LIFT. MOVE.
Across the country, a transformation is under way that will improve the nation’s energy security, reduce air pollution, and bolster the economy. The nation is going electric.

BY DENNIS J. WAMSTED
SINCE THE DISCOVERY OF ELECTRICITY in the mid-1700s by Benjamin Franklin, inventors have been trying to harness its immense power. Today electricity powers nearly everything—from computers, smart phones, and the internet to sophisticated medical instruments and scanners to locomotives and subway systems. Even now, scientists and engineers are developing new products—and reimagining old ones—that utilize this unique energy source.

“If it can be lifted, moved, or pushed,” says Cedric Daniels, electric transportation program manager for Southern Company, the driving force should be electricity. That idea has taken hold across the utility industry, with companies both rethinking their internal operations and working with customers to install electric technologies in innovative applications and at new sites.

This transition has largely escaped public notice, however, since it is happening one customer at a time. But executives involved with utility electrification programs say the tipping point is here.

Georgia Port Goes Green
Perhaps nowhere has the electric transition been as complete, and as largely unnoticed, as at the Georgia Ports Authority’s (GPA’s) Savannah facility. Work there began almost 15 years ago when the port complex bought its first two electric cranes to move cargo from ship to shore, and right from the beginning the results were positive. Richard Cox, GPA’s general manager of equipment and facilities, told the *EPRI Journal (Winter 2012)* that what had been costing the port seven dollars in diesel could be done with electric equipment for only one dollar. And that doesn’t even account for the greater reliability of the electric equipment, the reduction in emissions, the reduced possibility of fuel spills, and the quieter workplace.

Since then, in a close partnership with Georgia Power, the port authority has worked steadily to electrify its equipment at the Savannah facility. It completed the electrification of the port’s ship-to-shore cranes, reducing diesel fuel consumption at the facility by 1.5 million gallons a year in 2008. The port authority finished the installation of 34 electrified refrigerated racks to keep containers cool without having to run diesel generators in early 2009 (and eliminated another 600,000 gallons of annual diesel fuel consumption). And last December, the port put four electrified rubber-tired gantry cranes (the cranes that move containers around a port facility) into service. Each electric gantry crane, based on a calculation by GPA’s engineers, reduces diesel-fuel consumption by an estimated 95 percent when compared to conventional diesel-powered units. While the cranes rely on cleaner, shore-based power to handle containers, they automatically switch to diesel generators when moving from stack to stack (or across roads).

The port is now in the early stages of a long-term plan to retrofit all of its 169 rubber-tired gantry cranes to run on electric power. GPA says that when the project is complete in 2022, the port’s diesel fuel consumption will decline by almost six million gallons annually and the facility will save nearly $10 million a year—even

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after accounting for the additional electricity purchases.

This last figure is what really matters, said Ben Echols, electric transportation program manager for Georgia Power. “It is a huge savings for the port, and when a container moves through the port cheaper, the port can lower costs to shippers.”

It may be impossible to credit its electrification work for all the port’s recent growth, but clearly something is working for the Savannah facility. According to GPA’s website, the port of Savannah was the second busiest U.S. container port for the export of American goods by tonnage in 2011. Perhaps as important, according to the EPRI Journal (Winter 2012), the facility now handles almost three million 20-foot-equivalent container units, up from less than one million in 2000—a compound growth rate of more than 10 percent.

While perhaps not common knowledge, other utilities certainly have taken note of what Georgia Power and the state port authority have accomplished, and are paying particular attention to the new electrified rubber-tired gantry cranes there. Debbie Korenek, division vice president of marketing and sales at CenterPoint Energy, says the Savannah success could be replicated at Bayport, the new container terminal in the Port of Houston complex. The goal in designing Bayport, which has been open less than 10 years, was to make it a green terminal, she said. As part of that effort, ship-to-shore cranes are electrified and infrastructure is installed to enable future cruise ships to use shore power (so-called cold ironing) when they dock at the facility.

“But there is even greater potential at the port,” said Korenek, specifically mentioning the Savannah rubber-tired gantry crane program. Each electric gantry crane reduces diesel-fuel consumption by an estimated 95 percent compared to conventional diesel units.
These measures take on even greater importance in an area such as Houston, she added, explaining that because Houston is an Environmental Protection Agency non-attainment area, getting permits for new economic development can be difficult, if not impossible—making every emissions-reduction effort worth a second look.

