

U.S. Electric Transportation

Getting in Gear

BY MICHAEL BRITT AND TOM FLAHERTY



early every month major announcements are made about electric transportation (ET). That category includes on-road electric vehicles, infrastructure, and off-road transportation or handling by an original equipment manufacturer or a government entity.

These frequent ET announcements come from a wide range of OEMs, such as Volvo, Honda and Renault. They address production-line conversion, battery and charging technology performance, new development partnerships, expanded category offerings and autonomous vehicles. They are capturing an increasing share of news headlines.

Conspicuously absent, however, has been a demonstration of how the utilities industry is actively enabling ET market development.

Today's U.S. electric vehicle marketplace is different from what it was just two years ago.

However, it is still playing catch-up with developments in other parts of the world. As consumers recognize that automakers are offering attractive model options that appeal to their ownership preferences, EV sales will steadily increase.

With growing momentum behind EVs, U.S. OEMs have an opportunity to leverage their scale, reach and promotional clout to play a more visible role in the market. And as consumers consider whether to switch from vehicles with internal combustion engines to EVs, these OEMs may be poised to prosper.

But for the U.S. EV marketplace to get out of first gear, utilities need to play a more active role in accelerating public awareness and galvanizing commercial adoption. They can do that through collaboration with the global OEM community

Revvig Up

When EVs first began their Tesla-led emergence in the U.S. market around 2010, the common belief was that rapid proliferation would soon follow. Factors like high gas prices, increasing CAFE standards, available subsidies and the higher prices for conventional vehicles were expected to be primary drivers of consumer demand.

Recognition of the potential of EVs to reduce greenhouse gas emissions by the burgeoning environmental movement also was taking hold. It was expected to create an additional impetus for both individual and corporate consumers to opt for the cleaner offerings provided by EVs.

It was assumed that modestly priced, name-brand offerings would provide sufficient market stimulation to entice customers

Michael Britt is the vice president of Southern Company's Energy Innovation Center and leads growth initiative development and collaboration across the Southern Company system.

Tom Flaherty is a senior advisor to Strategy&, a part of the PwC network, and has consulted for more than forty years to the power and gas sectors on strategy and growth.

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to buy electric.

But the reality turned out to be far different than market forecasters had predicted. Instead of EV demand well exceeding one million vehicles by 2017, U.S. EV sales

accounted for a tepid two hundred thousand units, or around one percent of new sales, last year.

See Figure One.

OEMs were not able to overcome low gas prices, range anxiety and limited subsidies to realize loftier expectations for EV adoption in the U.S.

Contrast this U.S. experience with that of Norway, where the EV market share approaches seven percent of total vehicles. In 2017, approximately forty percent of new vehicles sold in Norway were EVs.

This level of adoption has been spurred by a concerted focus on internal combustion engine emissions control, generous incentives and ingenuity in building consumer demand.

For example, Norway created a blend of value-added taxes with import and road tax relief. Simultaneously, it provided attractive individual exemptions from roadway tolls, allowed EVs access to bus lanes, and offered free parking to EV owners. Norway also actively expanded its charging infrastructure to enable EV usage.

The result: Norway, with 5.2 million residents, now boasts the highest per capita number of all-electric cars in the world, with almost a hundred and fifty thousand EVs on its roads, according to the Norwegian EV Association.

By comparison, the U.S. is home to some three hundred twenty-five million residents and has about five hundred seventy thousand EVs traversing its roadways.

