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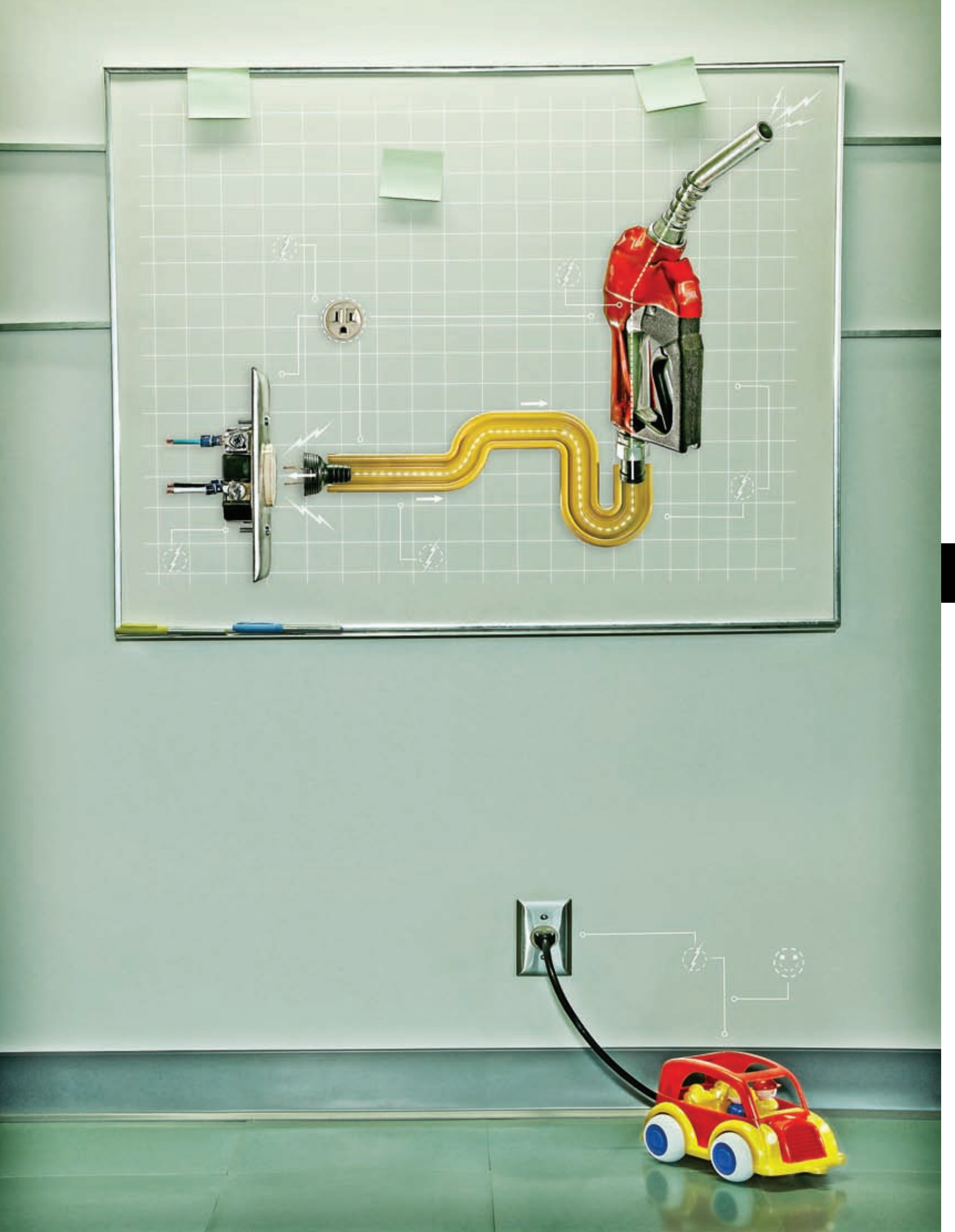
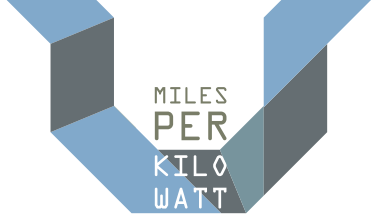
ELECTRICS GET READY TO TACKLE TRANSPORT

