TEXAS ADVANCED ENERGY BUSINESS ALLIANCE

PROJECT NO. 49125

REVIEW OF ISSUES RELATING TO ELECTRIC VEHICLES	§ § § §	PUBLIC UTILITY COMMISSION OF TEXAS

COMMENTS OF TEXAS ADVANCED ENERGY BUSINESS ALLIANCE

Texas Advanced Energy Business Alliance (TAEBA) hereby submits these comments regarding the Commission's questions in the above-referenced proceeding. TAEBA includes local and national advanced energy companies seeking to make Texas's energy system more secure, clean, reliable and affordable.[1] "Advanced energy" encompasses a broad range of products and services that represent the best available technologies for meeting energy needs. Among these are energy efficiency, energy storage, demand response, natural gas electric generation, solar, wind, hydro, nuclear, and electric vehicles (EVs). When considering issues related to electric vehicles, it is important to comprehensively consider how EV-related technologies work together with other advanced energy technologies in the broader context to make the electricity system more secure, clean, reliable, and affordable. TAEBA brings this broad, systems-level perspective to this proceeding.

As a business alliance, TAEBA is focused on reducing barriers to the economic adoption of advanced energy and continuing job growth in the State of Texas. Transportation electrification is just one of several advanced energy segments that is contributing to economic growth and job creation in Texas. The advanced vehicle industry, which includes hybrid, electric, natural gas, and fuel cell vehicles, has created 15,300 jobs, which accounts for 7% of the 233,400 advanced energy jobs in the state.[2] Specifically, within the transportation sector, our member companies represent EVs in a variety of ways including manufacturers of EVs of different vehicle sizes (from small low-speed vehicles to large heavy-duty vehicles), charging infrastructure providers, grid integration solution firms, fleet operators, and companies providing supporting technologies and software services. As the adoption of EVs increases, there will be a growing need for the construction of supporting infrastructure, further increasing job creation and stimulating economic activity. Policy decisions that remove barriers and promote competition are also key to continued economic growth in the state.

TAEBA appreciates the opportunity to provide the perspective of advanced energy companies to inform this proceeding, and these comments address the Commission's questions regarding projections and trends in electrification of transportation. TAEBA also provides recommendations on how to maximize the benefits of electrifying transportation in Texas.

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[1] https://www.texasadvancedenergy.org/about-taeba.

[2] www.texasadvancedenergy.org. TAEBA's Advanced Energy Jobs in Texas 2018 fact sheet is available for download.

GENERAL DATA

1. **The Commission requests that parties provide current data sources and projections for the expected deployment of electric vehicles in Texas over the next ten years. If available, the data sources should attribute the projections by vehicle class (i.e., personal, commercial short haul including fleets and buses, and commercial long-haul electric vehicles).**

The market for plug-in electric vehicles (EVs)[3] is relatively small at present. According to the Auto Alliance, from January 2011 through June 2019, the total sales of light duty EVs in Texas were 36,689 (which is 3% of the total US light duty electric vehicle (LDV) sales of 1,206,162).[4] As a point of comparison, there are more than 24 million registered vehicles in Texas.[5] Sales are growing rapidly, however. In North America, the EV market experienced a compound annual growth rate (CAGR) of more than 50% from 2011 to 2017.[6] Achievement of purchase price parity between EVs and internal combustion engine (ICE) vehicles, and the rapid introduction of various makes and models with ranges exceeding 200-300 miles, can be expected to accelerate EV adoption. Analysts estimate that, as battery prices continue to fall, the upfront cost of an EV will be equivalent to its ICE counterparts as soon as 2022.[7] As EVs are already less expensive to own and operate on a total cost of ownership (TCO) basis, due to lower fueling and operating/maintenance costs, purchase price parity will give EVs a strong overall value proposition for car buyers. The heavy duty transit market is also electrifying rapidly, with battery electric buses holding 10% of North American annual sales as of 2017.[8] Sales of plug-in electric buses increased 40% from 2016 to 2017, and analysts project a 19% CAGR over the next 10 years.[9] By 2030, forecasters anticipate that 84% of all municipal bus sales globally will be electric, such that 80% of the global municipal bus fleet will be electric by 2040.[10]

