Are Electric Cars the Future?

Getting America's power companies to invest in the clean transportation revolution is critical to reducing air pollution and the emissions that cause climate change. It will save us all money. The key is creating a system that allows utilities to lead the way

Jeff Allen is executive director of Forth, a trade association and advocate for electric and advanced mobility. Forth also presents the Roadmap Conference each June.

The transportation system is on the cusp of disruption — and not a moment too soon. Getting to and from work and play and running errands incurs, after housing, the second-highest total expenditure for most U.S. families — an average of $9,500 a year. Even in walkable, bike-friendly, livable cities like my home town of Portland, Oregon, where we drive about 25 percent less than the national average, most trips are still made by private automobile, and the average Portlander is still projected to drive over 20 miles a day in 2040.

The internal combustion engines that have powered our cars for more than 100 years rely on dozens of chemically inefficient contained explosions every second to drive pistons up and down, which is mechanically the wrong approach. It's no surprise such a Rube Goldberg contraption doesn't actually turn much of the energy in gasoline into forward motion. As if to purposely create irony, this machine also releases a lot of harmful combustion byproducts to the atmosphere, while obtaining adequate fuel requires subsidizing despotic regimes.

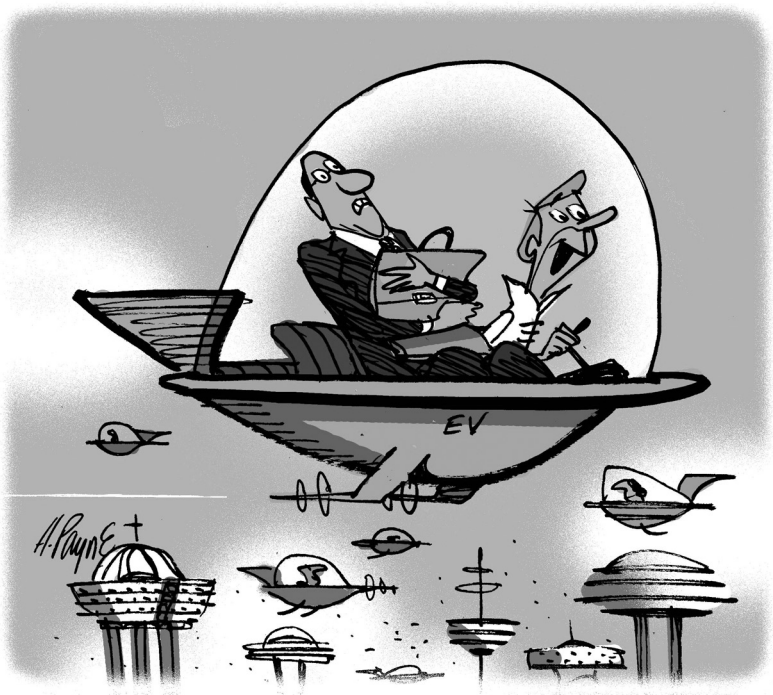
So much for the prime mover; what about the vehicle as a whole? We love our cars! We live in our cars! But the average car is parked about 95 percent of the time; when in motion, it is typically carrying an average of 1.08 people. In fact, the average car is used at less than 2 percent of capacity. It's like owning a home you live in only one week a year.

However, the modern mobility industry is now seeing upheaval at a scale and pace unique since the widespread proliferation of the automobile a century ago. Companies like Uber and Lyft aim to put private cars to work more hours of the day. Car-sharing companies like Car2Go and ReachNow have proliferated. Firms like Lime, Bird, Scoot, Jump, and others are replicating that model with electric scooters, bikes, and other vehicles. Luum and Scoop are revolutionizing the commute and carpool experience. Technology to allow self-driving vehicles is advancing rapidly, with pilot deployments popping up all over the country. Some consultants have predicted that these forces could reduce car ownership in the United States by 99 percent in coming decades.