Some countries like France, Germany, China and India are

FIG. 1 HISTORICAL U.S. EV SALES AND FORECAST

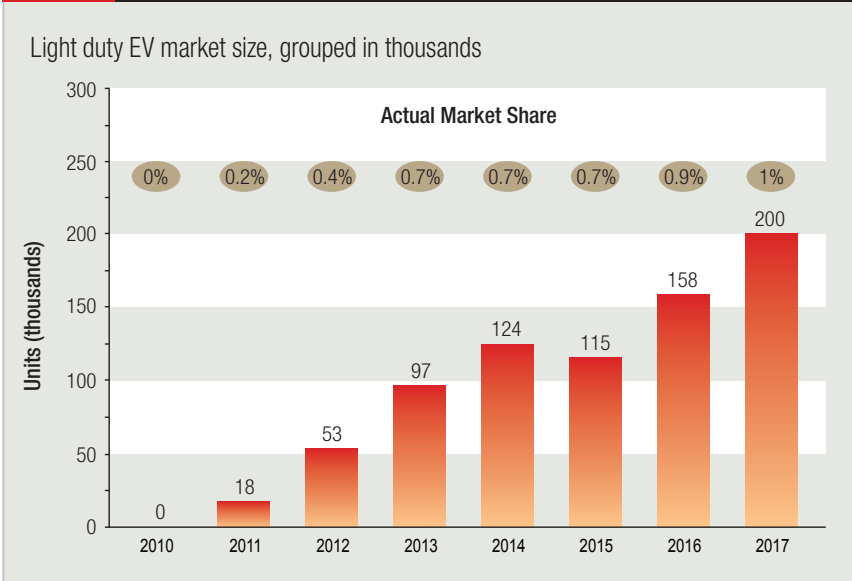
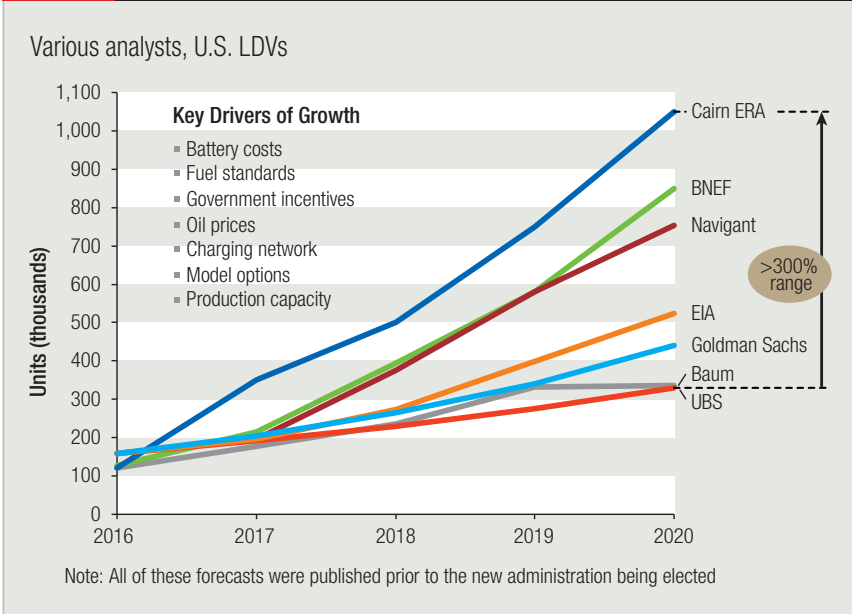


FIG. 2 EV SALES FORECASTS



customers vote with their pocketbooks. Low gasoline prices stifle near-term demand in the absence of other compelling economic advantages. Particularly when customers drive less than twenty thousand miles per year, the current total cost-of-ownership parity point.

And battery technology evolution to deal with questions of weight, safety and range advances has addressed consumer concerns more slowly than expected.

The OEMs, both automakers and infrastructure providers, are faced with the challenge of igniting demand, given a cautious mindset among individual and corporate buyers.

Utilities are similarly challenged.

They must obtain the necessary constructive regulatory treatment to offer their own incentives and establish new economic value sources from infrastructure buildout and demand uplift.

Fortunately, market observers are becoming more bullish on EV growth. Estimates range widely, but suggest that more robust growth may be emerging.

See Figure Two.

Forecast compound annual growth rates (CAGRs) range from twenty to seventy percent, compared to a fifty percent CAGR over the last five years. Unit sales are projected to increase from about two hundred thousand in 2017 to potentially more than seven hundred thousand by 2020.

Whether government and dealer incentives, along with lower battery costs, can support elevated growth is uncertain. It is undeniable, though, that U.S. OEMs need to significantly and rapidly enhance their market presence or risk falling behind their international counterparts to become a secondary provider.

At the same time, utilities need to move from passive observation to directly helping OEMs grow the EV market. While a neutral position on EV development by utilities may be seen as a virtue, it is risky and may slow development of EV markets.

U.S. utilities need to think and act in their commercial interests on infrastructure placement and demand fulfillment.