In its 2018 Long-term System Assessment, the Electric Reliability Council of Texas (ERCOT) made projections to estimate numbers of EVs on the road through 2033. The following table summarizes the ERCOT data:

[3] EVs includes all-electric battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs).
[4] https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/. Data are for the BEV plus PHEV categories.
[5] https://www.txdmv.gov/about-us/reports-data/cat_view/13-publications/25-reports-data/65-vehicle-titles-registration/229-registration-data
[6] https://www.navigantresearch.com/research/market-data-ev-geographic-forecasts.
[7] https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/manufacturing/deloitte-uk-battery-electric-vehicles.pdf.
[8] https://caltransit.org/cta/assets/File/2019%20Fall%20Conference/Concurrent%20Sessions/MAINT-Real%20Life%20with%20BEBs%20-%20Finnern.pdf.
[9] https://about.bnef.com/electric-vehicle-outlook/
[10] https://about.bnef.com/electric-vehicle-outlook/

Table 1: Adapted from ERCOT's 2018 Long-term System Assessment for the ERCOT Region.[11]

Vehicle Class	Year	Number of Vehicles
Cars	2020 2025 2030 2033	~ 10,000 ~ 500,000 ~ 1,500,000 ~ 3,000,000
Long Haul Trucks	2020 2025 2030 2033	~ <5,000 ~ 25,000 ~ 100,000 ~ 200,000
Short Haul / buses	2020 2025 2030 2033	~ <5,000 ~ 15,000 ~ 40,000 ~ 80,000

While the 2020 estimate by ERCOT is low (as there were already nearly 40,000 EVs on the road in Texas as of mid-2019), ERCOT is projecting roughly 1.5 million EVs on the roads in Texas by 2030, which is consistent with national estimates forecasted by others. For instance, the Edison Electric Institute (EEI) projects the number of EVs on U.S. roads is projected to reach 18.7 million in 2030.[12] This would be about 7% of the 259 million vehicles (cars and light trucks) expected to be on U.S. roads in 2030. Therefore, a projected 7% market share of the 24 million vehicles in Texas would account for roughly 1.68 million EVs on the road in Texas, on par with ERCOT's forecast.

2. **Please provide any current data sources and information on the expected amount of new load attributable to electric vehicles over the next ten years. If available, the data sources should attribute this load by vehicle class (i.e., personal, commercial short haul including fleets and buses, and commercial long-haul electric vehicles).**

The overall contribution to demand is determined by the number of vehicles that are electric, so if vehicle penetration is higher, demand will rise. ERCOT provides estimates based on the year 2033 in its 2018 Long Term Assessment, as shown in the table below.

[11] http://www.ercot.com/content/wcm/lists/144927/2018_LTSA_Report.pdf,See pp 49-50.
[12] https://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20EV%20Forecast%20Report_Nov2018.pdf

Table 3: EV Penetration & Charging Demand Estimation for Emerging Technology Scenario from "ERCOT's 2018 Long-term System Assessment for the ERCOT Region," December 2018.[13]

Type	Number of Vehicles in 2033[14]	Per Vehicle Charging (kWh)	Peak Charging Demand (MW)
Cars	3,000,000	20	5,940
Short Haul / Buses	80,000	350	2,800
Long Haul / Trucks	200,000	600	10,200

It is important to note that EVs will have minimal impacts on the grid in the near-to-midterm. Furthermore, if policymakers, grid operators, utilities, and other market participants can anticipate the load of charging EVs and plan for it proactively, they can not only accommodate the load at low cost, but also reap numerous benefits to the entire system. These benefits include: avoiding new investment in grid infrastructure, optimizing existing grid assets and extending their useful life, enabling greater integration of variable renewables (wind and solar photovoltaics), reducing electricity and transportation costs, improving energy security, and supplying ancillary services to the grid, such as frequency regulation and power factor correction.[15]