Small and Mighty
Given the need to look at every possible mitigation measure, it is not surprising that CenterPoint Energy has long supported sales of electric forklifts. While not major emitters individually, forklifts are everywhere, and taken together their emissions add up. The company has an aggressive clean air technologies program to help Houston businesses cut emissions, and spurring sales of electric forklifts is a key component of that initiative, said David Owen, the company’s clean air technologies program manager.

In place since 2006, the program has recorded more than 2,200 sales, avoiding the release of an estimated 635 tons of nitrogen oxides, a key smog precursor. This is the equivalent of taking more than 17,000 cars off the road, according to Owen.

Georgia Power has had a similarly positive response with its efforts to move electric forklifts from market novelty to mainstay, says Echols. There were misconceptions about their performance in the past, and, faced with a purchasing decision, managers often would stick with what they knew: an internal combustion engine (ICE).

But the reality is, adds Echols, “if you are moving things or people you should be doing it with electricity.” And speaking specifically about forklifts, he says that electric models “have gone way beyond what internal combustion engines can do. They are more efficient, there is no vibration, they are faster, and they are quieter.”

If you were building a distribution facility from scratch today, he continues, there is no way that you would buy ICE-based equipment. “We have gotten to the point now where electricity really can compete.”

Stan Sittser, project manager for transportation electrification at Portland General Electric (PGE), agreed with Echols’ assessment. “An electric forklift is not going to grab any headlines, but it is important.” What will get the electric forklift truly into the mainstream, he predicted, are the development and widespread use of quick-charging solutions. Not having to plan for overnight charging will be vital to their broader market adoption, he said.

Electric Equipment Takes Off
Another arena where electricity has become the fuel of choice is at the nation’s airports, particularly in the equipment (the baggage trucks, conveyor belts, tugs, and other vehicles) that ground crews use to service aircraft throughout the day.

Continental Airlines, now a part of United, was a strong backer of electric ground service equipment conversions, says CenterPoint
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Energy’s Korenek. As early as the mid-2000s, it had converted almost 50 percent of the ground service equipment it used at IAH, Houston’s main airport, now known as George Bush International Airport. According to a case study done by the Electric Power Research Institute (EPRI), the airline saved money using the electric equipment (despite its initial higher cost) because maintenance costs were so low. In addition, EPRI found that employees preferred using the electric equipment—a finding that has surfaced repeatedly when utilities and other entities have converted from internal combustion engines to electric.

Korenek says CenterPoint Energy is looking at further electrification efforts with United, and that the new Southwest Airlines terminal at Hobby, Houston’s second airport, will be electrified. “We are trying to help,” she says.

That is the same approach that Georgia Power took with Delta at Atlanta’s Hartsfield-Jackson airport, says Echols. The fuel of choice used to be diesel but the utility worked closely with Delta throughout the 2000s to show the airline, by far the largest operator at the airport, that electric equipment could do the job. They were skeptical, Echols admits, but the persistence paid off. Delta and other airlines now have transitioned to electricity to power much of the ground equipment at the airport.

“We helped establish electricity as the preferred fuel at airports,” says Echols.

They were so successful, in fact, the airport’s new international terminal, opened in 2012, is all-electric, a fact touted by the airport on its web site: “All Concourse F gates provide pre-conditioned air and 400-hertz power supplies for aircraft. This cuts jet fuel use dramatically, because aircraft auxiliary power units are not required to power or cool aircraft at the gates. Plug-in electrical chargers for ground services equipment…will be available at all Concourse F gates, saving fuel and reducing greenhouse gas emissions.”

**Evs Move to the Mainstream**

The electric transition in the automotive market is just beginning, but developments over the past several years offer a tantalizing glimpse of what is to come.
“Five years ago,” says Ed Kjaer, director of the electric vehicle readiness program at Southern California Edison (SCE), “electric vehicles [EVs] were an advocacy thing; the environmental community was pushing them, but there was little interest from the automakers and regular customers.”

