POWER CONSULTING INSIGHTS

E-Mobility Builds a New Age Utility Company

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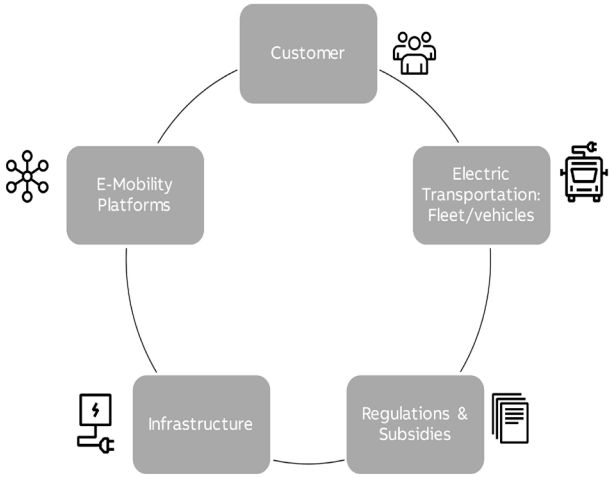
Electrification of transportation creates new opportunities for utilities companies.

E-Mobility is not a new concept, but in the past five years or so, there has been an abrupt advancement in key market drivers and technologies. With that, comes a need for utility companies to address the changes in the energy industry and take advantage of opportunities. With trends in the energy industry such as decarbonization, decentralization, the decrease in battery prices, and fossil fuel volatility, e-mobility is seeing tremendous growth worldwide. From the perspective of Power Consulting at ABB, utilities can gain from opportunities such as increased electricity demand load, new investments and business models, smart charging, and ancillary services, all of which lead to new businesses and increased revenues for utility companies.

Introduction

When most people think of e-mobility, they primarily think of electric vehicles, however, there is much more to e-mobility than the vehicle itself. Gartner defines e-mobility as, "the concept of using electric powertrain technologies, in-vehicle information, communication technologies, and connected infrastructures to enable the electric propulsion of vehicles and fleets." E-mobility is an ecosystem that consists of five parts: electric fleets and vehicles, infrastructure, customers, e-mobility service platforms, and regulations and subsidies. Electric transportation includes light-duty passenger vehicles, public transit vehicles, like rail and buses, fleet vehicles ranging from light-duty to heavy-duty, and other equipment such as electric cranes. The infrastructure part of the ecosystem encompasses the charging infrastructure supplier, the charging station operator, and the electricity supply. Customers are the individual consumers, businesses, as well as the public. E-mobility service platforms include charging management and battery optimized navigation services. Lastly, government regulations and subsidies play a significant role in the growth of e-mobility. This can be on a state wide and national scale for regulations and include subsidies on electric vehicle purchase price and infrastructure.



A common misconception of electric transportation is that it only includes electric battery cars. However, both electric fueled and hydrogen-fueled fleets and vehicles are included in e-mobility.[1] Both use electricity, however, the difference is in how the electric motor is powered. An electric fueled vehicle uses an electric battery to power the motor and a hydrogen-fueled vehicle uses a hydrogen fuel cell to power the motor. The hydrogen fuel cell takes hydrogen and turns it into electricity. Both are plausible, however, electric fueled vehicles currently have a greater market share and electric charging stations completely outnumber hydrogen fueling stations. Additionally, electric vehicles and fleets have much more popularity than hydrogen-fueled vehicles and fleets, especially when it comes to the market and consumer knowledge. That's not to say this could change in the future, but since electric is much more well-known than hydrogen-fueled, utilities should focus on electric battery vehicles and fleets for now.

Market Overview

Globally, the e-mobility market is expected to grow into a $390 billion market by 2020.[2] The electric vehicle supply equipment ecosystem will be a $2.6 billion market within the next five years.[3] With a market developing to this extent within the next two years, it's a great chance for utility companies to break their stagnant growth slump and be a part of this rising industry. The marketplace for public transit, fleet vehicles, and light-duty passenger electric vehicles will see tremendous growth within the next few decades, each with varying patterns and trends. While public transit and fleet vehicles are currently in more of an emerging market phase, passenger electric vehicles are in a rapid growth phase. Additionally, many of the sectors of e-mobility, such as light-duty passenger vehicles, are expected to grow even faster than projected trends, especially with the ideal driving forces, such as government regulation banning the sale of cars with internal combustion engines. Additionally, some OEM companies are driving this market, like BYD, which is the world's largest manufacturer of electric vehicles and produces everything from forklifts to passenger cars to semi-trucks.[4] However, since this is a developing ecosystem, there is still plenty of room for other players to join, especially players that will be the backbone to the market, like electricity providers.