EV charging could reshape the load curve, with the most pronounced effect being an increase in evening peak loads as people plug in their EVs when they return home from work or after completing the day's errands.[16] Analysts project we will not see any real impact on the grid until about 15% of vehicles on the road go electric in 2035, and growth in e-mobility will not drive substantial increases in total electrical-grid power demand in the near future, thus limiting the need for new generation capacity during this period.[17] Also, as energy efficiency measures and policies improve and motors become more efficient, this will offset or mitigate any impact that EVs would have on the grid.[18] Policymakers have an opportunity to shape policy to facilitate integrating of EV loads into the system in a way that maximizes their benefits, reduces any impacts on the grid, and supports their potential future use as a resource. EVs are a form of distributed energy resource (DER), and ensuring that DERs are fully integrated into utility and grid planning and wholesale markets will bring substantial value to Texans. The growing number of electric vehicle batteries could provide a wide range of valuable grid support services, including peak shaving, load shape

[13] http://www.ercot.com/content/wcm/lists/144927/2018_LTSA_Report.pdf.
[14] ERCOT reviewed traffic flow information from the Department of Transportation, to estimate the adoption of EVs by 2033 in an "emerging technology scenario." The electricity consumed by every vehicle was estimated based on an assumed daily driving distance.
[15] https://rmi.org/wp-content/uploads/2017/04/RMI_Electric_Vehicles_as_DERs_Final_V2.pdf
[16] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-potential-impact-of-electric-vehicles-on-global-energy-systems#.
[17] https://about.bnef.com/electric-vehicle-outlook/#toc-download
[18] https://energypost.eu/the-impact-of-electric-vehicles-on-electricity-demand/.

smoothing, and renewables integration. EV batteries will also have a second useful life as grid storage. Additional work is needed to allow for EVs and other DERs to capture the full monetary benefits to compensate them for the services that they can provide on the distribution system. EVs could be used either directly, through active participation in wholesale markets to provide ancillary services, or indirectly (i.e., incenting charging behavior) as flexible loads to reduce demand when needed or build load to use excess generating capacity (e.g., times of peak renewable generation).

As discussed in TAEBA's 2019 report, *The Value of Integrating Distributed Energy Resources in Texas*,[19] Texas customers could save $5.47 billion over 10 years if DERs can be more fully integrated into the electricity system.[20] TAEBA has commented in detail on DER issues in Project 48023, "Non-traditional Technologies in Delivery Service," which we incorporate here by reference. To reiterate and expand upon some of the recommendations TAEBA has made in the past to facilitate DERs, including EVs, we urge policymakers to consider the following actions to avoid future grid impacts and maximize benefits:

- ***Increase Transparency in Utility Distribution Systems:*** Policymakers should require additional transparency in utility distribution system planning processes so that the market has more information about distribution system capacity for DERs, including EVs.
- ***Examine opportunities for DERs to Provide Wholesale Market Services:*** Customers who invest in EVs (and/or other DERs) should have the opportunity to participate in any and all markets they are able to, whether individually or as an aggregation, and any services provided should be compensated according to value and performance. Any barriers to participation in markets should be removed.
- ***Incorporating smart charging and rate design into policy***: Smart charging refers to proactive efforts to shift load, typically from longer dwell time chargers to times that are the most beneficial for the grid. A recent report from the Smart Electric Power Alliance (SEPA)[21] notes that residential EV rates are an important first step to promote grid benefits. Price signals provide incentives for resources, including DERs, to locate in the correct places.

3. Please identify any anticipated load "hot spots" in the state for electric vehicle charging. Please specify whether these hot spots are expected to result from personal, commercial short-haul, or commercial long-haul electric vehicle deployment and charging.

