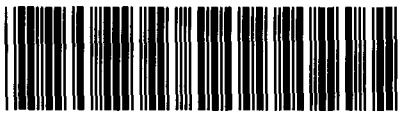

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PROJECT NO. 49125

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

NRG ENERGY INC'S COMMENTS REGARDING ISSUES RELATING TO ELECTRIC VEHICLES

I. INTRODUCTION

NRG Energy, Inc. (NRG)[1] respectfully files these comments addressing the questions submitted for comment on December 13, 2019. NRG looks forward to participating in the Commission's project on Electric Vehicles (EVs). The Commission is right to be proactive on the subject of EVs and to begin discussion of potential market and operational impacts in Texas since EVs appear poised to transform the transportation sector. According to the Bloomberg New Energy Finance (BNEF) research group, approximately two million EVs were sold in 2018 compared to just a few thousand in 2010; and passenger EV sales are expected to increase to ten million in 2025, and over fifty million by 2040.[2] The electrification of the transportation sector holds the potential to contribute meaningfully to efforts to decrease the growth of carbon emissions in the U.S. and abroad. This potential is especially promising in Texas given the abundance of renewable resources supplying electricity in the state.

The potential for rapid EV adoption, as outlined by BNEF, is driven by several factors. First, lithium ion battery prices have rapidly declined and BNEF forecasts that by the mid 2020's, EVs will be the same price or lower than internal combustion engine vehicles.[3] Next, tighter emissions standards for internal combustion vehicles will increase both the need for innovation and demand for electric vehicles.[4] Finally, decarbonization of the transportation sector is imperative to meet stated sustainability and climate action goals of Fortune 500 corporations, cities, and states. According to the Rocky Mountain Institute, transportation is the single largest carbon-emitting sector in the United States, accounting for 29% of all

[1] NRG Energy, Inc. is the parent company of several competitive energy providers, including certificated power generation companies, power marketers, and retail electric providers operating in ERCOT.

[2] BNEF, *Electric Vehicle Outlook 2019,* https://about.bnef.com/electric-vehicle-outlook/ (BNEF Electric Vehicle Outlook) (last visited on Jan. 24, 2020).

[3] *Id.*

[4] *Id.*

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emissions.[5] Electrification in the transportation sector is already showing signs of increased adoption. Amazon recently placed an order for 100,000 EVs with start-up company Rivian to help meet their environmental goals.[6] The United Postal Service recently signed a deal with Arrival to purchase 10,000 electric delivery vans through 2024.[7] And the City of Houston announced a climate action plan to reach net-zero emissions by 2050, noting that nearly half of the citywide greenhouse gas emissions come from transportation.[8]

ERCOT's competitive market is well suited to enable the proliferation of EVs and NRG is planning to be an active participant in the EV space in numerous ways. As the largest provider of electricity to retail customers in Texas, NRG sees an important role to ensure EV customers are able to easily charge their vehicles and provided with retail electricity plans that optimize their usage and charging decisions. Potential grid impacts and infrastructure costs can be avoided by offering the economic incentives for customers to charge their EVs during times of low grid stress such as during night time hours or times with high renewable output. Prices will help guide the desired behavior through competitive retail products offered by retail electric providers (REPs). NRG also anticipates a future where EV discharging capability can be used as a demand response resource to lower consumption during times of scarcity. In addition, by aggregating EV customers together and controlling EV discharge as a single resource, EVs could participate in ancillary service markets to provide frequency response although market rules would need to evolve to accommodate it. NRG looks forward to exploring the potential impacts and contributions of EVs in the ERCOT market during the course of this project.

II. COMMENTS

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**

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[5] Britta Gross, *1 in 5 Cars Need to Be Electric by 2030: What Will it Take?*, Rocky Mountain Institute (RMI), Dec. 18, 2019, https://rmi.org/1-in-5-cars-need-to-be-electric-by-2030-what-will-it-take/ (Gross, RMI 1-in-5) (last visited Jan. 24, 2020).

[6] Elija Shama, *Amazon is Purchasing 100,000 Rivian Electric Vans, the Largest Order of EV Delivery Vehicles Ever*, CNBC, Sept. 19, 2019, https://www.cnbc.com/2019/09/19/amazon-is-purchasing-100000-rivian-electric-vans.html (last visited Jan. 24, 2020).

[7] Steve Hanley, *UPS Orders 10,000 Electric Delivery Vans From Arrival*, CleanTechnica, Jan. 29, 2020, https://cleantechnica.com/2020/01/29/ups-orders-10000-electric-delivery-vans-from-arrival/ (last visited Jan 31, 2020).

[8] City of Houston, *Houston Climate Action Plan, DRAFT Outline of Recommendations for Public Comment*, Jul. 29, 2019, http://greenhoustontx.gov/climateactionplan/2019-DRAFT-CAP.pdf (last visited Jan. 24, 2020).

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).