Meanwhile, the basic vehicle hardware is undergoing a major transition as well, from those inefficient and dirty internal combustion engines. Electric-drive vehicles are faster, simpler, and — with double-digit annual decreases in battery costs — increasingly cheap to purchase and operate. Sales of electric vehicles are growing fast, with automakers seeming to announce

new models and major investments every quarter. Well over half of all new cars sold in Norway are now battery powered, and over 1.1 million electric vehicles were produced and sold globally last year. China is responsible for over half that number. Owners are happy — electric cars accelerate more quickly, are cheaper to maintain, and come with a bevy of high-tech options.

It's not just cars that are going electric. Dozens of transit companies have pledged to electrify their entire fleets, finding that battery buses are cheaper to operate over their lifetime than their diesel equivalents. Companies like Daimler and Tesla are taking orders for electric long-haul trucks, many school districts are testing clean school buses, and even airplanes are getting an electric-drive makeover.



All this disruption comes not a moment too soon. Our cars and trucks have always been one of the largest sources of unhealthy air pollution in our cities. More recently, the transportation sector has overtaken generation and manufacturing as the largest (and fastest growing) single source of carbon pollution in the United States. Our transportation system also kills some 30,000 people a year in collisions in the United States alone, wastes billions of hours of our time in traffic jams, and causes a host of other problems.

But changes have been underway in earnest for less than a decade, and they are quickly raising in their wake a host of legal and policy questions. In particular, the electrification of the transportation system creates for the utility sector a number of opportunities, challenges, and questions.

Power companies have a lot at stake here. Utilities across much of America have seen stable or declining demand, even in the face of rapid economic growth. This is a tribute to the increasing effectiveness of energy efficiency, the growth of rooftop solar and other forms of distributed generation, and an increasingly smart power grid. It is in many ways a great trend. However, it also creates a problem: how will we continue to pay for the grid we rely on for reliable power while integrating diverse generation sources and loads — and keep costs affordable?

Electrifying mobility is one of the most promising ways to replace declining load, and to do so in a way that takes advantage of an increasingly smart and clean system. Electric cars buy a significant amount of power, generating revenue for utilities, but naturally tend to charge at night when there is a lot of cheap, excess power. In other words: they are a profitable market for generators. One study by California consulting firm E3 found that each electric car in the Golden State was worth between $2,778 and $9,799 to the utility and ratepayers over its lifetime. Studies in other states have also found substantial, if more modest, benefits.

Electric vehicle charging can also be managed fairly easily — nearly every car allows a driver to schedule charging for the middle of the night, while smart chargers allow rates to vary slightly in real time to create a shock-absorber effect. Cars' large batteries can potentially provide other valuable services to the grid, even storing excess wind or solar power to be released later as needed.

In addition to providing profitable and flexible load, transportation electrification can also strengthen the utility's brand and thus its relationship with consumers. A survey by the Edison Electric Institute found that almost two thirds of ratepayers want their power company to take a leadership role in promoting

electric transportation. People tend to have an emotional bond with their cars, and utilities can become a trusted partner in that relationship.

Electric utilities are increasingly recognizing the potential of transportation electrification. California utilities have led the way, but others are following quickly. According to the Atlas EV Hub tracking site, 25 utility program filings in 14 states have been approved by regulators across the country, which will result in $1.1 billion in total investment. Another 31 filings in 16 states are under review by regulators and would add another $1.4 billion. And this is just the beginning: roughly 40 percent of all utility proposals tracked by Atlas EV Hub since 2012 were filed in 2018.

Environmental advocates also have a lot at stake in transportation electrification. Increasingly, they are realizing that the path to a low-carbon economy will require not only squeezing the heat-trapping element out of every kilowatt-hour, and squeezing more work out of every kilowatt-hour through efficiency, but also electrifying as much of the economy as possible. In other words, decarbonize the grid, then electrify everything.

The path to a low-carbon economy will require not only squeezing the most from every kilowatt-hour but also electrifying as much of the economy as possible — especially the transportation sector

Transportation is one of the most promising places to start, especially because it is so inefficient to begin with. The Union of Concerned Scientists regularly produces "well to wheels" comparisons of gasoline and electric vehicles, and most recently concluded that driving an average EV in the United States is equivalent to owning a gasoline car that gets 80 miles per gallon. Furthermore, while most cars get dirtier every year as they age, electric cars actually get cleaner, as the grid gets cleaner. Electrifying mobility has to be the core of any long-run carbon strategy.