Factors Driving Change

As mentioned, e-mobility is not a new notion, but recent trends have sparked interest in this electrification of transportation. In the past decade, there has been a tremendous push for decarbonization and decentralization of energy. Additionally, government regulation and policy has made it more attractive for stakeholders in the e-mobility market, and certain economic factors have contributed to preferable market conditions.

Decarbonization and decentralization are major trends that are shaping the energy industry and driving expansion for electrification of transportation. According to GTM Research, decarbonization is "the reduction of greenhouse gas emissions from the electricity sector as a response to climate change." Because of decarbonization, many utilities too are expanding their renewables generation and switching away from coal-fired power plants. GTM Research describes decentralization as "the transition of the electricity grid from one with primarily centralized generation and unidirectional power flows, to a more dynamic, localized networking incorporating a wide way of distributed energy resources."[5] With decentralization, both consumers and utilities are generating more electricity via solar and wind, and there are new technologies to help optimize the energy supply and demand on the grid. Renewables such as solar and wind have been around for a while, but the speed of deployment is rapidly growing because of the declining costs of installation. Both wind and solar have reached grid price parity and are getting closer to competing with conventional sources pricing, according to Deloitte's report on Global Renewable Energy Trends.[6] Additionally, by the beginning of 2018, 121 countries had over 495 GW of onshore wind power, and 187 countries had 386 GW of utility-scale solar photovoltaic (PV). Commercial solar PV and residential solar PV have also seen increasing deployment and decreasing prices. Energy consumers are now also becoming energy producers, a new age utility customer – in need of a new age utility company.

Another driver of electrification of transportation growth is government regulation and subsidies. Whether it's a country-wide, state or city level, these government policies are encouraging electrification for consumers, businesses, and organizations. When governments offer monetary benefits for the adoption of electrification of transportation, it makes it more attractive to make the switch, especially if it competes with the price of the traditional vehicle. Additionally, with many carbon policies set in place worldwide, it pushes companies and organizations to comply and utilize more efficient and renewable forms of energy. Additionally, it forces them to look for ways to reduce their carbon footprint, and with transportation being a large producer of carbon emissions for many countries, electrification of transportation is a great opportunity.

Additionally, economics plays a large role in the vastly growing market. In the past, people opted out of buying electric vehicles because the price compared to a traditional vehicle was extremely high. However, electric vehicles and fleets powered by electric motors have become cheaper to make, and hence a cheaper selling price, due to the decreasing battery prices. Batteries are usually the most expensive element; however, the price of a lithium-ion battery fell from $1,000/kWh in 2010 to $227/kWh in 2017, and the price is predicted to fall even further to around $100/kWh in 2020, according to McKinsey & Company.[7] Even so, Wood Mackenzie estimates that by 2027, electric vehicle costs will be competitive with a traditional internal combustion engine vehicle.[8] The decrease in price has made electric vehicles a more realistic option for individual consumers, fleet owners, and municipalities. Additionally, gas price volatility is a major concern with internal combustion engines, as gas prices have fluctuated in the past. Gas prices are so volatile because they are connected to international oil markets where events from around the world can drive the prices up and down.[9] Consumers are unhappy with unstable gas prices and are always hesitant of the next price hike, which has caused vehicle owners to be more receptive to e-mobility. Electricity prices are connected on a regional level and are much more stable than compared to gas prices, making e-mobility a less risky and reliable means of transportation.

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There has been a tremendous push for decarbonization and decentralization of energy. Additionally, government regulation and preferable market conditions have made e-mobility more attractive for stakeholders.

Unique Value Proposition for Utilities

The energy industry is facing a crossroads. Current utility models are becoming increasingly outdated and are needing to be replaced by more complex, decentral emerging models. The industry is being shaped by decarbonization, decentralization, and digitalization. Renewable energy is becoming increasingly apart of utility energy mix and is taking over older forms of energy generation. More and more distributed energy sources, like solar panels and battery storage, are popping up on the grid and causing utilities to take a new approach to how they handle and optimize the grid. In the past, utilities looked at decentralization as a threat, not realizing the untapped potential Distributed Energy Resources (DER) could offer utilities. Lastly, digitalization is making it easier for utilities to manage data and create interoperability between their physical assets and software applications.

