Argonne helps the grid get smart

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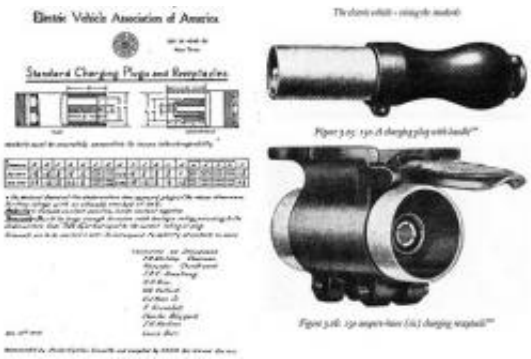

Today manufacturers are meeting to agree on a standard plug for the home hub, cars and appliances. But it turns out that American manufacturers already agreed on a standardized electric vehicle plug—in 1913! In the early days of cars, electric vehicles seemed a likely competitor for gasoline-powered engines and 30,000 were on the road; thus, the plug seen here—complete with wooden handle. Images found by Ted Bohn / Argonne National Laboratory.

President Barack Obama has called for one million plug-in hybrid electric vehicles (PHEVs) to hit the road by 2015. If the demand for PHEVs skyrockets, a flood of new electric cars could strain America's power networks to the limit.

That is why the U.S. Department of Energy is analyzing how the power grid can be redesigned to better meet America's energy needs. A multidisciplinary mix of scientists from Argonne National Laboratory is working to help develop a "smart grid" that will not only adapt in real-time to handle larger electricity loads, but also operate more cheaply and

efficiently than the existing grid.

"The smart grid proposes to reorganize the way power is used in the home and how it is distributed," said Ted Bohn, an electrical engineer at Argonne's Center for Transportation Research.

In the home, electric vehicles and all major appliances would be connected to a central hub that monitors how much electricity they use. The hub in turn would "talk" to local power suppliers. All of these appliances and the grid would talk to each other and could also share power.

The communication between vehicles, appliances and the grid allows suppliers to track electricity use in real-time. With that information, more utilities could vary the price of power by time of day and create incentives for consumers to use electricity at certain times. If power suppliers are overwhelmed during peak demand, consumers will receive a high price signal that will encourage them to reduce their consumption until the situation eases.

"Say you're running the air conditioning and charging your car battery at the same time during a hot afternoon," Bohn said. "With a smart-grid infrastructure, your AC and battery charger will automatically dial down their consumption, and then run it back up again when prices are lower."

The smart grid offers more choice to consumers by letting them micro-manage their energy bills. A consumer concerned about price could set a dishwasher to run when power is cheapest, usually at night, when demand is lowest. Environmentally conscious consumers could also choose to pay a clean energy premium for solar and wind power and thereby promote the use of these renewable energy sources.

"The smart grid doesn't propose to revolutionize the way we do power,"

Bohn said. "It's just about doing the same things more efficiently—smarter."

Les Poch and Matt Mahalik of Argonne's Center for Energy, Environmental, and Economic Systems Analysis (CEEESA) are concerned with the demand on the existing grid as more and more electric vehicles hit the road. Poch and Mahalik model the potential strain on the grid if millions of new electric vehicles were to plug in every night.

"Depending on what Americans do with their new cars, energy suppliers could be overwhelmed—or they could stand to gain a lot," Poch said.

Electricity suppliers closely monitor regional demand. To prevent shortages, they must predict how much electricity will be needed at any given time. "Until now, the pattern of power use in the U.S. has been relatively stable and predictable for the past 30 years," said Mahalik. "The last major bump was probably the widespread adoption of air conditioning."

Now, electric vehicles stand poised to throw off that stable pattern. No one knows how quickly electric cars will catch on, in what areas they'll be most popular, or when everyone will choose to plug in their cars.

Today's electricity demand follows well defined cycles. It increases during the daytime when commuters head to work, as homes and offices turn up the air conditioning and factories power up the machinery, and falls sharply during nighttime.

Utilities must prepare for that afternoon peak. "The way we build power plants now is to make sure we have enough to meet the highest demand possible—the maximum amount of power on the afternoon of the hottest day of the year," said Vladimir Koritarov, deputy director of CEEESA.

"Then they add some more for backup in an emergency. The rest of the year we won't need nearly so much power, but we have to be prepared for that one day."

For this reason, utilities must maintain a large reserve capacity that is unused for the majority of the year. Koritarov thinks that with the right approach, the smart grid could work out to everyone's advantage.

By using incentives to smooth out demand for electricity between day and night, a utility can produce power more economically. Also, smart charging of electric and hybrid vehicles during the off-peak periods can significantly help with that goal by filling up "demand valleys."

A significant stumbling block for power distribution is the lack of technology to store power for extended periods. Stockpiled power from variable resources, such as solar and wind, could be fed back into the grid at peak times to reduce the strain on the grid and conventional power plants. A team of Argonne materials scientists, chemists and engineers - already renowned for their successes in the field of advanced battery development for vehicles - is working to develop large-scale energy storage technologies that will capture energy whenever it's available and store it for use at a later time.

"The smart grid isn't a theoretical concept," said Bohn. "It's happening now." Across the country, aspects of the smart grid are being tested in homes and neighborhoods. As America moves forward, science and Argonne work to improve the future—for households, businesses and utilities alike.

Provided by Argonne National Laboratory

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