At the same time, most environmental advocates working in transportation share a strong dislike for private automobiles, and bear the scars of years of fights with auto companies. As one progressive advocate said to me, "Why would we make it easier to charge your car downtown? We don't want your car downtown!" Environmentalists have tended to focus more energy on encouraging good transit systems, bike and pedestrian facilities, sound land use planning, and measures like congestion pricing to reduce excessive reliance on cars. These are all important tools and we will still need them all in a zero-emission mobility system. Too often, though, they are seen in opposition to efforts to encourage cleaner cars, rather than as equally vital pieces of an "all of the above" strategy.

Automakers are also conflicted. They have long fought the Zero Emission Vehicle Mandate imposed by California and several other states, which has required them to sell increasing numbers of EVs. Most car companies still make 99 percent of their sales, and all of their profits, from gas and diesel cars, and have little incentive to disrupt themselves. Many car companies are still only selling their electric cars in small numbers, in a few segments — there is still no battery-powered pickup truck — and in a few geographic markets (notably those ZEV states). Outside of those markets, it has been exceedingly difficult to move transportation electrification forward.

More recently, however, many car companies have begun to see electric vehicles as the future of their industry. Electrification is the only viable path forward in the face of concerns about air pollution and climate change; markets around the world are pushing in this direction; governments are imposing mandates and other inducements; and frankly, the technology is just better. As a result, nearly every major automaker has made a substantial public commitment to electrifying its fleet. Manufacturers are increasingly embracing plug-in hybrids that reduce gas usage, battery-only vehicles, and fuel cell vehicles that use hydrogen to produce electricity. Collectively they have committed to dozens of new models and billions in new investment. Meanwhile, new entrants like Tesla are demonstrating the huge consumer interest in battery vehicles, and heavier-duty electric vehicles, like transit buses and trucks, are also becoming increasingly cost-competitive — and available nationwide. In a major development, General Motors recently floated its own proposal for a national ZEV program.

Utility ratepayers also have a lot at stake in electrifying transportation — and not in the way you might think. Critics — especially oil companies — have been fostering the argument that "I don't want to pay extra on my power bill because some millionaire drives a Tesla." It's a natural concern — but misplaced. The truth is that more electric vehicles will mean lower power bills for everyone. As noted above, electric ve-

Continued on page 40

Sidebar

Great Cars, But Ultimately Still Niche Products

I bought a Tesla Model 3 this year, and it is perhaps the coolest car I have ever owned. It's an iPhone on wheels, with a minimalist driver interface. It's a stoplight dragster with instant torque. It's an apex-carving athlete with a low center of gravity. It's a fuel saver.

Yet the Tesla's inherent limitations as an electric vehicle make it — like the Toyota Prius last decade — a fashionable niche car rather than a harbinger of a broader, battery-powered future.

EVs are still hobbled by range, infrastructure, and customers that don't see the environmental urgency of going electric. If there is a mass application for electric cars, it's likely an autonomous future with electrified, self-driving fleets.

The first viable auto startup in my lifetime, Tesla has brought Silicon Valley's unique perspective to the automobile. Like other digital geniuses (Uber's Travis Kalanick, Google's Sergei Brin, Amazon's Jeff Bezos) who have re-defined services and products from taxis to books, Elon Musk has re-imagined the car. Most reminiscent of Apple's Steve Jobs, Musk is a brash, controversial figure who understands the allure of bold design in selling a technological vision.

But as new as the Model 3 feels, battery-powered vehicles have been around a long time.

They are clean and easy to operate, but their cost and range disadvantages have doomed them to play second-fiddle to the internal combustion engine for a hundred years. In the early 20th century companies like Detroit Electric enjoyed success with wealthier customers by producing easy-starting battery cars compared to cranky, crank-start gas-mobiles. The advent of the starter motor spelled electrics' doom.

Battery-power made a resurgence in the early 21st century as Greens rose to political power — stoking fears of peak oil and global warming. The wildly popular Toyota Prius became the first battery-powered car to sell over 100,000 units a year in the United States.