Leading the Pack

To date, foreign OEMs have outpaced their U.S. counterparts in driving EV development. Almost all traditional European and

leapfrogging the incentive-driven approach and simply mandating that internal combustion engine vehicles be banned within two decades. Even individual cities, such as Paris, are joining the push toward eliminating traditional internal combustion engine vehicles.

These bold actions signify the seriousness with which foreign countries are acting on environmental policies. Even where gasoline-powered vehicles are not targeted for elimination, countries are requiring annual EV rollout goals to support policy objectives.

Meanwhile in the U.S., incentives have dwindled in many states. Very few cities or states have significant infrastructure development support programs, and those are primarily located on the West Coast.

To be fair, consumer sentiment is supportive of EVs, but

Japanese OEMs have been active market participants and are now being joined by new Chinese manufacturers.

In 2017, Asian OEMs were expected to account for around half of all plug-in hybrid electric vehicle and battery electric vehicle powertrain production globally. Comparatively, European OEMs account for about thirty-five percent of total production.

The U.S., by contrast, was expected to only account for some fifteen percent of the total powertrain mix in 2017. However, American production is expected to grow to almost twenty-five percent by 2020.

This shift in powertrain production contribution by the U.S. OEMs reflects a more than fifty percent CAGR by 2020, compared to a thirty-seven plus percent CAGR for all global regions.

Some automakers, such as Volvo, are totally retooling their assembly plants and rapidly accelerating toward full EV production by 2019. Other European OEMs are blending expanded model offerings, battery and autonomous car research and EV manufacturing joint ventures in China to enhance their EV production capacity.

In Japan, a similar move is taking place by leveraging in-country partnerships to advance EV market presence. Toyota and Mazda are collaborating on EV manufacturing capacity development in the U.S. Mitsubishi, Nissan and Renault are aligning on a common platform for low-priced EVs.

In fact, Toyota has recently announced that every model in its lineup will have an electrified option by 2025.

And in the largest EV market in the world – China – an entirely new and integrated EV industry is being created, with the help of global OEMs looking to sell into this market. This integrated industry value chain aligns with China's stated policy to establish a quota for what it describes as "New Energy Vehicles" (NEVs).

China mandates that NEVs account for twenty percent of all vehicle sales by 2025. The country is also said to be considering banning sales of vehicles powered by traditional internal combustion engines, but would unlikely enact such a regulation for near-term compliance.

Whether because of environmental concerns, government mandates, or simply a bet on a future market, both European and Asian OEMs have accelerated their efforts.

The U.S. is behind. But U.S. OEMs have not been entirely stuck in park.

Tesla has been a national champion for EV and battery technology and production. General Motors and Ford have announced that they intend to broaden their model portfolios by 2020–2022, while investing in fuel-cell vehicles, ride-sharing and charging technology development.

While GM has promised investment in EVs, it has not announced a corresponding dollar amount, and has indicated that much of its planned EV strategy is directed toward China. Ford indicates it will invest eleven billion dollars by 2022, which represents about twenty-six percent of its estimated overall capital spend for the period.

Given their technological prowess and knowledge of consumer interests and local markets, there is no reason why U.S. OEMs cannot surpass their European and Asian counterparts in the EV market.



“ Only West Coast states are meaningfully focused on EV adoption. Incentives range from rebates and loan programs to tax exemptions and credits. ”

– Michael Britt

The policies of regions and countries have great influence on the development of EV markets. And when congruence occurs between national environmental policy and economic interests, new markets are more easily primed for local and global growth.

Gaps should be expected to exist today between the U.S. and other developed countries. Other countries are more expansive when it comes to providing incentives and utilizing a combination of tax, rebate, exemption and convenience offerings.

The U.S. largely leverages a single income tax credit model, although even that had to be defended in the latest tax code overhaul.

In the U.S., generally only West Coast states are meaningfully focused on EV adoption. The incentives those states choose range from rebates and loan programs to tax exemptions and credits.