When identifying hot spots, researchers and electric vehicle service providers (EVSPs) have used geospatial-analytics forecasting of zip-code-level EV penetration, traffic patterns, and real-time utilization of existing charging stations.[22] This research shows that we can expect to see suburban and urban areas as the first EV-adoption hot spots for personal vehicles. Level 2 chargers, which charge a vehicle at about 25 miles in an hour, are typically located where an EV driver may be over an hour, including single family homes, workplaces, parks and recreation areas, and other long dwell-time locations. DC fast charging, on

[19] www.texasadvancedenergy.org
[20] https://www.texasadvancedenergy.org/
[21] https://sepapower.org/knowledge/sepa-report-residential-ev-time-varying-rates-that-limit-system-peaks/
[22] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-potential-impact-of-electric-vehicles-on-global-energy-systems

the other hand, which typically has a capacity of 50kW and above, is used frequently in urban areas where EV drivers may live in multi-unit dwellings and are unlikely to have access to home charging. Common use cases for DC fast chargers are locations where a driver will be an hour or less, including retail centers, restaurants, grocery stores, airport cell phone lots, and other short dwell time locations. DC fast chargers increasingly are used to serve light duty fleets such as rideshare and car share applications as well. Contrary to popular belief, usage of DC fast chargers along major highway corridors remains low, and again, usage is much higher in urban and suburban markets. Finally, in addition to identifying site locations for personal use drivers, it will be important to identify where large fleets and commercial clusters will be, for instance: rail and seaports, truck stops, school and municipal bus barns, office buildings, hotels, large apartments, downtown centers, and medical centers.

4. **Describe the observed or anticipated load profiles and impacts of various types of electric vehicle charging stations (e.g., residential Level 1, Level 2, and Level 3 DC Fast charging) and the class of the vehicle charging (i.e., personal, commercial short-haul including fleets and buses, and commercial long-haul electric vehicles).**

Different charging technologies have different impacts on the grid. Level 1 chargers have a low impact on the local system because they are using smaller amounts of power over a longer period of time. Level 2 chargers have an increased impact on the system and customer's specific electric service, occasionally requiring customers to upgrade the size of their electric service. Though most charging today takes places at home or the workplace with Level 1 or Level 2 charging, Level 3, or DCFC chargers, which are 50kW and above, may have the greatest impact on the local system because they are using a large amount of power instantaneously. The different types of chargers are summarized in Table 4 and discussed further below. [23]

Table 4: EV Charging

Type	Typical Voltage / Power	Typical Charging Time (LDVs)
Level 1	120-volt outlets at up to 1.9 kW	5 miles of range for every hour of charging
Level 2	240-volt outlets at up to 19.2 kW	10-30 miles of range for every hour of charging
Level 3 or DCFC	480-volt outlets at 50-150 kW	25-75 miles of range for 10 minutes of charging

- ***Level 1:*** Level 1 EVSE uses standard 120-volt household outlets to "trickle charge" at slow rates (under 2kW) - equivalent to running a hairdryer- generally requiring continuous charging whenever the vehicle is parked. The benefit of these chargers is the ability to use existing infrastructure- i.e., any standard electrical outlet. Level 1 chargers usually provide about 2-5 miles of range for every hour of charging, or about 40 miles of range after eight hours of charging.[24] Thus they can meet

[23] https://info.aee.net/advanced-energy-policy-brief-ev-101
[24] https://afdc.energy.gov/fuels/electricity_infrastructure.html

the needs of EVs that are driven relatively short distances, whether daily or occasionally. As context, studies show that 78% of commuters drive less than 40 miles per day.[25]