The egg-shaped "Pious" was a must-have accessory for eco-conscious celebs as gas prices pushed $4 a gallon in 2008. Manufacturers flooded the market with gas-battery vehicles like the Ford Fusion hybrid, Ford C-Max, Chevy Bolt, Honda Insight, Lexus ES, and more.

Pundits predicted a hybrid sales boom, and in 2011 Toyota declared that the Prius would eclipse the Camry as its best-selling vehicle by the end of the decade.

Everyone was wrong.

Henry Payne

The oil shale boom vaulted the United States to the world's number-one oil supplier, gas prices plunged under $2 a gallon, and not only are Prius sales down 35 percent (to less than 90,000 units), but the best-selling Toyota model is now an SUV — the RAV4, at 400,000-plus annual sales. Hybrid sales have stalled at below 3 percent market share, and the Volt and C-Max are in the dustbin.

Electric vehicles face similar challenges. The Model 3 has electrified EV marketing, but range issues persist. Most EV sales have been in California where the weather (temperate) and political climate (big subsidies) are favorable. But here in Michigan, my 310-mile range Model 3 could not make a routine, 240-mile business round-trip to Battle Creek this December because cold weather degrades range by 30 percent.

I had to add 30 minutes into my commute in order to refuel at a Battle Creek Tesla Supercharger. While I waited, another plugged-in Model 3 owner lamented the challenges of his weekly Chicago-Detroit business trips.

The problems are more acute for EV owners without access to Tesla's exclusive charging network. Most of my peers cringe at the complications of charging EVs outside their homes. Just as in the early 20th century, Teslas make sense to upscale households with multiple vehicle options.

Mainstream EVs like the Chevy Bolt, meanwhile, have struggled to gain sales traction. Meanwhile, governments are forcing EVs on a reluctant American public and carmakers who are reluctant in turn. Essentially, manufacturers are now required to make two types of vehicles — profitable gas cars popular with customers and money-losing EVs popular with pols.

In the Bolt General Motors sees an opportunity to satisfy both constituencies, and the predicted Age of Autonomy may be EVs best chance of adoption. With the Chevy EV as the flagship of its emerging self-driving Cruise Automation fleet, GM — and competitors like Waymo, Uber, and Argo — see batteries as best-suited to ferry passengers and goods 24-7 in cities. In short-range urban environs, fast-charging seems a natural fit for their daily routine.

Of course, superchargers aren't cheap and pose huge grid challenges as manufacturers push 350 kW charging (beyond Tesla's current 120 kW draw). That's a business problem. In the meantime, look to Tesla as the Apple computer of passenger cars: high style, low market volume.

Henry Payne is the auto columnist for the *Detroit News*. Also a syndicated cartoonist, he has penned the *Forum*'s covers for nearly 30 years.

hicles are profitable load for utilities, allowing them to spread the fixed cost of generating and transmitting power across more power sales. That lowers costs for everyone. These benefits become even greater if utilities actively manage charging, channeling cheap excess power into cars when it's not needed and slowing charging during peak periods. Electric vehicles can even provide emergency power during natural disasters or other grid problems — over 7,000 homes in Japan already use this technology, and Nissan Leaf cars were used to power streetlights there after the Fukushima typhoon in 2011.

Electric vehicles have broader economic benefits, too, returning money to owners that would otherwise be spent on gasoline, much of it imported from unstable regions. A study by the California Electric Transportation Coalition found that every dollar shifted from buying gasoline to making other kinds of purchases produces 16 times more jobs. Other studies have found that every electric car purchase can increase state GDP by as much as $2,000 per year. The potential benefits of this "electric dividend" are enormous. A recent report by M.J. Bradley & Associates found that increased use of battery-powered cars would save Minnesota residents — even those who do not own one — $120 per year on their power bills, while providing net benefits of $30 billion statewide by 2050. People who drive electric cars save even more money: in most of the country, "filling up" on electricity is equivalent to paying about $1 per gallon for gasoline, and drivers can expect to save hundreds of dollars every year.