BY RICHARD SCHLESINGER *ILLUSTRATION BY TOD KAPKE*

The electric car has been quietly rolling down the road for more than a hundred years, but it's never picked up much momentum in the marketplace. And once gas-powered cars sported mufflers and no longer frightened the cows out of their milk or the neighbors out of their wits, electric cars lost their quiet advantage to the greater range and power of the internal combustion engine. ⟶





Sure, when the air in L.A. became something you could see and touch in the 1980s, fuel prices rose as a result of the oil embargo, and California passed an aggressive clean-air mandate, it looked like electric vehicles might get a new lease on life. But the air cleared and gas prices fell, the mandate was revoked and electric cars all but disappeared.

But now that the polar ice caps are melting and gasoline is taking on the aura of a Cheval Blanc '53, the electric car is beginning to look a whole lot more attractive. All of the major domestic and foreign automakers have announced plans to begin to market some sort of electric vehicle and the only question is when they'll actually ramp up production. The implications are enormous for the world's environment, for the auto and petroleum industries, for consumers and, of course, for the electric utility industry.

Sooner or later — and with gas prices what they are, probably sooner — we'll begin to see meaningful penetration of plug-in hybrid electric vehicles and pure electric vehicles, certainly within the next five years. When we do, a key concern is what effect it will have on the grid. Last year, a U.S. Department of Energy study concluded the system has enough excess capacity to recharge 75 percent of the light cars and trucks on the road today if they were electric. EPRI computer models conclude much the same. Based on likely economic and population growth between 2006 and 2030, incremental demand for electricity should grow by a little under 2,000 million megawatt-hours; of that, about 340 million megawatt-hours, or less than one-fifth, would be attributed to PHEVs and EVs. In other words, if capacity must increase approximately 50 percent over the next 25 years, the addition of electric cars won't matter one way or the other.

In fact, the introduction of the electric car is not much different from the introduction of any new electric appliance. Rick Tempchin, director of retail distribution policy at the Edison Electric Institute, likens it to the introduction of plasma televisions. It represents additional demand, but it's not as though people will rush out to buy them for the holiday season one year and plug in 40 million new electric cars to charge on Christmas morning. "Once we launch the technology," says Tempchin, "we'll know what to expect and we'll have time to deal with anything we need to do. That's our business. The first vehicle to come to market will be a simple appliance and it will evolve from there." Nancy Gioia, director, sustainable mobility, transportation and hybrid programs at Ford, thinks ramp-up to reasonable commercial production will take a minimum of five years and perhaps a little longer, and while some companies are predicting a shorter timeline, virtually no realistic scenario presents a threat to the grid.

While a new appliance presents no serious threat to the grid, neither does it represent a sudden windfall for utilities. The greatest immediate benefit to the utility industry will come in the form of increased efficiency, assuming the new generation of cars plug in during off-peak hours. And that's the most likely scenario. Virtually all of the car companies are aiming for an all-electric range between 20 and 40 miles, whether from a hybrid or a pure electric. Because the average commute falls within that range, cars could conceivably go back and forth to work without using any gas and without needing to recharge during the day. Although most utilities operate in a regulated environment and don't necessarily realize increased profit from the sale of additional electrons, more efficient operation of installed capacity will benefit the bottom line, and increased use of off-peak capacity will dramatically increase overall efficiency.

Furthermore, increased off-peak usage will facilitate the shift to renewable energy. Energy from wind, for instance, tends to peak during the evening hours, so charging electric vehicles at night would be a perfect opportunity to boost the percentage of electricity generated by wind and, in the process, help utilities meet their renewable mandates. A tangential benefit to plug-in vehicles is that they could eventually function as a distributed energy storage facility for the grid. Their high-density batteries could serve as a widely distributed source of emergency power during periods of excessive peak demand. But this vehicle-to-grid function is at least 20 years down the road — pun intended — which raises the issue again of just what obstacles still need to be overcome before we begin to realize the benefits of the electrification of the transportation system.