- ***Level 2:*** Level 2 EVS uses 240-volt outlets, providing approximately 7.7 kW at 32 amps, which is typical for a home 240-volt connection. This reduces charging time by as much as 75% compared to Level 1, but requires installation of dedicated equipment.[26] Level 2 chargers, especially those used in public-purpose charging applications, can operate at up to 80 amps and 19.2 kW. Level 2 chargers provide about 10 to 30 miles of range for every hour of charging.[27] Tesla's Level 2 charger, when equipped with optional dual chargers, can supply over 50 miles of range every hour per vehicle.[28] Level 2 chargers are well suited to EVs with ranges of 80 miles or more and can completely recharge a 200-mile EV in approximately 10 hours. Level 2 chargers are also conducive to home and workplace charging, as well as some public sites (e.g. shopping centers) for "topping-up" EVs. It is important to note that incentivizing workplace charging through policy and financial tools will help reduce load impacts from DC fast charging.
- ***Level 3 or DCFC (Direct Current Fast Chargers):*** Direct current fast chargers (DCFC), or Level 3 chargers, are able to provide at least 90 miles in 30 minutes. Today, the most commonly deployed DC fast chargers are at least 50kW, though the weighted average charge rates [given the battery capacity of most vehicles in operation today] do not reach that level. This will increase as vehicle battery capabilities increase. DC fast chargers are best suited for public locations in cities and high-density suburban areas, in retail locations and on heavy traffic corridors (e.g., highways), though as noted above, corridor usage remains relatively low to the urban use case across the country. Nonetheless, Level 3 chargers are still necessary for road trips that extend beyond the range of a single charge. Additionally, because DC fast chargers are often used by apartment dwellers without access to charging at home or the workplace, increasing the preponderance of public DCFC is important to expanding EVs to new demographics and addressing equity.

5. **What, if any, emerging vehicle charging technologies are anticipated to be commercially available in the next ten years that could impact electricity markets in Texas?**

As discussed above, the impact of EVs on the electricity grid can be mitigated through thoughtful and well-planned policies as well as deployment of advanced energy technologies, which can turn EV load into a grid asset. Smart charging, sometimes referred to as "V1G," is essential to managing the load and impact on the grid, as smart charging solutions minimize electricity bills for consumers, reduce the need for utility infrastructure upgrades, and allow for better management of power supply and demand. This is most commonly discussed in the context of longer dwell time chargers such as Level 1 or Level 2 chargers, which provides for more scenarios by which customers may shift load as opposed to DC fast chargers, which have shorter dwell time locations and more consistent load profiles throughout the day. Smart charging approaches can either be passive (such as through rate design), or active (demand response). Passive smart charging includes both dynamic pricing, and fixed time-of-use rates.[29] Active smart charging uses signals from distribution or transmission grid operators and/or aggregators to shift charging or vary charging speed, both up and down, in response to dynamic grid conditions, and is not dependent on uncertain

[25] http://evsummit.org/speakers/presentations/Gross_Drive_Electric_Florida_BKGross.pdf
[26] https://citizensutilityboard.org/wp-content/uploads/2017/04/2017_The-ABCs-of-EVs-Report.pdf
[27] https://www.afdc.energy.gov/fuels/electricity_infrastructure.html
[28] https://citizensutilityboard.org/wp-content/uploads/2017/04/2017_The-ABCs-of-EVs-Report.pdf
[29] https://sepapower.org/knowledge/sepa-report-residential-ev-time-varying-rates-that-limit-system-peaks/

customer response to price signals. [30] Analysts have identified EVs reduce their electricity usage by 65% to 95% when using smart charging, therefore reducing impact on the grid.[31] Moving forward, it is essential to incorporate smart charging practices to manage load and get the maximum benefits from EVs.