Every dollar shifted from buying gas to other purchases produces 16 times more jobs. In California, every electric car purchase can increase state GDP by $2,000 per year

Despite these benefits, ratepayer advocates and regulators have often been slow to support transportation electrification proposals from power companies. To some extent, this is exactly because utilities have become more aggressive — after all, ratepayer advocates and regulators spend a lot of their time acting as a check on what utilities want to do. Specifically, policies and regulations have spent the last few decades creating incentives to reduce power use — which has been conflated with reducing energy use. Advocacy groups have pushed in this direction with substantial success. Load building has become a pejorative. With battery mobility, however, the best way to reduce energy use is by using *more* electric power — and correspondingly *less* gasoline. This requires some major changes to the way we think about, and regulate, power companies. It also requires some major shifts in political alliances and relationships.

It is also important that we build equity and inclusion into this work from the beginning, not as an afterthought. As noted, transportation is the second highest expense for most households, and an even greater burden for low-income Americans and communities of color. Major transportation investments have a history of reinforcing inequality — whether it's a freeway demolishing neighborhoods or a bike lane that accelerates gentrification. We need to learn from these mistakes and ensure that electric and other advanced mobility technologies benefit traditionally underserved communities. This is not just a moral imperative — it's a very practical one. Bringing them the benefits of electric mobility will have greater economic and environmental benefits than bringing it to affluent suburbs. Furthermore, if we fail to do so, we deliver potent ammunition to our political opponents, who have already shown that they will use it.

With these cross currents and headwinds, it's hardly surprising that utilities, environmentalists, ratepayers, transit systems, and car companies are not yet singing in harmony. Promising alliances such as the Transportation Electrification Accord are slowly emerging to even out the score. However, advocates across all sectors need to be faster and bolder — we need a stronger, more strategic campaign to electrify mobility via coordinated state and local implementation of forward-looking, problem-solving national policies.

The cleanup of our grid offers one promising model for improving transportation in many respects. In the early days of renewable energy, advocates had to justify wind and solar power based on the preexisting utility regulatory structure as sources of grid stability, price stabilization, etc., or perhaps based on the potential future risk of carbon regulation. Eventually, advocates shifted strategy to establishing a *renewable portfolio standard* that simply requires utilities to buy or supply a minimum amount of renewable energy (typically starting at 15 percent, and increasing over time.) The

Continued on page 42

Sidebar

Electric Companies Are Powering a Revolution

Working with their customers as well as with cities and states, electric companies are making significant investments in clean energy and smart infrastructure. As of 2017, the power sector's carbon dioxide emissions are down 28 percent from 2005 levels — the lowest since 1988 and lower than transportation. More than one third of the nation's electricity comes from carbon-free sources, like nuclear and renewables, and another third comes from low-carbon sources.

Emissions will decrease even more as electric companies transform their energy mix to meet their customers' expectations for clean power. Since 2005, the percentage of renewable sources in the energy mix has quadrupled, and more than half of new capacity is wind and solar.

The industry's carbon reduction efforts can be amplified if we enable the transportation sector to electrify, providing substantial environmental benefits by reducing both CO_2 emissions and other air pollutants. Transportation electrification is the bridge that connects our cars, trucks, buses, and trains to the energy grid and to cleaner electricity and lower carbon emissions. And electric companies are ready to help.

In a major milestone, the number of electric vehicles on U.S. roads surpassed one million last year. The Edison Electric Institute and the Institute for Electric Innovation project this number will grow to more than 18.7 million in 2030. This growth will only happen, however, if purchasing an EV is an easy choice for customers and ownership is rewarding as well.

Electric companies are well suited to address two of the primary barriers holding customers back today: awareness about the benefits of EVs and the availability of charging infrastructure. Generators can use existing customer communication channels to increase interest in EVs and help streamline the buying process, and they can give customers more charging options by deploying infrastructure at homes, workplaces, multi-family dwellings, and public locations.

The benefits of electric transportation are not limited just to passenger vehicles. While about 60 percent of transportation-related carbon emissions in the United States is from passenger cars and light-duty trucks, nearly 25 percent comes from medium- and heavy-duty vehicles. As electrification becomes an economic choice for a growing number of commercial applications, power companies can take this same model — educating their customers and providing charging options — and apply it to commercial operators.

Kellen Schefter

Electrifying fleet vehicles like buses and trucks, and even material handling operations at ports, airports, and warehouses, reduces emissions and can improve local air quality, which is critical for affected communities. Transit systems and new ridesharing and carsharing platforms can benefit from transportation electrification as well.