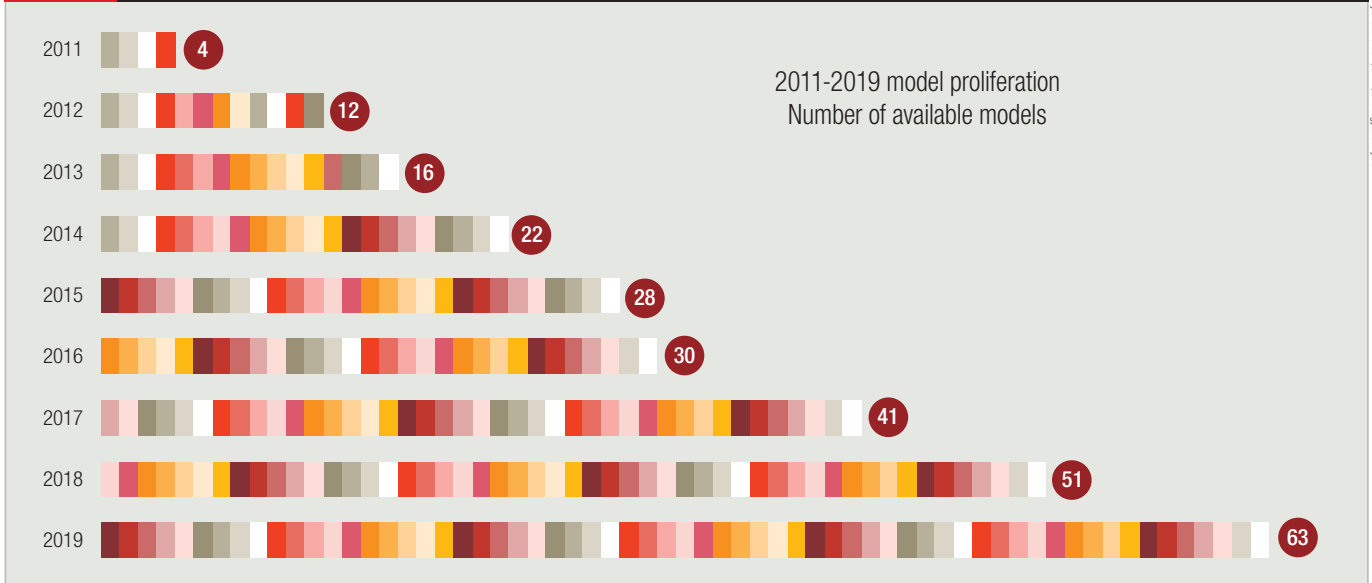
But these incentives still amount to much less total purchase-value defrayment than some European and Asian countries provide.

Oddly, whether in the U.S., Europe or Asia, less attention has been directed toward the development of the charging infrastructure.

Some countries and U.S. states offer home charging equipment rebates or credits, but few governmental entities other than the state of California have coordinated charging infrastructure investment in their territories.

FIG. 3**MODEL PROLIFERATION**

Source: Hyndacars.com, EPRU, Strategy & analysis



Volkswagen's commitment of two billion dollars to expand the U.S. charging network over the next ten years under its Electrify America initiative may signal that OEMs may move from EV promotion to market development. They may move individually or in collaboration with governments.

EV markets are already global, even though they reflect country-specific policies, conditions and values. However, as battery technology and performance advance, these enhancements can further break down consumer diffidence toward EV acquisition.

Model Showcase

Rapid advancements in energy storage, semi-conductors, sensors and specialty materials like carbon fiber are helping make EVs more affordable and raising performance levels beyond some of the most expensive super-cars in the world.

The price premium for EVs is falling rapidly and should reach parity with gasoline-powered vehicles between 2022 and 2025. This will create a tipping point, where conventional drive trains will become too expensive to produce in large numbers.

The transition from conventional to electric drive trains is being carefully managed by OEMs because of the lead time from auto design to production readiness. But that transition has already triggered billions of dollars in announced investment.