There are numerous sources that estimate future EV sales and market share. BNEF's annual study of EVs, "Electric Vehicle Outlook 2019," estimates 28 million EVs will be sold in the year 2030 globally compared to 2 million in 2018.[9] McKinsey predicts the global share of EVs could range from 10% to 50% of new vehicle sales in 2030 depending on emissions regulations and consumer incentives.[10] EV Adoption estimates EV sales in the U.S. will total over 388,000 in 2020 and increase to 3 million in 2028.[11] While EV sales forecasts specifically for the state of Texas do not appear to be readily available, Texas ranked 5th in total EV sales by state in 2018 with approximately 11,764 EVs sold, which is 117% more sales than the previous year.[12]

BNEF forecasts global EV market share growth in all vehicle classes in the next 20 years with buses, light commercial vehicles, and passenger vehicles having 68%, 38%, and 30% share of their vehicle class, respectively, by 2040. Advancements in drivetrain technology are expected to improve the economics of light, medium, and heavy commercial EVs in the years to come to support the anticipated growth.

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).**

Electricity consumption from EVs is expected to rise from 74 terawatt hour (TWh) in 2019 to 2,333 TWh in 2040 which would account for 6.8% of total global electricity consumption.[13] EVs are expected to increase electricity consumption in the U.S. by 11% in 2040.[14] A study by the Energy Institute at the University of Texas found that if all passenger vehicles in Texas were EVs,

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[9] *Id.* at page 1.

[10] McKinsey & Company, *Automotive Revolution – Perspective Towards 2030,* Jan. 2016, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/disruptive-trends-that-will-transform-the-auto-industry/de-de (last visited Jan. 24, 2020).

[11] EV Adoption, *2020 US EV Sales Forecast: 25% YOY Increase,* Dec. 23, 2019, https://evadoption.com/2020-us-ev-sales-forecast-25-yoy-increase/ (last visited Jan. 24, 2020); EV Adoption, *EV Sales Forecasts,* https://evadoption.com/ev-sales/ev-sales-forecasts/ (last visited Jan. 24, 2020). EV Adoption is an organization that provides EV-related analysis and research.

[12] EV Adoption, *EV Market Share by State,* https://evadoption.com/ev-market-share/ev-market-share-state/.

[13] BNEF Electric Vehicle Outlook.

[14] BNEF Electric Vehicle Outlook.

the electricity consumption in the state would increase by 110 TWh per year or approximately 30%.[15]

In addition to the sources above, ERCOT included a high EV adoption scenario in their 2018 Long-Term System Assessment (LTSA) which forecasted EV charging demand of 18,500 megawatts (MW) over the nighttime hours and 5,000MW to 6,000MW of EV charging demand over peak hours.[16] As discussed in the response to question 6 (c), NRG recommends that ERCOT continue to include and refine EV adoption scenarios in their biennial LTSA to examine potential increases in electricity consumption and demand from EVs by vehicle class.

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.**

Since the majority of passenger EV charging will take place at home or at work, EV charging demand will be the greatest in areas with higher populations.[17] A survey by Volvo provides insights on concerns of prospective EV buyers compared to those of EV owners.[18] Range anxiety[19] was the top concern for 58% of prospective EV buyers but the concern dropped to 38% for EV owners as they got familiar with charging at home.[20] While public EV charging stations for passenger vehicles will be important, the study found home charging met most of the needs for EV drivers.[21] It is important to note that Texas already has 1,265 public charging stations with 3,713 charging outlets.[22] Only California, Florida, and New York have more public charging stations than Texas. Therefore, companies in the competitive market are stepping up to provide public

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[15] The Conversation, *Switching to Electric Vehicles Could Save the US Billions, but Timing is Everything, Dec. 4, 2018,* https://theconversation.com/switching-to-electric-vehicles-could-save-the-us-billions-but-timing-is-everything-106227.

[16] ERCOT, *2018 Long-term Assessment for the ERCOT Region* at 10, December 2018, http://www.ercot.com/content/wcm/lists/144927/2018_LTSA_Report.pdf.

[17] The Rocky Mountain Institute (RMI) estimates that 80% of all charging takes place at home. Gross, RMI 1-in-5.

[18] Volvo, *The State of Electric Vehicles in America* (Volvo State of EV), https://www.media.volvocars.com/us/en-us/download/249123.

[19] Range anxiety is a fear that a vehicle has insufficient range to reach the destination(s) to which the driver expects to travel.

[20] Volvo State of EV at 4.

[21] Volvo State of EV at 5.

[22] US Department of Energy, Alternative Fuels Data Center, *Alternative Fueling Station Counts by State,* January 24, 2020, https://afdc.energy.gov/stations/states (last visited Jan. 24, 2020).

charging stations in Texas, eliminating the need for ratepayers to subsidize utility-provided charging stations as seen in other states.

EV demand will be concentrated for buses and commercial EVs at centralized, commercial grade charging stations which again are likely to be near urban centers. Charging demand for long-haul trucking will likely be along delivery routes and interstate highways. The Commission may consider directing ERCOT to include specific EV adoption scenarios in the LTSA to assess the impact of varying EV charging demand on the transmission and distribution system.

