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Jeremy Rifkin The internet offers a model for developing a hydrogen-powered energy network which would be less vulnerable to blackouts

Powering the people

Last week's massive power blackout in the north-east and mid-west regions of the US is a reminder that the electrical grid is the central nervous system that coordinates a densely populated urban existence. So how likely is it that the electricity will go off, not just for a brief moment but for extended periods of time? Unfortunately, the power grid is increasingly vulnerable to disruption because of energy shortages and terrorism.

The problem with the existing grid in the US and elsewhere is that each part of the system is so dependent on the rest of the system working that when a single malfunction occurs anywhere, it can result in power loss everywhere. To prevent a repetition of this kind of blackout requires the creation of a decentralised, distributed electricity grid powered by millions of hydrogen fuel cells.

There is an important lesson here to be learned from the development of the decentralised worldwide web. The Pentagon created the precursor to the internet in the late 1960s. The Department of Defense (DOD) was concerned about power blackouts and the potential vulnerability to attack or other forms of disruption of centrally controlled communication operations. They were looking for a new kind of decentralised communications medium, in which all parties could produce information and send it to one another in a way that would continue to function even if part of the system was disrupted or destroyed.

The solution came in the form of the Arpanet, developed by the DOD's advanced research projects agency. The Arpanet metamorphosed into the internet. Today, a billion people connect with each other via the internet and the world wide web. Each person, armed with his or her own computer, becomes a potential producer and disseminator as well as user of information.

Hydrogen-powered fuel cells are analogous to personal computers. That is, the fuel cell allows its user to produce, disseminate and use energy. Convertors are attached to either the gas line or the electricity line coming into the home, office or factory. In the case of natural gas, a catalytic convertor strips out the hydrogen from the natural gas, via a steam-reforming process, and stores it for later use in a fuel cell. Alternatively, an electrolyser can be attached to the electricity line and electricity can be used to separate hydrogen from water. This way, end users can store energy, in the form of hydrogen, and use it to generate electricity in fuel cells if and when a power surge or blackout occurs. Hydrogen fuel cells will initially be used as back-up generators.

Over the course of the next three decades, millions of people will purchase their own power plants. Fuel cells inside cars, homes, factories and offices will be capable of producing electricity for their own use during emergencies, while sending the surplus back to the power grid to share with others. To connect all those fuel cells — mini-power plants — will require a reconfiguration of every nation's power grid.

In many ways, the current power grid resembles the state of the broadcast industry before the advent of the web. Today's transmission systems are not set up to direct specific quantities of energy to specific parts of the grid, so power flows all over the place, often causing congestion, energy loss and blackouts. Transforming the power grid into an interactive network of thousands, and then millions, of small suppliers and users is a challenging task. New technology developed by the Electric Power Research Institute in the US called Flexible Alternative Current Transmission System (Facts) gives transmission companies the capacity to "deliver measured quantities of power to specified areas o: the grid". American Electric Power (AEP) purchased the first Facts in 1998 for its Ken tucky operations, and nine utilities are now using it.

The integration of computer hardware and software can transform the centralised grid into an interactive intelligent energy network. Sensors and intelligent agents embedded throughout the system can provide information on energy conditions, allowing current to flow where and when it is needed and at the cheapest price. An American company, Sage Systems, for example, has created a software program that allows utilities to "shed load instantly" if the system is at its peak and stressed to the limit, by "setting back a few thousand customers' thermostats by 2 degrees ... [with] a single command over the internet". Another new product, Aladyn, allows users to monitor and make changes in the energy used by home appliances, lights and air conditioning, all from a browser.

Soon, sensors attached to every electrical appliance — refrigerators, air conditioners, security alarms — will provide the latest information on energy prices and on temperature, light and other environmental conditions, so that factories, offices, homes and whole communities can continuously and automatically adjust their energy requirements to one another's needs and to the energy load flowing through the system.

The coming together of millions of hydrogen-powered fuel-cell mini-power plants and systems intelligence changes the energy equation for ever. For the first time, the potential exists to replace a traditional top-down with a new bottom-up approach to energy — a democratisation of energy, in which everyone can be his or her own vendor and consumer.

The consequences of connecting every owner of a fuel-cell micro-power plant with every other owner in an energy-sharing network will be as profound and far-reaching as was the development of the world wide web in the 1990s. Equally important, with everyone producing their own power and sharing it on the decentralised, interactive electricity grid, the kind of blackout America just experienced would be a thing of the past.

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