Power companies are critical to ensuring that EV charging is integrated with the energy grid in an efficient manner. Generators already are working with customers to site infrastructure where the grid has the capacity to support it. While this is not typically an issue for home charging, it is important for high-power applications like public direct current fast charging or charging infrastructure to support large fleets. Power companies also are providing customers with rate structures that facilitate transportation electrification in an equitable and efficient manner, including testing new options to see what works best for this new type of energy customer.

EVs are flexible resources that can charge at different times, which creates an opportunity to manage charging in a way that benefits both customers and the grid. For example, in states with large amounts of solar energy, electric companies might send price signals to encourage charging during hours of peak sunshine. Programs that encourage charging to occur when the grid has available capacity will minimize costs and help it operate more efficiently — effectively lowering the average system cost for all users. Electric companies are evaluating a range of solutions that meet customers' needs, including not only education but also improved rate design and smart charging platforms.

The benefits of electric transportation are clear, and America's power companies stand ready to deploy the infrastructure needed to power a clean energy future that benefits all customers and communities. 17 states have approved power company electric transportation programs, with Maryland and Michigan the latest, and there are in addition numerous pilots promising further transformation. This momentum is critical in helping to leverage the carbon-free transition of our generating fleet already underway into a cleaner vehicle fleet as well. Let's keep it going.

Kellen Schefter is senior manager, sustainable technology, at the Edison Electric Institute.

more traditional roles of utility regulators — such as ensuring prudence and cost effectiveness — were then applied as constraints shaping strategies to meet that goal.

Iowa adopted the first RPS in 1983. At last count 29 states and the District of Columbia have adopted such standards, and several of those are now approaching 100 percent. This system has worked well — and helped us reach a point where renewables are now cheaper than fossil-fueled power plants in many cases. This effort benefited from national coordination and support of state-level campaigns; it required new and stronger coalitions between stakeholders; and it took decades to come to fruition.

We are far from that kind of a framework with transportation electrification. Only a few states, so far, have even explicitly allowed utilities to spend ratepayer funds to accelerate transportation electrification. Only California and Oregon have required utilities to do so. Neither of those last two states has set a legally binding target, comparable to an RPS, though California is inching in that direction.

Even in the most progressive states, utilities are whipsawed between competing and often directly contradictory policy direction from different state and local governments. Utility cost-of-service regulation does not generally allow consideration of other goals, such as clean air. In a single state, it's common to have an energy or environmental agency pushing transportation electrification to reduce carbon emissions, while the public utility commission slows power investment, a transportation department pushes for higher fees to offset lost gas tax revenue, and cities make it difficult to site charging facilities.

Only a few states have explicitly allowed utilities to spend ratepayer funds to accelerate transportation electrification. Only two have required utilities to do so

It is up to advocates and decision-makers to align the goals of state and local energy, environmental, and economic policy with clear intentions and policy goals. An organizing principle similar to the RPS is a good place to start. State legislatures should require that power companies promote the electrification of the transportation system. These laws should set specific targets, with an ultimate goal of 100 percent of new vehicles being fully electric no later than 2040. States should then require utilities to submit plans intended to achieve and support electrification of transportation.

Just as RPSs set clear long-term expectations for renewable energy, this kind of "electric mobility standard" will create objective and clear guidance for utilities and other stakeholders and allow us to start with the end in mind. Utility regulators and ratepayer advocates can then focus on what they do best — making sure that we pursue those social goals as cost effectively and fairly as possible. Ideally, this kind of policy should be paired with a country-wide mandate to ensure vehicle model availability, such as the national ZEV program proposed by General Motors. There are certainly other supporting policies needed, from updated, "EV ready" building codes to streamlined permitting for charging. However, these efforts will be much more effective when supported by clear, objective, long-term goals and clear implementing directions to utilities.

Once we have clear policy direction, what should a robust role for utilities look like? It will appear different around the country, and will change over time. After all, this is a rapidly moving field, with new business models and technologies emerging constantly. However, we know it will need to be a wide-ranging role with many different components.

