Charging Stations

Sioshansi studying distribution of the electric car power system

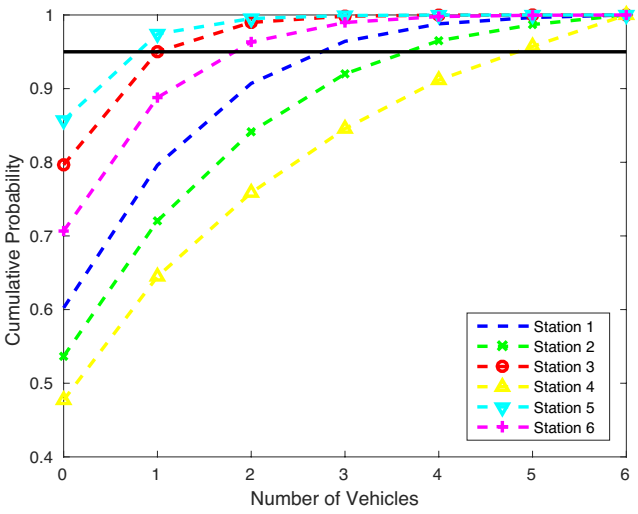
When considering an electric vehicle, many motorists encounter a paradox: they would be willing to make the leap if there was more of a support infrastructure for them.

Conversely, investors might loosen the purse strings to fund electric vehicle infrastructure, such as charging stations, if more people drove them. To help both ends, Ramteen Sioshansi, Ph.D., associate professor of integrated systems engineering at The Ohio State University, is studying the efficiency and optimal locations of electric vehicle charging stations. He has developed a simulation technique using high performance computing at the Ohio Supercomputer Center to find control strategies for electric power system distribution.

"Ultimately, in some sense, you have to start somewhere," Sioshansi said. "If you're just building a small handful of stations, and you're doing it to try to eliminate that barrier to people buying electric vehicles, you want to do a good job of deciding where to put them."

Luckily for Sioshansi, the Mid-Ohio Regional Planning Commission had data sets that modeled typical driving patterns in central Ohio. Sioshansi studied the location of vehicle concentrations at different times of day, assuming a random one percent sample of vehicles were electric.

"We did lots of scenario generation where we kept resampling the one percent out of there," Sioshansi said.



"That made the model actually quite large, and so that's what having an HPC system was useful for."

With charging locations determined, the next question is: how much load can electric distributors handle? A fast-charging station for electric vehicles can put out 150 kilowatts (comparatively, a wall outlet is 1 to 2 kilowatts). To offset the energy drawn through the distribution feeder, one option is a rechargeable battery; another is solar panels. However, Sioshansi's group found that by effectively managing the charging load, simultaneously charging multiple vehicles is possible without overloading power circuits. For example, if a vehicle is parked at a charging station in a grocery store parking lot and only needs to charge for 15 minutes out of the 30 it will be parked, that load can be transferred to another vehicle that also needs to be charged.

"That's a nice finding," Sioshansi said. "As long as there is a small controller in the charging station, there's not all this added cost of having to put batteries or solar panels or things like that or do expensive upgrades on distribution transformers to manage the load." •

Above: Ramteen Sioshansi, Ph.D., processes huge amounts of driving data through OSC to determine the optimal locations for electric vehicle charging stations, using central Ohio as a test market.

Left: A graph showing the cumulative probable number of vehicles near particular charging station locations.

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