This has changed dramatically in just the past couple of years, he continued, driven in large part by the success of the Nissan Leaf and the Chevy Volt, the two trailblazing EVs. Drivers love these cars, he continued, pointing out that the cars’ driver satisfaction ratings are more than 90 percent. “We would have killed to have customers like this,” notes Kjaer, who spent the early years of his career in the auto industry.

Lee Krevat, an EV driver himself as well as director of smart grid and clean transportation for San Diego Gas & Electric (SDG&E), adds: “The driving experience is fantastic. The acceleration is much better than a regular car.”

“One of the most important parts of his job, he says, is simply “showing people that EVs work, that the stuff is real. Having our customer representatives driving EVs is a huge benefit. That is where you spread the seeds.”

“Every single hybrid owner is a natural candidate to buy an EV next time in the market,” continues Kjaer. The move toward EVs is not the same as flipping a light switch, he adds, it isn’t going to happen all at once, rather it will be a steady upward trend.

While Kjaer acknowledges that the transition isn’t going to happen overnight, he is certain of the outcome. “Electric vehicles will become the dominant technology.”

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Innovative Rates for Fast-Charging Stations

Upward of 80 percent of all drivers in the United States travel less than 40 miles per day, which means most electric vehicle (EV) charging can occur at home, generally overnight. This assumption has been borne out in early data collected by The EV Project, an Energy Department-funded project tracking the behavior of roughly 7,500 EV drivers across the country. While it is too soon to say definitively, “common wisdom is that 80 percent of charge events for a typical driver will be at home,” the project reported in its year-end 2012 report.

Although this solves much of the problem, it does not account for the drivers who travel more in a given day, do not own a private home with access to their own personal charging station, or simply are not comfortable driving without access to a “refueling” station. For these scenarios, public charging stations are needed.

Exactly how many of these stations will be needed, and what type of charging equipment will be required, is unknown at the moment. Residential charging equipment, commonly called Level 1, takes between 8-12 hours to recharge an EV. Level 2 equipment, which is similar to a dryer outlet and is found both in residential and commercial applications, takes 4-8 hours to recharge an EV. And Level 3 or fast-charging equipment can refuel an EV in 30 minutes or less.

In Oregon, Portland General Electric (PGE) and the state government, in cooperation with the business community, are moving ahead with an aggressive effort to install state-wide public charging stations.

According to Stan Sittser, PGE’s project manager for transportation electrification, the state now has more than 700 publicly available charging stations, including at least 275 in the metropolitan Portland area alone. This will go a long way toward reducing, if not eliminating outright, the range anxiety that new EV drivers experience, he said.

Oregon’s network of EV-charging stations is growing fast. Websites, such as PlugShare, feature maps with the current charging station locations. iPhone and Android smart phone apps that locate charging stations also are available from PlugShare, Recargo, and CarStations.

Last year, PGE and the state completed their part of the West Coast Electric Highway, an initiative to make it possible for EV owners to drive on Interstate 5 from British Columbia to Mexico by installing quick-charging refueling stations every 25-50 miles along the 1,350-mile-long route.

PGE installed seven fast-charging sites with 20 hookups in all, Sittser said. But to make the process economic, he added, the utility needed to come up with a way to charge for the high, yet infrequent, electric demand from the charging stations. Because current-generation fast-charging stations can suck upward of 50 kilowatts from the grid when plugged in they can be liable for hefty demand charges, a costly proposition that would skew the economics of refueling.

So PGE came up with an “out-of-the-box solution,” says Sittser, adapting an existing rate schedule for high occasional demand for use with the new EV fast-charging facilities. “Just like the off-label uses of some prescription medicines,” he said, “we developed an off-label rate structure.”

The current rate, schedule 38, is designed to accommodate churches and other facilities that have infrequent periods of high demand. Instead of hitting a church with a demand charge when it fires up its power-hogging convection ovens for a monthly pot luck, Sittser explained, schedule 38 allows the utility to charge the facility more per kilowatt-hour than other customers and has a higher peak period rate, but there is no demand charge.

This is a solution that works for all parties, Sittser continued: It provides income to the utility, but doesn’t stifle occasional high electric use. Going forward, he continued, utilities elsewhere are going to need to develop similar innovative solutions to make public charging facilities work for everyone.
The beauty of a marathon, continues Kjaer, is that there is plenty of time for utilities to adjust. The grid has evolved over the years to account for and incorporate a host of new electric technologies, he says, including air conditioning, computers, high-definition TVs, and the like. It will do the same with EVs.