Wireless charging is another emerging EV charging technology. Although still years off from widespread implementation, stationary and dynamic inductive charging options, which are already available for other consumer products (such as smartphones, smart watches, and electric toothbrushes), have the potential to make charging a more seamless experience. Wireless charging for EVs can additionally provide potential impacts on city planning including implications for on-street bus parking and impacts for the future of transportation when it comes to shared and autonomous driving. Wireless charging kits have been developed by third parties to work with vehicles from manufacturers such as BYD, BMW, Mercedes-Benz, Nissan, GM, Ford and Tesla.[32]

GRID IMPACTS

6. **The Commission requests that parties provide a detailed explanation on the following items: The anticipated impacts of electric vehicle charging, including residential and commercial charging stations on the distribution system in the next ten years; The anticipated impact of electric vehicle charging stations on the transmission system in the next ten years; and the anticipated impact of electric vehicle charging stations on long-term system planning at the regional transmission organization level, given a widespread adoption scenario.**

7. **What is the overall anticipated impact of electric vehicle charging in the next ten years in terms of energy and peak demand? What changes, if any, should be made to energy and peak demand forecasts to incorporate this impact?**

Given that peak demand is a key driver in determining infrastructure needs, TAEBA responds to these two questions together. As discussed previously, the impact of EVs on the grid will be minimal in the near to mid-term. ERCOT has estimated there will be 3 million EV cars in Texas by 2033, which will account for 5,940 MW in peak charging demand.[33] To put this in context, ERCOT estimates the total projected peak load in 2030 in Texas to be roughly 95,000 MW, so EV load would be approximately 6% of the total peak electricity load in 2030. The 6% estimate tracks with BloombergNEF's estimate that global electricity demand from all types of EVs (2,333TWh) would add 6.8% to total global electricity consumption in 2040.[34]

As highly flexible load, with appropriate policy design very little of this EV load would occur during times of peak demand.[35] Most EV load, especially for longer dwell-time chargers in the Level 1 or Level 2 space, can be shifted off-peak. Off-peak EV charging can provide net benefits to all utility customers by

[30] https://greenlots.com/solutions/smart-charging/.
[31] https://www.sae.org/publications/technical-papers/content/2015-01-0304/.
[32] https://www.pluglesspower.com/learn/wireless-charging-evs-guide-tesla/.
[33] http://www.ercot.com/content/wcm/lists/144927/2018_LTSA_Report.pdf.
[34] https://about.bnef.com/electric-vehicle-outlook/.
[35] 7th Joint IOU Load Research Report.

shifting EV charging to hours when the grid is underutilized, and the cost of electricity is low. For example, in regions with high solar penetration, EV charging can be shifted to the middle of the day, and in regions with high wind penetration, EV charging can be shifted to the night. Already, the load profile for public DC fast chargers, especially in a fleet use case, is compatible with solar integration. To the extent that individual customers or fleet owners have invested in additional DERs, such as distributed generation, those customers can combine multiple advanced energy technologies to optimize on an individual or fleet basis. For instance, TAEBA member company Greenlots has partnered with the Volvo LIGHTS project, which is investing in battery EV charging solutions for heavy duty fleets.[36] Furthermore, in one study, customers who used sub-metering for EV loads were able to shift 84% of their load into off-peak periods.[37] These data show that with adequate information and the appropriate price signals, customers can and will tailor their behavior appropriately, but it is important to have solutions in place during the early adoption period so that proper charging habits can being ingrained from the start.

Incentivizing charging behavior to optimize the grid will depend in part on rate design and retail pricing, and those specific solutions will be different in ERCOT regions (where retail pricing is established through competitive means) and in non-ERCOT regions, (where utilities currently remain vertically integrated). In general, rate designs should align with utility cost causation, incent charging behaviors that optimize the use of the grid, and ensure that customers have the ability to manage their energy usage and energy costs. In competitive areas of the state, some retail electric providers are offering plans for EV pricing (i.e. MP2 Energy's "Electric Vehicle Incentive Charging Plan" [38] or Reliant Energy's "Reliant Electric Vehicle 12 Plan" [39]). In non-ERCOT areas, the Commission should require utilities to adopt well-designed TOU rates for residential, commercial, workplace, and fleet charging and explore over time more granular time-varying rate options that include dynamic pricing elements. In some other states, utilities have developed commercial EV rates to encourage transportation electrification and to increase load from fleets and public DC fast chargers. [40]