On top of leveraging the energy industry disruptors, electrification of transportation provides utilities a way to solve the day-to-day challenges of flat electricity demand, especially in developed countries, optimizing decentralized systems, and weak customer engagement. It can help solve these daily utility problems and create an opportunity to revitalize their businesses. Utilities are a critical partner for connecting vehicle charging stations to the grid and have the capabilities to own, operate, and support the charging infrastructure. Deloitte stated that utilities can also prepare for the increase in electricity demand, load, and charging patterns by preparing to manage and control new electric vehicle load through smart grid technologies, which will help companies better manage the new decentralized power system.[10] Electric vehicle and fleet batteries also can act as energy storage for utilities and help them better manage the grid, especially with the integration of DERs. Additionally, according to the Head of Smart Mobility at EDP, a Portuguese electricity operator, the majority of utility customers would prefer to buy charging services from their energy provider.[11] This puts utility companies in a unique position to drive e-mobility and revenue from vehicle charging if their customers are more willing to switch to electric vehicles and fleets when services can easily be provided to them. If utilities act sooner rather than later, utility companies can help fuel the electrification of transportation future and secure their role in this evolving market.

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Increase Load Demand

With many utility companies facing stagnant demand growth, electrification of transportation will increase load demand and provide additional revenue opportunities for electric companies. According to Seth Frader-Thompson, co-founder of EnergyHub, electric cars will "upend the idea of no load growth," especially in developed countries, who often face flat demand growth.[12] Deloitte found that electricity demand stopped increasing in developed countries, such as the United States, due to energy efficiency standards and technology improvements.[13] Although these are deemed as good things, it still creates a challenge for utilities as their business model is dependent on electricity usage. Additionally, Bloomberg New Energy Finance (BNEF) predicts that global electricity consumption from electrification of transportation will rise from 6tWh to 2,000tWh in 2040, that's about 6% of total global energy consumption. This increase in electricity consumption leads to increased revenue opportunities for utilities. Reports from McKinsey & Company also find that demand from medium and heavy electric trucks could cause significant increase demand load on the grid and require grid upgrades, due to the large demand from supercharging stations necessary to charge these larger electric vehicles.[14] The potential benefit of increased revenue should encourage capital upgrade investments and guarantee an attractive return on investment.

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E-Mobility offers utilities an opportunity to increase demand by stimulating the growth of electricity consumption worldwide.

Electric vehicles represented about 0.3% of energy load demand in California in 2015, however, by 2025, this number is expected to increase to 3% of total load demand and will continue to climb with the growth of electric vehicles. With strong electrification of transportation initiatives, the California Energy Commission estimates that electric vehicles will require about 250,000 public chargers, which could increase peak demand by 1 GW.[15] Taken on a national scale, U.S. demand growth could increase significantly due to electric vehicles. An analysis conducted by National Renewable Energy Laboratory (NREL) predicts steady growth of electricity demand, which is greatly driven by e-mobility. NREL tested three scenarios in their analysis and found that by 2050, transportation can add as much as 38% to U.S. electricity consumption, with annual growth rates of 1.6% – a significant opportunity for utilities to profit from electrification of transportation.

Europe's total electricity consumption by electric vehicles, as reported by the European Environment Agency, will increase to 9.5% in 2050, up from 0.03% in 2014.[16] Additionally, driving an electric vehicle 15,000 km per year and charging it at home could increase household electricity consumption from 3,500 kWh to 6,500 kWh a year in the Netherlands. Based off analysis by the Institute for Applied Ecology, if electric vehicles made up 80% of the vehicle market by 2050, electric vehicles would contribute up to 5% of electricity demand in several European countries by 2030.[17] Additionally, demand would range from 3% to 25% among the different European countries by 2050, and on average electric vehicles would contribute 9.5% of total electricity demand. For many utility companies in Europe, this is tremendous growth and a tremendous opportunity for new revenues. In France, the CEO of Electricite de France (EDF) is preparing for a slight stagnation in power demand due to efficiency gains but then sees a pickup in demand from 2030 onwards.[18] EDF is planning to boost the number of charging stations it operates throughout Europe from 5,000 to 75,000 in 2022. Utilities should start planning now for the inevitable increase in electricity consumption due to e-mobility.