“A lot of EV charging will naturally occur at night, when consumers are home,” Kjaer says. And from an economic perspective this is good news for everyone: There is plenty of excess capacity at night so finding a new market for that electricity makes the system as a whole operate much more efficiently, benefitting all consumers.

SCE has done a lot of planning to incorporate anticipated new load into its forecasting, he continued, adding that now when the utility replaces transformers it includes estimates of expected load from EVs. But in reality not much has changed, Kjaer said, adding: “What we are seeing is a good harbinger for what the rest of the country is going to go through.”

There could well be one million EVs in SCE’s service territory in the future—that’s a lot of cars, but it still would be less than 20 percent of the number of registered vehicles in Los Angeles County alone so it is not that outrageous of an estimate—but by the time that happens “we will be looking at an entirely new grid as well,” says Kjaer, pointing out that nothing stays static in the utility industry and investment is a constant.

PGE’s Sittser made a similar observation, explaining that the Oregon utility recently did an exercise to estimate the impact an overnight transition to 20 percent EVs would have in its service territory. While such a transition is unrealistic, Sittser said, the utility found that the system could handle it.

But this does not mean utilities should stand on the sidelines, they need to be involved, continues Sittser. “Utilities have a great opportunity to shape the development of the EV industry,” he says, and can do a great deal to help keep costs down for everyone, particularly with the installation of charging stations.

On this point, Sittser used the analogy of a

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Utilities can play a similar role in building out the infrastructure necessary to make EVs a success. “Utilities can help the industry find the sweet spot where costs are lowest,” he says. “We know the grid, transformer capacity, and so forth.”

**Off-Peak Rates Work**

Another opportunity for utilities to shape the EV market, says SDG&E’s Krevat, is through time-of-use rates. The company has been using such rates on an experimental basis for roughly two years now, he said, and the findings are conclusive: Time-of-use rates work.

In fact, according to SDG&E data, the rates don’t just work, they work really, really well. Since June 2011, Krevat said, just 9 percent of
the customers in the experiment have plugged in to recharge their EVs during peak demand periods. In contrast, 79 percent waited until the utility’s super off-peak fare kicked in (from midnight to 5 AM) to start charging, with the remaining 12 percent opting to charge during shoulder periods. Compared to peak rates, the super off-peak rates are about 46-percent less expensive and the shoulder-period rates are discounted about 38 percent.

SDG&E, which has been at the forefront of the smart grid movement as well, is planning to propose time-of-use rates for all its customers, not just EV owners, later this year, Krevat continued. Such rates are the logical next step in integrating the grid and customer, and they benefit all parties involved. The new rates, which require California regulatory approval, would not take effect until 2015.

Krevat also cited a new project at the San Diego Zoo as another example of what the integrated future will look like in SDG&E’s service territory. The parking lot project, which was completed late last year, links 10 solar canopies, five EV charging stations, and a battery storage platform. The canopies are capable of producing 90 kilowatts (kW) of electricity; that electricity can be used directly to charge EVs at the five charging sites or to store energy in the 100 kW battery. If the battery is full and there are no EVs hooked up to the system, the power is sent into the utility’s grid. A further benefit, the solar canopies provide shade for roughly 50 cars.

**America’s Home-Grown Fuel**

An electric transition is clearly under way in the United States, a transition that promises both to reshape how the industry does business and to generate significant benefits for individual consumers and, by extension, the economy as a whole. While the industry is just beginning to publicize this transition, the executives interviewed for this article already have the marketing tag ready: Electricity: Made in America.

“EVs are red, white, and blue, and green, too,” said SDG&E’s Krevat.

Or, as SCE’s Kjaer expressed it: “The grid is getting cleaner, the grid has excess capacity, and the electricity is American-made. From an energy security, environmental, and jobs perspective, it all makes sense.”

Similarly, Southern’s Echols said: “Electrification is only going to become more a part of the solution. Everything is moving toward greater electricity use.”

And finally, National Grid’s Gilbrook concluded: “We haven’t even scratched the surface of what this technology is going to do for customers in this country.”

Made in America indeed. ✰