The most obvious issue to be addressed is the battery. As of this writing, no battery capable of reliably powering anything larger than a mini-sized Think-type car is in commercial production. Lithium-ion batteries powering test vehicles produced by Ford, GM and Chrysler are built virtually by hand. The lithium-ion battery isn't the only option. A sodium metal halide battery used in small European electric cars has great promise for certain types of vehicles, such as the hybrid electric locomotive that GE is developing, but for various technical reasons, the consensus is that some form of lithium-ion battery will power cars in this country.

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Nissan insists the battery issue will not prevent ramp up of retail production of the company's planned all-electric car by 2011. Similarly, GM's Tony Posawatz, line director for the Chevy Volt, is "very confident" that the automaker's partnerships with A123 Systems and Compact Power, a subsidiary of LG Chem of Korea, will yield batteries in sufficient numbers to assure the launch of the Chevy Volt within the intended 2011 timeframe. But Nancy Gioia of Ford is more cautious. "It's going to take a little bit of time and a chunk of change to go from the science lab to the pilot production phase to mass production of an efficient battery cell line of 10 million units a year." Among the issues she believes must be settled before commercial production of the batteries becomes feasible are battery life, reliability and the ability to operate under broad temperature ranges.

More significant from the perspective of utility companies, plug-in cars will need to communicate intelligently with the grid, and that means smart meters. Plug-in cars can be charged from any outlet, whether 110 volts or 220 volts, although the higher voltage cuts recharging time in half. Smart meters will allow utilities to control demand and shape the load and charge customers incentive rates for charging off-peak. California is ahead of the curve in installing smart meters, according to Efrain Ornelas, environmental technical supervisor for Pacific Gas and Electric's clean air transportation department. With a goal of equipping all 5.4 million customers by 2012, Southern California Edison also intends to fully deploy smart meters to its five million customers by 2012, and utilities across the country are following suit. "We're working closely with the Society of Automotive Engineers to develop codes and standards for how vehicles will communicate with the grid," says PG&E's Ornelas. "Customers will be able to program when to charge and to look for specific pricing signals with the option of giving us direct control as part of a broad demand-response program."

General Motors' plug-in, rechargeable electric-powered Chevrolet Volt is seen at the North American International Auto Show in Detroit in January.
SOURCE: AP/CARLOS OSORIO

Ultimately, the combination of smart chargers built into the cars and smart meters will permit a roaming capability, which will allow cars to recharge away from their home base, with electricity billed to the car's owner. But that's complicated, with transaction costs easily exceeding actual energy costs. With thousands of separate utility entities, it could make the phone industry's disastrous experience with roaming look mild by comparison.

The issue of developing codes and standards that both automakers and utilities can use efficiently points to what is perhaps the most fundamental unresolved issue on which the success of plug-in hybrids and all electric vehicles rests: a shared business model. Ed Kjaer is the director of electric transportation at Southern California Edison, and before that he held key positions with major auto manufacturers. He calls the electrification of the automobile a fundamental paradigm shift. "This is not about the automakers launching the next car model. It's about how do we integrate transportation into the energy system," says Kjaer. "It's an absolute win-win for two titan industries. If you think of this as part of an energy system, as opposed to a car, you start to explore some of the values on the utility side of the equation than can be monetized and returned to the customer in terms of value. For instance, if we connect the wheels to the grid at night, we're spreading fixed costs over more energy use and that potentially puts downward pressure on rates."

The new business model will go far toward defining the future of automakers, utilities, and the economy as a whole. But the challenges are significant. "We announced a partnership with Ford a few months ago, and it took us literally the first month of talking to each other before we mastered each other's vernacular," Kjaer recounts. "The business models are completely different. Throw out all the old ones. Start with a blank sheet of paper and a whole lot of imagination, and at the end of the day you come up with a shared vision where transportation connects to the grid. Our industries are being driven by the same forces: energy efficiency and environmental impact."

The environmental impact of electrifying transportation through plug-in hybrids and all-electric vehicles is clear and incontrovertible. No matter which of nine models is used, regardless of the generation carbon mix, a major study undertaken by EPRI and the National Resource Defense Council concludes that the environmental impact, both in terms of air quality and greenhouse gas emissions will be dramatic, with greenhouse gas emissions reduced by as much as 10.3 billion metric tons by 2050. With inevitable carbon constraints on both the utility and the auto industries, both stand to benefit enormously from the increased efficiency this new technology represents.

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