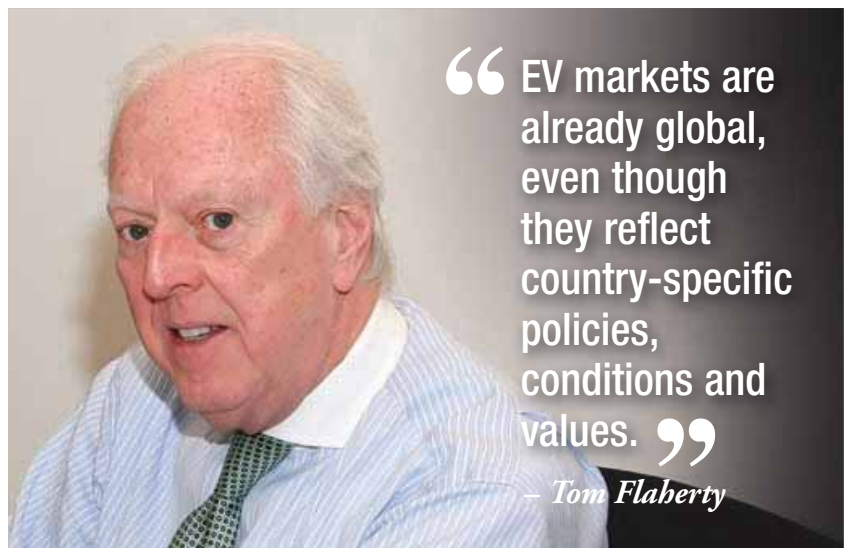
The total investment commitment by OEMs to shift to electric vehicles tallies more than ninety billion dollars to retool plants for demand projected three to five years in the future. Those plants will leverage a rapidly evolving set of technologies.

The vast majority of these investments were announced in

2017 or in the first weeks of this year, and will require further marketing spend to promote awareness.

To be sure, the challenges OEMs face are daunting, as EVs become a core transport offering sold globally versus just a so-called compliance car sold primarily in carbon-conscious countries or zero emission vehicle (ZEV) states.

Ultimately, adoption of a product with thinner margins may cannibalize traditional OEM models in both the retail and fleet markets.



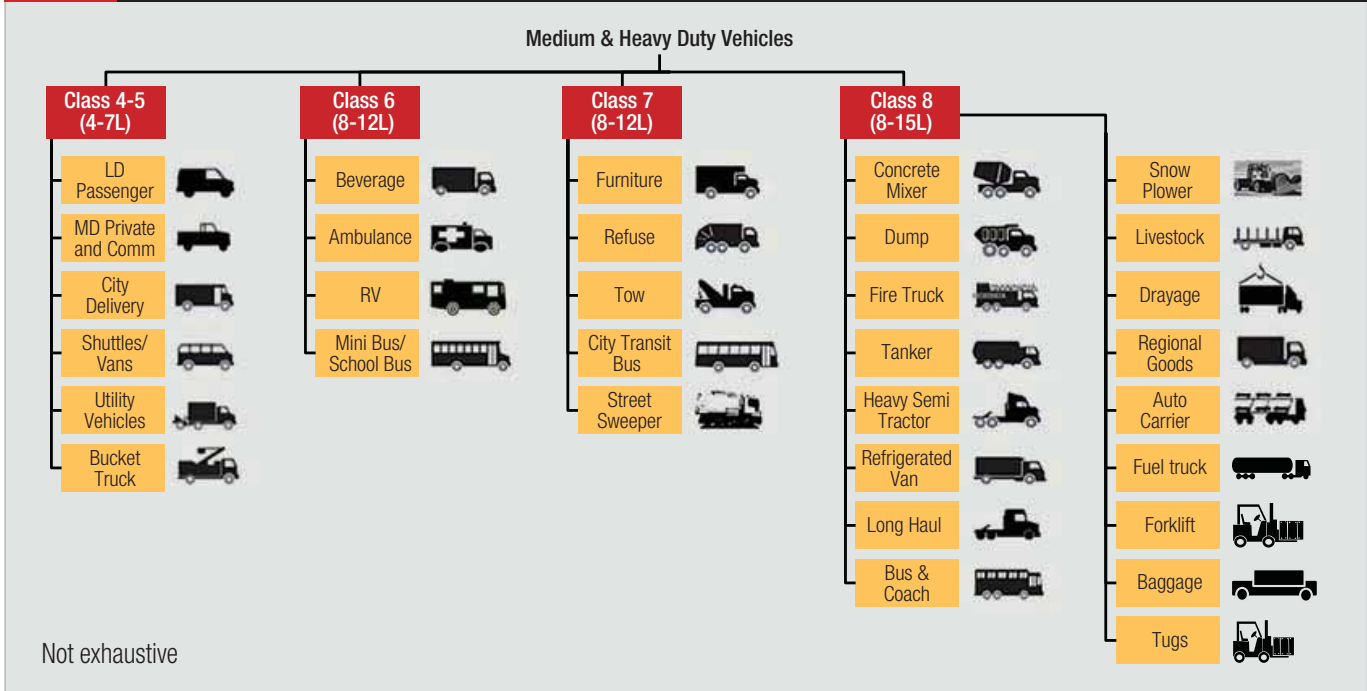
EVs represent an enormous opportunity for global development and growth for both OEMs and the utility industry. Leaders such as Tesla are helping define the path to success. Traditional OEMs, many of whom are well positioned to benefit in the long term, are accelerating their own efforts.