Demand charges are an important consideration when it comes to EV rate design, as demand charges are based on the highest level of electricity usage on a per kW basis for a certain time period during each billing cycle. Demand charges are intended to better align revenue collection with utility costs and provide a price signal to incentivize customers to adjust their usage decisions to account for their impacts on the grid.[41] However, demand charges can be problematic in specific use cases, particularly

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[36] https://www.lightsproject.com/about/
[37] 7th Joint IOU Load Research Report
[38] https://www.mp2energy.com/mp2-energy-launches-electric-vehicle-incentive-charging-plan.php
[39] https://www.reliant.com/en/public/electric-vehicle.jsp
[40] One example is [40] Connecticut Light & Power ("Eversource"), which has offered an Electric Vehicle Rate Rider Pilot (EVRRP) since July 1, 2014. By an order issued March 6, 2019, the Connecticut utility regulator has extended this pilot program for another three years. Existing stations were allowed to switch onto this tariff. National Grid also has a commercial EV rate available in Rhode Island. See Rhode Island Public Utilities Commission, Docket Nos. 4770 and 4780.
[41] https://info.aee.net/advanced-energy-policy-brief-ev-101

those where the charger is normally characterized by low utilization, with an occasional high usage event. An example would be a DC fast charger along a highway where two Teslas pull up for a charge at the same time. Policymakers should consider modifying demand charges associated with such use cases, particularly when vehicle electrification is in its infancy.

Finally, the broader suite of advanced energy technologies provided by TAEBA member companies will play an important role in the effort to reduce the impact of EVs on the grid. The increasing adoption of rooftop solar and other DERs will reduce peak demand, and we anticipate that customers will increasingly adopt combinations of these technologies. For example, companies like Tesla and Envision have realized the benefits of solar + batteries + EVs with their consumer products such as "Powerwall" [42] and "Electric Vehicle Autonomous Renewable Charger" respectively.[43] TAEBA member company EVgo has piloted energy storage projects[44], including projects with second-life batteries, powered by 100% renewable energy. Furthermore, it is important to consider the role of energy efficiency, DERs, and renewable energy in relation to EVs and charging, as they are all interconnected. As more DERs are integrated to the grid, loads curves become more stable, reducing peak demand impact.

8. What are the capabilities of electric vehicle related technologies, such as vehicle-to-grid, to participate in wholesale electricity markets?

Researchers report vehicle grid integration (VGI) revenue from grid service markets will reach $1.4 billion by 2030, but this strong growth depends on removal of technical and regulatory hurdles.[45] These researchers believe the proliferation of wireless communications standards in vehicles will quickly enable basic forms of VGI (such as managed charging), with significant benefits. From time of use rates, smart charging, and rate resign, VGI gives utilities and grid operators more options to balance the grid and optimize the use of power available on the grid at any given time.

Vehicle-to-grid (V2G) technology refers to the capability of an EV owner to participate in the electricity market as an energy supplier rather than a passive load. Potentially, V2G can balance the variable and intermittent output of renewable power generation, provide grid services such as voltage and frequency control, and supply emergency backup power.[46] Though this is still early stages, some companies are beginning to integrate V2G technologies and make them commercially viable. For instance, Enel X is working with Nissan and RSE to launch Italy's first test of V2G applied to innovative services,[47] and Nuuve has developed V2G solutions for fleet managers, residential programs, and bi-directional

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[42] https://www.tesla.com/powerwall.
[43] https://www.envisionsolar.com/ev-arc/ec-arc/.
[44] https://www.evgo.com/about/news/evgo-balances-ev-fast-charging-with-14-battery-storage-systems-across-11-evgo-fast-charging-stations/
[45] https://www.navigantresearch.com/news-and-views/vehicle-grid-integration-revenue-from-grid-service-markets-is-expected-to-reach-14-billion-by-2030
[46] https://www.nrel.gov/docs/fy17osti/69017.pdf
[47] https://www.enel.com/media/press/d/2019/05/electric-mobility-enel-x-nissan-and-rse-launch-italys-first-test-of-vehicle-to-grid-technology-applied-to-innovative-services

charging stations for both AC and DC connections.[48] Highland Electric Transportation[49] and Proterra[50] are pioneering V2G integration capabilities enabling school buses to feed power back to the grid and essentially serve as mobile power generators, which can benefit cities and school districts.