Most stakeholders recognize that there should be some utility role in charging infrastructure, for example, and that's important. Selling power to drivers as a fuel is simply not profitable at this point, and won't be until we have a lot more electric cars on the road. Fast chargers that allow vehicles to drive away in 20 to 30 minutes are particularly important — and expensive. If we want to enable drivers to take their cars anywhere, we need a network of these chargers, and some of them will have to be in remote rural areas that will not be used very often. For example, several key fast chargers in Oregon that enable travel to the coast or to other parts of the state are only used a few times a week. But without them, electric car adoption in the state is constrained.

Electric utilities know how to provide reliable service, and how to support new customer needs, whether it's air conditioning in the last century or an EV charging station today. Regulated utilities also have the patience to build infrastructure, even when it may take 10 or 20 years to pay back. That's why we counted on them to bring power to our rural communities and

Continued on page 57

Sidebar

Working on the Railroad to Reduce Emissions

Railroads have the lowest carbon and other pollutant emissions among land transportation modes, and work is underway to further reduce those emissions by electrifying locomotives and other elements of the rail system.

As part of this strategy, America's railroads are developing new battery technologies to support electrification. In late 2018, BNSF Railway and General Electric Transportation announced a partnership to develop and pilot a hybrid locomotive system that takes advantage of recent advances in energy storage.

Factors that give rail its inherent efficiency advantage include low rolling friction (steel wheels on steel rail), dedicated rights of way, and the ability for trains to carry multiple cars. Trains use less than a third of the energy that trucks do per ton-mile moved, resulting in a sustainability win-win: lower operating costs and lower emissions, including particulate matter and carbon.

Fortuitously, locomotive wheels are already powered by electric traction motors. Electricity to these motors can be supplied by different methods, such as diesel engines, overhead power lines, or batteries. Diesel's high energy density has made it the preferred fuel for powering long, heavy freight trains. Electricity can be supplied by overhead electric lines for rail systems with shorter, lighter, and faster trains.

The initial BNSF and GE project is expected to increase fuel efficiency by roughly 10 percent. The project is co-funded by the California Air Resources Board and sponsored by the San Joaquin Valley Air Pollution Control District. The hybrid concept is similar to a plug-in hybrid car: attach the car to a dedicated power outlet in the garage, convert dynamic braking power to stored energy, and use a smart system to manage the battery, electric motor, and supplementary internal combustion engine.

The hybrid locomotive system, as part of the BNSF-GE pilot, will include two traditional diesel-electric locomotives; one battery-electric locomotive; and a smart energy management system, a General Electric product called Trip Optimizer. The batteries will initially be charged in the rail yard and additionally capture energy from downhill dynamic braking events that would otherwise be wasted as heat from friction.


John Lovenburg

BNSF is also partnering with manufacturers to develop battery-electric and electric equipment at yards where consumer products in containers and trailers are moved between trucks and trains. BNSF has already deployed wide-span electric cranes that eliminate onsite emissions and provide productivity benefits at intermodal yards in Seattle, Chicago, Kansas City, and Memphis. Active and planned R&D projects include battery-electric trucks, electric side loaders, and hybrid straddle cranes.

So why electrify? Electric motors have roughly triple the efficiency of internal combustion engines, which means less energy consumed, local emission reductions, less impact on the climate system, and an improved social license to operate.

Further advances will come with battery innovation breakthroughs. Solid-state and air-metal batteries are among technologies that could result in quantum leaps in energy density. These types of advances might enable batteries alone to power local and regional trains and spur the conversion of long-distance freight trains to electric power.

But because BNSF's rail yards operate 24 hours a day, charging of batteries can mean significant down time as well as higher equipment costs. For example, if a piece of apparatus needs to charge one hour for each hour of operational use, twice as much equipment would be needed to replace its diesel equivalent. That places a significant burden on electric replacements to be economically and environmentally superior.

One strategy to deal with this issue is "opportunity charging" — plugging in during work breaks. Other charging options that would require less time are overhead power lines, ground-level third rails, or inductive charging. This last is the same concept as those mobile-phone charging pads showing up in some coffee shops.