Offerings are rapidly proliferating, with more than sixty models planned to be offered in 2019.

See Figure Three.

FIG. 4

ELECTRIC TRANSPORT CLASSES



This represents a significant number of options in virtually all vehicle classes, with the exception of the largest full-size SUVs and pickup trucks.

The value utilities can derive from EVs goes well beyond incremental kilowatt-hours and associated grid upgrades. EVs have the potential to increase alignment with environmental stakeholders and cities seeking to reduce their carbon footprint through electrification.

The EV products emerging from OEMs appear to be superior in terms of performance and on a trajectory to be at or below conventional vehicle manufacturing costs.

EVs are likely to represent the future of transportation. It represents a significant new source of load, often at times of day where incremental load would be very welcome.

The value is there for consumers and shareholders. However, utilities need to think more broadly than they have so far to recognize that the commercial opportunities extend beyond cars and infrastructure.

Changing Lanes

EVs have already moved from the category of experimental curiosity to the category of growing reality. This has been accomplished with limited direct engagement by electric utilities and sometimes by OEMs.

The next step in ET market development – to move from limited deployment to conventional adoption – will need to reflect a much-expanded presence and participation from the power sector.

Utilities have narrowly thought of participation in the ET space as a function of fundamental infrastructure investment

The value utilities can derive from EVs goes well beyond incremental kilowatt-hours and associated grid upgrades.

but specialized vehicles, infrastructure assets, energy services, grid management and financing.

Utilities thinking needs to shift from viewing ET as an alternative transportation novelty to an infrastructure (and beyond) business catalyst. That means thinking beyond traditional passenger and light-duty vehicles to ET more broadly.

The drivers for ET adoption at the consumer and commercial customer level apply equally to more industrialized or specialized uses. Further battery costs and performance improvements will further extend the range of electric transport applications.

Light-duty usage extends to medium and heavy-duty uses, including shuttles, buses, emergency vehicles and local delivery and long-distance trucks such as the recently announced Tesla Semi that is already garnering significant interest and orders.

It also extends to specialized vehicles, such as refuse trucks, plows and sweepers.

See Figure Four.

Other vocational uses, such as refrigeration, wrecking, mixing and even utility field work, are beginning to attract interest. Material access and handling equipment, including forklifts,

to support charging stations. But the ET value chain is far broader.

It extends from front-end market awareness building through back-end secondary market engagement.

It also includes not just commercial fleets,

ET VALUE CHAIN SEGMENTS

How utilities can participate in the ET market extends well beyond traditional thinking. Multiple areas exist to provide creative and commercially attractive services:

eTransport Development	Market development activities raising awareness and supporting R&D	Promotions, education programs, ride and drives and other technology demonstrations
Financing & Incentives	Supporting accessibility to discounts, rebates and lending services for corporate fleets and consumers	Financing, leasing programs, rebate programs and incentives
Infrastructure Development	Design and development of charging infrastructure to support existing and future ET	Mass transit infrastructure, charging configuration, network readiness and charging installation
Fleet Services	Enabling the electrification of fleets through customized solutions designed to meet customer needs	Electric transportation (on/off road) acquisition, conversion, configuration, routing, fleet performance management and support services
Infrastructure Services	Enabling the electrification of transportation through support services that manage infrastructure to ensure reliability of charging services	Network monitoring and upgrades, charging equipment maintenance, mobile charging services, battery monitoring and replacement
Grid Exchange	Energy services to support grid stability leveraging vehicle to grid (V-2-G) capabilities	Rate arbitrage, energy bundling, V-2-G/G-2-V, scheduling services, grid management and ancillary services
Energy Management	Vehicle energy storage services used to provide premise energy management services	Demand management, energy services, supply aggregation, rate arbitrage
After Market	Secondary or tertiary market placement of electric transportation vehicles and equipment	Secondary market placement, battery repurposing and battery management services

gantry cranes, loaders and tractors, can also be electricity-powered, as can specialized mining and construction equipment.