For developing countries, like India, electrification of transportation can bring an even greater increase in load demand than predicted for developed countries. Between 2017 and 2040, India will be the largest contributor to additional world energy demand. According to a study by Brookings India on e-mobility, by 2030, there could be as many as 300 million electric vehicles on the road.[19] Brookings India's analysis showed that electric vehicles could add as much as 50% to peak demand and 3 percentage points to peak demand growth from 2017 to 2030.

Additionally, about 15% of those 300 million electric vehicles will be fleet vehicles, including taxis, buses and three-wheelers, which will contribute 30% to the total load capacity of electric vehicles. However, their instantaneous loads are higher, meaning the power that they demand when plugged into the grid is greater than passenger electric vehicles. Fleet vehicles will be demanding 50-60% of the electricity from transportation. If utilities in developing countries are not prepared for the demand growth that e-mobility will bring, power outages and overloads will be extremely common.

New Investments and Business Models

A major aspect of the e-mobility ecosystem is the charging infrastructure, and the charging equipment for vehicles directly affects electric distribution networks and their ability to manage load demand. According to Hans Kobler, CEO of Energy Impact Partners, when the transportation sector is 100% electrified, it will result in a $6 trillion investment, and half of it is coming from the infrastructure side.[20] Therefore, utilities are a critical partner and in the perfect position to take advantage and study and plan for how charging infrastructure will affect its distribution network. In addition, they can deploy their own charging infrastructure and make a capital investment to upgrade existing assets to support the new demands of e-mobility.

Utilities can invest in a variety of charging infrastructure ranging from residential to public to fleet and municipal charging, all offering opportunity to enter into new business markets and increase revenues. And depending on the country, charging preferences vary, so utilities should plan and make sure their investments will be optimized for usage, i.e. residential chargers versus public chargers. The global vehicle charging infrastructure market has already seen tremendous growth and is expected to continue to grow exponentially. By 2030, there will be more than 30 million residential chargers, which amounts to a market that's about $10 billion large.[21] Additionally, the public charging market will grow to more than 7 million charging points by 2030, and according to a report by Grand View Research, the global electric vehicle charging infrastructure market will be $46 billion by 2025.[22] Additionally, GTM Research predicts that number of public charger points will grow to 1 million by 2020 and 7 million by 2030.[23]

According to GTM Research, the total residential charging market in North America is expected to reach $1 billion by 2020 and $4.5 billion by 2030.[24] Particularly, in the United States, electric vehicle charger demand, for all types, is expected to grow 39% annually between 2016 and 2025. The European market is predicted to be a slightly smaller market than North America for residential charging and projected to be $740 million in 2020 and $2.8 billion in 2030, according to GTM.[25]

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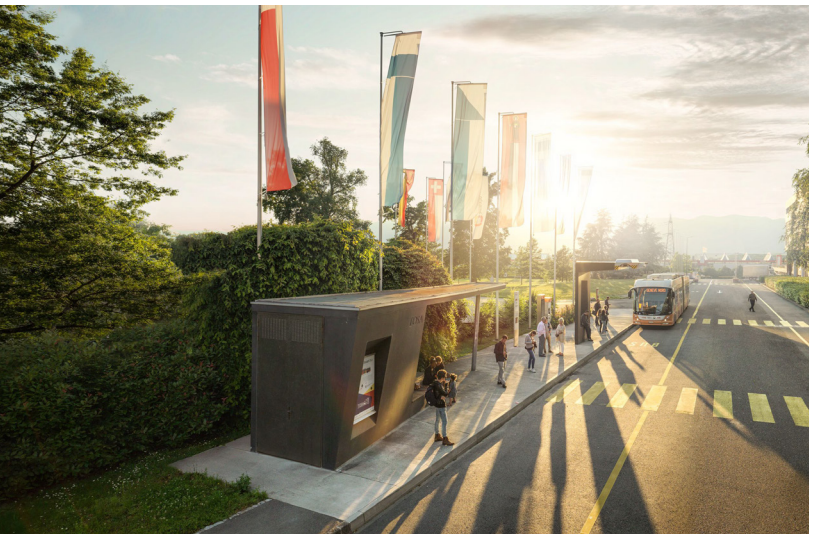
Charging infrastructure directly affects electric distribution networks and their ability to manage load demand.