Keys to commercial success in electrifying the railroad will be safety, operational compatibility, and lower total cost of ownership. Keys to environmental success will be lower carbon emissions and lower emissions of diesel pollutants such as particulates. Policymakers can help facilitate the needed technologies by partnering on research and development, subsidizing electric vehicles and associated infrastructure, and advancing other policies that reduce the costs of electricity versus diesel.

We've been working on the railroad to make it better. The present is good and the future is bright.

John Lovenburg is the environmental vice president for BNSF Railway and the co-sponsor of a BNSF battery initiative.

"Are Electric Cars the Future?"

Continued from page 42

farmsteads decades ago, and we need them to enable clean transportation there as well. A national network of chargers is also an important driver of electric vehicle adoption — which, to repeat, will benefit all ratepayers, even those who don't drive. However, this focus on charging has often overshadowed the many other important roles power generators need to play to transform the mobility system.

Utilities should also play an active role in managing charging load to maximize benefits and minimize costs to all consumers, and their rate design is an important piece of this puzzle. However, some past proposals have tried to force zero emission vehicle owners onto "time of use" rates or into complex and confusing systems that could complicate or discourage electric vehicle adoption. Meanwhile, stakeholders also need to help utilities revisit demand charges. These charges, based on maximum potential load, are intended to assign costs to customers with expensive infrastructure needs but low utilization. However, they are particularly problematic for fast chargers and large workplace charging installations, where they can make up over half the monthly cost of operating such necessary infrastructure.

These installations are critical to encouraging widespread use of electric cars, thus providing benefits far beyond their local use — but may not be used enough to cover demand charges for many years, if ever. While rate design is important, it's just one tool for managing and rewarding charging behavior that maximizes benefits for everyone — and stakeholders need to keep the overriding goal of a clean, electrified mobility system front and center.

We also need utilities to play a major role in driving consumer engagement. There is no coordinated education campaign to promote electric vehicles, and it shows. Even in California, where the electric revolution is most advanced, over half of consumers cannot even correctly name a single battery-powered car model — and that statistic has not improved in the past six years. Power companies are a natural and trusted source of information about electricity and efficiency. Utilities have helped transform other markets in the past, building on their consumer relationships and community partnerships. For example, energy efficiency campaigns across the country have been hugely effective in reducing power demand. Many of these programs rely on contractors and regional partnerships, including multi-state compacts, and this will be important in transportation as well. Many people will travel a long distance to buy a new car, and media markets can be even larger. What's clear, though, is that the transition to battery drive will take at least the same level of effort and investment from utilities that energy efficiency programs have required, and will provide equally large benefits to ratepayers going forward, which is to say all of us.

Just as power companies generally have dedicated programs to help low-income customers pay their bills, we need them to have dedicated programs to help those customers access clean electric mobility. However, many attempts to address this issue so far have been primitive or even counterproductive. For example, several utilities have agreed to install a certain share of chargers in low-income areas. However, if people in those areas don't own electric cars, such charging doesn't help them and may even drive gentrification. Likewise, zero emission transit buses can help, but only where communities are already well served by transit. Shared electric cars may work for some easy to schedule needs (grocery shopping, medical appointments) but not for others (commuting). The first step to getting equity right is to listen hard to neighborhood needs and make sure that impacted communities are in the room shaping the strategy. Current ratepayer advocates know a lot about low-income energy needs, but may not understand low-income mobility needs. There are promising pilot projects around the country, but we need more equity-focused organizations engaged in this vital work.

It has taken us decades to transition from coal to renewables in power generation. Moving from oil to electricity in transportation will be even harder. While a kilowatt-hour is a kilowatt-hour — a commodity that's invisible to most people — the way we get around is much more personal, and emotional. A mile riding in an aging diesel bus in urban traffic is different than driving a mile in an electric convertible on an open road. Advocates will also face much harder opposition and inertia. The coal and natural gas lobbies are powerful, but pale in comparison to the oil lobby — and to the inertia of individual drivers.

As it should, most of the action will occur where utility regulation already takes place, at the state level — operating under national policies, programs, and standards, with city governments also playing a role, particularly in charging infrastructure and in transforming transit. To succeed, government officials at all levels need to work with drivers, car companies, bus systems, mobility advocates, and environmentalists to help utilities play a leadership role in transportation electrification. **TEF**