9. **Please explain any preferred or best practice facilities siting and design standards for commercial electric vehicle charging stations and why such standards are recommended.**

Installing public charging stations can be a time-consuming process, and "awaiting utility interconnect" is a pending state that delays when drivers can start using chargers. As many states have already done for distributed generation, regulators should develop standardized and streamlined service requests associated with EV charging stations to help speed the process of connecting new EVSE to the grid, reduce interconnection costs, and avoid undue discrimination and expenses for charging infrastructure projects. Some recommendations include an expedited review process for EV charging projects, standardized service agreements, and an electronic application process.[51] For technical interconnection standards, well-developed guidance already exists. For example, the Institute of Electrical and Electronics Engineers (IEEE) series 1547 standards address interconnecting distributed resources with the grid, including allowing PEVs to be used as V2G resources in the future.[52]

To get the most out of EVs as a resource, make the customer experience as seamless as possible, ensure equitable access to charging infrastructure that is funded with public money[53], and ensure the reliability of the grid, regulators should address interoperability issues. One way in which regulators can help prevent technological obsolescence is by requiring industry interoperability standards for publicly funded, publicly available EVSE equipment. There are several elements of interoperability standards when it comes to EVs and EVSE, but they generally fall into three categories: the physical connection between the EVSE and vehicle, payment systems, and data and communications protocols. Charging networks that have been deployed to date with public funds have too often lacked true payment system interoperability. For example, some require customers using a network to have a membership in a private network in order to pay for charging their vehicle. The resulting balkanized system makes it difficult for drivers to move from a charging station in one network to a station in another network. Requiring that payment systems for publicly funded EVSE have standardized options, at the minimum having the ability to use credit cards via a card reader or mobile app or telephone option, will ensure that no EV drivers have the experience of pulling up to a station that is publicly funded only to find themselves unable to charge their vehicle. Basic open standards for data communications ensure that publicly funded, publicly available charging equipment

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[48] https://nuvve.com/united-states/
[49] http://www.highlandet.com/
[50] https://www.proterra.com/
[51] https://info.aee.net/advanced-energy-policy-brief-ev-101.
[52] https://www.nrel.gov/docs/fy15osti/63157.pdf
[53] Public funding in this context can mean either taxpayer funded grants, or rate-payer funding, as appropriate, and acknowledging that in ERCOT utilities will not be rate-basing EV chargers.

from different vendors can communicate information in the same manner, which allows a network owner/operator to expand the network at any point using any vendor's equipment. At the same time, it reduces the risk for the investors in public networks in the event that a vendor goes out of business in the future because it allows for other vendors to take over the network and add new charging equipment, knowing that all the units on the system can still communicate.[54]

Conclusion

Although sales of electric vehicles are still relatively small, the market is growing rapidly, driven by a convergence of powerful trends in advances in technology, automation, urbanization, and more. As the transportation sector electrifies, policymakers have an exciting opportunity to be proactive in developing a plan for EVs in order to enhance the benefits that EV adoption can provide the grid and its customers. Texas has the opportunity to be one of the leading states in the nation on electrification of transportation, so early policymaker action will drive the acceleration of the EV market. TAEBA appreciates the opportunity to provide the perspective of advanced energy businesses in Texas and we look forward to working with the Commission and stakeholders on these important issues.

Respectfully submitted,

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[54] https://info.aee.net/advanced-energy-policy-brief-ev-101.