The value chain identified earlier defines where to play in the ET space. More important is how to win and defining how value pools can be accessed by utilities across both assets and services.

The full ET value chain vastly extends the possibilities that offer utilities a way to participate in the commercial ET market.

Utilities now need to consider ET market participation as a growth lever, not just as an incidental investment.

New revenue or marginal sources now emerge from many offerings. Those include financing arrangements, fleet consultative services, mobile charging, equipment maintenance, battery replacement, supply aggregation, grid exchange and after-market battery replacement.

Utilities now have an opportunity to shape their ET market participation around both facilitating deployment and enabling optimization. ET needs to be thought of as more than an asset: it can be an integral element of system demand and supply.

OEMs are already designing smart applications into their ET offerings that can increase the level of load requirement from any single vehicle.

What's more, these vehicles are being positioned as both

sources and sinks for power. Driving and charging patterns will be important determinants of initial and following loads during the day and night.

Thus, utilities need to position themselves in a role where their legacy technical expertise can be leveraged. Designing the requirements of the vehicle-to-grid (V-2-G) and grid-to-vehicle (G-2-V) interface, as well as performance of this important grid exchange role, is a natural fit for electric utilities.

Where utilities ultimately decide to house their ET assets and services will depend on the nature of the local state regulatory model. Market participation can be achieved with either model, though commercial applications may be more or less constrained.

Some ET value chain elements, such as those that are asset-based, may be a better fit under traditional regulation.

Others that extend beyond assets, including technical services to fleet owners, financing or energy services, may be better delivered from a nonregulated business platform.

Utilities need to think more expansively about how to deeply integrate their presence into ET market, infrastructure, customer, supply and, energy dynamics.

This means moving from a narrowly constrained and passively executed mindset to one that is broadly defined and actively commercialized.

Accelerating Pace

To achieve ET's full potential, all stakeholders – including OEMs, utilities, government, NGOs and service providers – need to collaborate closely to ensure that open standards permit rapid development of efficient, reliable and interoperable ET infrastructure.

Open architecture will enable seamless use of charging stations by EV consumers across the country.

This is already paying off in the announcement by VW to select open-architecture charging infrastructure companies such as Greenlots for Electrify America's charging infrastructure investment.

Collaborative groups such as the Alliance for Transportation Electrification will be increasingly important for balancing innovation and standards development, while utility trade and research associations will be able to complement these views.

But cross-industry collaborative groups will need to tackle a number of complex issues before the growth curve will begin to accelerate.

These include determining how best to improve on the roughly twenty to thirty minutes currently needed to fast-charge an EV for a two hundred fifty-mile range to achieve parity with the time it takes to refuel a gasoline-powered vehicle.

Such an improvement will likely require a form of ultrahigh capacity charging, such as three hundred fifty kilowatts at eight hundred volts.

Such solutions are being promoted by OEM joint ventures, including the recently announced Ionity collaborative effort between Mercedes-Benz, BMW, Ford, VW, Audi and Porsche. They plan to deploy four hundred high-power charging sites across Europe by 2020.

These rapid refueling centers will require significant collaboration with utilities to identify grid locations that are convenient for refueling. The planners will have to reduce operating and capital intensity and integration requirements to make the economics effective.

As more EV models become available to consumers across a wide range of buyer segments and as price and performance improve in concert with state and local initiatives, consumer



START YOUR ENGINES

The utilities industry is just beginning to get in the ET race. Here are ten formative actions that can help move ET from cruising to the passing lane:

- Work with EEI and EPRI to shape strategic opportunities and outcomes;
- Join a cross-industry collaborative to increase access to industry players and help shape mutually beneficial solutions;
- Create an on-ramp for educating key stakeholder groups on the challenges and inherent benefits of electrifying the transportation sector;
- Pursue market approaches that keep infrastructure architectures open and standards based;
- Demonstrate utility leadership in, promoting and aligning OEM interests and customer needs;
- Consider what types of utility supported incentives could be useful to promote and advance adoption;
- Develop strong social media support and online buying tools to enhance the flow of information to consumers;
- Establish pilots to demonstrate the value of charging infrastructure to consumers to regulators, legislators and other key stakeholders;
- Support commercial fleet conversion and electrification by starting with your own light-duty vehicles; and,
- Support off-road electrification to facilitate the shift from diesel fuel and reduce operating costs and improve environmental impact.

demand will rise rapidly.