The first space utilities can play in is the residential charging market. This includes Level 2, AC electric chargers which fall between the basic Level 1 charging, a typical electric outlet, and fast DC charging, and can allow for a wide range of charging speeds. Level 2 charging uses a similar amount of energy that an electric dryer would use and includes a box and a cord that improves safety by waiting to send power to the plug until it's plugged into an electric vehicle. Level 2 charging usually takes around 4 to 6 hours to completely charge a battery. This type of charging is ideal for consumers that like to charge their cars in their garages overnight. By offering incentives and making it easier for utility customers to make the switch to electric vehicles, this will benefit utilities in the long run with new business services and revenue opportunities.

Another fast-growing sector that utilities can make an investment in is public charging infrastructure. This type of charging infrastructure includes Level 2 charging, DC destination, and DC fast charging. The major difference between Level 2 charging and DC charging is that DC charging is faster and requires more power, but it charges the vehicle in a smaller amount of time. Utilities can deploy Level 2 charging for the public in locations such as workplaces, where consumers will keep their car parked all day. DC destination charging, which gives a full charge within 1 to 3 hours, should be deployed in parking lots or shopping malls, where consumers usually park and stay for a significant amount of time. On the other hand, some electric vehicles will need a full charge as quickly as it takes to fill up gas. That's where DC Fast charging steps in. It can be used in public areas such as along highways and truck stops when a quick recharge is needed. DC Fast charging can give vehicles a full charge within 20 to 90 minutes. This type of charging requires more electricity, so utilities need to plan the best places to deploy this infrastructure.

Lastly, utilities can invest in charging infrastructure for public and commercial fleet charging, and this includes AC destination and DC High Power charging. Fleet charging can cover charging e-buses at depots overnight, including school buses and public transit, or charging a delivery truck fleet, like DHL. Fleet vehicles will be charged in one of two ways, at a depot when they are not being used or during vehicle use. At an overnight depot, AC destination charging can be used, where vehicles are charged within 4 to 16 hours. If fleet vehicles need to be charged while they are being used, DC High Power charging can charge a vehicle as quickly as 5 to 15 minutes. This can be ideal for an electric delivery truck that can get a quick charge while running its route. Due to the substantial loads that will be created by charging fleets, it's apparent for utilities, public transit agencies, and commercial fleet owners to start planning and piloting for the mass deployment of this type of charging. This will entail capital-intensive upgrades to the distribution system, so utilities need to go ahead and make the investment now to further alone electrification of transportation.

Smart Charging

With the massive growth of electric transportation and deployment of infrastructure in the near future, it is essential for utility companies to utilize smart charging to improve grid reliability and create additional revenue. Smart charging occurs when charging can be shifted based on grid loads.[26] According to the World Economic Forum, smart charging involves controlling the power of charge to match with network capacity, renewable energy, and customer's needs.[27] For example, instead of a person running their dishwasher whenever they please, it is delayed to run during the middle of the night, when the grid load is lower than during the evening time after dinner. The same can be held true when it comes to vehicle charging. A person might return from work and plug in their car to charge, instead of the car charging right after work, it can be put off until the middle of the night and is still ready for use with a full charge in the morning.

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Smart charging will facilitate more flexibility within the grid system and help utilities improve grid reliability and optimize load demand.

Smart charging uses data and algorithms to select the right time for the vehicle to charge. Cloud-based platforms create profiles for each vehicle and look at the vehicle's charge level, distance traveled, weather, traffic, and more to calculate the charge and stabilize the power supply in harmony with the vehicle's anticipated electricity needs. With smart charging, utilities can benefit from the revenues from charging during nonpeak hours as well as reduce curtailment from renewables they might have in their generation fleet. Smart charging can assure that renewable energy, such as solar or wind, is prioritized for charging electric vehicles and fleets instead of going to waste. Additionally, according to NREL, even just having a few electric vehicles in the same neighborhood could make delivering power more difficult. Smart charging will be necessary to smooth out this peak demand. Although distribution networks can handle the charging of electric vehicles and fleets to an extent, utilities need to prepare for a rise in peak load. Being able to get in front of e-mobility allows for utilities to manage these demand loads and maintain a reliable grid.

