challenge grid operators may face comes at especially sunny or windy times. At these times, renewables may generate more power than the grid can use, or they may generate only a fraction of the demand. To absorb the variable nature of renewables, the grid needs ways to smooth out those swings. One way is "dispatchable load," power consumption that can be scheduled, such as industrial production. This approach draws more energy in times of peak energy generation and releases clean power back to the grid during the valleys.

Learn more at How to drive fossil fuels out of the US economy, quickly.