Some aggressive growth projections by market forecasters range up to a billion EVs on the road globally in 2050, and illustrate just how significant this market can become.

To position for strategic advantage in serving this expected
(Cont. on page 71)

more and more, because they're going to have the data and the distributed energy sources, and the efficiency tools, to do it.

The question goes back to the states and utilities that have yet to fully embrace competition and give the ultimate choice to the consumer. How are they empowering consumers to be a part of the larger advanced energy system of the future?

PUF: Kenny, what's the future for utilities? For your company, but also the industry.

Kenny Mercado, SVP, CenterPoint: It's an excellent future. It's a great future. I hope it continues to take a long time for other states to catch up, as their lag becomes an opportunity for Texas that's going to bring more jobs and people to Texas.

U.S. Electric Transportation

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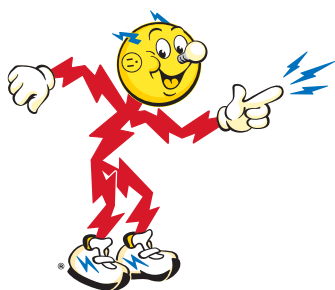
surge in demand, utilities can adopt several potential, but not mutually exclusive, roles.

Market catalyst: At a minimum, utilities can fulfill the simple role of increasing public EV awareness and broadening consumer understanding of market trends, vehicle information and participation options.

Infrastructure enabler: A more fundamental role for utilities is ensuring that the underlying distribution network, such as circuits, are strengthened and charging stations are installed so consumers and commercial fleet owners have facility access at necessary voltage levels.

Commercial partner: Aggressive utilities may position themselves as an active provider of a broad range of value-added services such as vehicle conversion and charging system configuration. These will simplify EV adoption and deployment.

V-2-G integrator: Utilities will need to anticipate and manage the alignment of EVs as a potential source of supply to the grid and coordinate how capacity can be aggregated. Active EV fleet integration with the grid fits a traditional sweet spot of utility capabilities.



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In Texas, we're going to be so far ahead of the curve, that the jobs will be here, and the opportunities will be here. And our demand will increase.

We're going to continue to promote clean energy and sustainable energy. Very reliable. Very resilient. We're going to be hurricane proof. We're going to be protected against whatever may occur out there.

We will electrify, and provide more and more value, because the air is going to be cleaner. It's going to be a win-win for our state. We're very excited about the future. As a wires company, we are very happy being in Houston, and serving this great state of Texas. **PUF**

Utilities in states with clear support for ET have been engaged for some time in supporting development of these markets.

However, for those utilities located in regions where the future for ET is less clear, it is time to help shape the future of transportation electrification.

Utilities should position themselves to capture the full value of electrification for customers and shareholders. The ET value chain points toward opportunities that exist for utilities beyond their conventional focus.

Entities that take a narrow, reactive approach to the market are likely not going to be able to push their ET markets to their maximum potential. That narrow approach primarily focuses on kilowatt-hour sales and grid infrastructure investments to support charging, and on acting only when there is a demand for a charging station.

Companies that take a broader, more proactive stance in the market will pursue multiple elements of the value chain.

Importantly, suppliers in some segments may not yet be fully developed. That would potentially require a utility or OEM to enter a space outside of its core business to help facilitate the market until robust competition can emerge.

Electrification is the future of transportation, representing a significant new source of load, often at times of day where incremental load would be very welcome. The increased load factor and reduced fixed costs per kilowatt-hour delivered by ET will benefit those who get on the track now rather than waiting to see how the race turns out.

The utility industry needs to be ready to help catalyze the transition to ET. It is time for utility leadership to make ET a high priority in its allocation of human, financial and political capital. **PUF**