Many developed countries have seen "peakier" electricity demand – power demand during peak time is rising and electrification of transportation could potentially make this even more strenuous for the power grid without the help of smart charging.[28] Smart charging provides utilities with the benefit of lowering the cost to serve peak electricity loads by dispersing electricity demand throughout the day.

Now while smart charging makes sense in theory, utilities still need to get consumers onboard by offering incentives to enroll in smart charging programs, such as discounted pricing. Dynamic pricing gives utilities the opportunity to charge customers for energy usage during certain times.[29] Dynamic pricing lowers prices during off-peak demand times to help even out the demand curve, allowing utilities to have more control and guarantee the reliability of power for the grid. In California, if all electric vehicles were charged during peak demand hours in 2020, it would increase peak load by 13% and cause much stress on the distribution network and requiring significant investments on peak generation assets.[30] With smart charging, California could save $700 million in 2030 by smart charging 4 million electric vehicles at optimal times.[31]

Additionally, electric vehicles and fleets can become DERs and provide controllable electricity demand to the grid as well as act as storage and electricity supply when smartly connected to the grid. Smart charging will facilitate more flexibility within the grid system and help utilities improve grid reliability and optimize load demand. Utilities that supply a mix of energy sources such as solar and coal can use smart charging to use the excess energy from a sunny day and avoid renewable curtailment.

Ancillary Services

Electric vehicles and fleets might demand electricity from utilities, but they also can distribute electricity back to the grid, especially during peak demand times to help utilities optimize the grid. Utility companies are in the ideal position to control this so-called vehicle to grid service. Currently, the global vehicle to grid chargers market is growing at a rate of 50% CAGR from now until 2022.[32] Surprisingly, the term vehicle to grid has been around since the mid-2000s and was developed around the idea that idle car batteries could contribute back to the grid. However, recently, this idea has become more attractive and attainable because of the lithium-ion batteries that electric vehicles use. The capacity of the lithium-ion batteries in electric vehicles are not being used around 95% of the time, according to Green Tech Media.[33] Additionally, lithium-ion batteries have fast start-and-stop-capabilities that provide services that help with balancing the grid such as voltage regulation, voltage support, frequency regulation, and more, according to Deloitte.[34]

Val Miftakhov, CEO of eMotorWerks, explains that electric vehicles and fleets are a cheaper way for utilities to deploy energy storage without capital and operating costs.[35] Utilities will be able to curb the power flows between the electric vehicles and fleets and the grid to support the balance of electricity supply and demand as well as improve power reliability. For example, the vehicle and fleet batteries could absorb the excess supply of renewable energy and then deploy it back to the grid when the renewable energy supply is reduced, such as when the sun goes down. With this, if the vehicles and fleets are plugged in, utilities can use them as energy storage without actually owning the storage. Vehicle to grid would not be possible without the necessary technologies that enable communication between the electric vehicle and fleets and the grid. Although vehicle to grid is still in its early stages and being tested in pilot programs, electric vehicle owners in Denmark are benefiting from an extra $1,500 a year from providing power back into the grid from a program by Enel and Nissan Motor Company.[36]

Now while vehicle to grid seems like a groundbreaking idea, currently, there are a few barriers making it difficult to execute, such as battery degradation and automaker warranties. However, it's only a matter of time before issues like these will be addressed. According to SEPA, vehicle to grid is more of a conceptual idea right now than it is commercial, but the technology is expected to develop over time.[37] A director from Navigant predicts that vehicle to grids services will most likely show up in public or commercial fleets before residential electric vehicles –it's a matter of having a sufficient amount of power to give back to the grid. School buses, for example, which spend the majority of their time in parking lots can use the energy from the bus batteries to supply power back to the grid when necessary.

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Electric vehicles and fleets can distribute electricity back to the grid.

Conclusion

E-mobility is rapidly growing, whether it's due to government regulation or the decentralization of energy, and utilities can piggy-back off the growth to reinvent their businesses. The advancement of electrification of transportation brings numerous opportunities for utilities to grow revenue and enter new markets, and with the uncertainty of the changing energy industry, e-mobility offers guidance for the future. To learn more about the implications of e-mobility in the energy industry, reach out to ABB Power Consulting today. We would be happy to further discuss and help plan for this electric transformation.

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