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).**

The load profile or consumption pattern of each EV will depend highly on the use of the EV, the charging capability of the EV, the type of charging system, and the state of charge of the EV. Charging duration and kW demand is dependent on the voltage of the EV charging system connection and capability. Therefore, higher voltage EV charging systems will cause higher spikes in demand for shorter duration. A passenger EV used for short, daily commutes may retain a high state of charge and require a much lower amount of electricity consumption. Commercial EVs or buses with lengthy duty cycles will require larger amounts of daily consumption. This is where REPs will play an important role to provide plans to incentivize charging at times that are optimal for the grid and wholesale market. A recent study by the National Renewable Energy Laboratory (NREL) for the Colorado Public Utility Commission found that time-of-use (TOU) rates will be critical to successfully integrate the mass adoption of EVs into the grid.[23] Providing incentives to charge EVs during periods of low system cost will reduce the demands on the system and lower the costs of integration.

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?**

The ability to connect and control EV charging equipment remotely is improving utilization of charging facilities. Level 2 charging equipment and EVs typically have an option to

[23] National Renewable Energy Laboratory, *Electric Vehicle Charging Implications for Utility Ratemaking in Colorado*, https://www.nrel.gov/docs/fy19osti/73303.pdf (last visited Jan. 24, 2020).

be controlled through an app.[24] Increased connectivity and communication between charging systems and EVs is expected to continue which can allow for integration into demand response programs. EV charging equipment used at apartments, buildings, and retail locations may utilize power management programs to limit demand and reduce the need for electrical distribution system upgrades at the sites. Power management capabilities at charging stations can also balance the available power so that a larger number of vehicles can charge at the same time perhaps at a slower rate.[25] Evolving options for sharing power at charging stations include equal charge balancing, first-in first-out, and round-robin.

Demand for Fast DC charging and Ultra-Fast DC charging up to 500kW is expected to grow.[26, 27] Each charging station may have multiple charging outlets and the demand can be high, especially if all charging outlets are used at the same time. Power management as described above or software to limit demand will likely be needed for these locations regardless of whether the charging station is used for passenger or fleet vehicles.

The value chain that supports the mass-produced internal combustion engine vehicles, retail fueling, fleet management and logistics has evolved over the past century. The electric vehicle value chain is embryonic by comparison. Battery technology is still evolving with research focused on battery chemistry, how the battery cells are configured and optimized, anode chemistry and potentially a step change to solid state batteries. Likewise, there is rapid change with charging speeds that could reduce the charge time from hours to minutes. These major advances are on the horizon and should be commercial by 2030.[28]

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[24] Level 2 (AC) charging stations are used with a 240V outlet (like a clothes dryer) and charge an EV faster than Level 1 (AC) charging stations, which are used with a standard electrical outlet.

[25] Ajay Agrawal, *Charge More EVs with Power Management,* Chargepoint, July 18, 2017, https://www.chargepoint.com/blog/charge-more-evs-power-management/ (last visited Jan. 24, 2020).

[26] DC chargers convert alternating current (AC) electricity to direct current (DC) and supplies DC power directly to an EV's battery. Fast DC and Ultra-Fast DC charging stations can charge an EV in a fraction of what it would take for a Level 2 charging station.

[27] Electrive.com Industry Service for Electric Mobility, *ITT Cannon Shows DC Charging at up to 500 kW,* Oct. 24, 2019, https://www.electrive.com/2019/10/24/itt-cannon-announces-dc-charging-up-to-500-kw/ (last visited Jan. 24, 2020); Eric C. Evarts, *EVgo Launches First Public 350-kw Fast Charger*, Green Car Reports, Dec. 18, 2018, https://www.greencarreports.com/news/1120518_evgo-launches-first-public-350-kw-fast-charger (last visited Jan. 24, 2020).

[28] BNEF Electric Vehicle Outlook.

Grid Impacts

6) The Commission requests that parties provide a detailed explanation on the following items:

a. The anticipated impacts of electric vehicle charging, including residential and commercial charging stations on the distribution system in the next ten years;

The majority of EV charging is expected to take place in off peak hours which will reduce potential impacts to the distribution system. EV charging technology and retail electric products offered by REPs can work together to ensure charging takes place during times that are optimal for the distribution system. Higher non-peak demand and increased consumption from EVs will increase the utilization of the distribution system and potentially require upgrades due to higher thermal stress. Transmission and Distribution Service Providers (TDSPs) have managed the significant growth in rooftop solar and distributed generation well. EVs pose a similar challenge that reflects the changing needs of customers of the distribution system. While upgrades may be required, substantial distribution system improvements are not expected to be required.

b. The anticipated impact of electric vehicle charging stations on the transmission system in the next ten years; and

The majority of EV charging is expected to take place in off peak hours which will reduce potential impacts to the transmission system. EV charging technology and retail electric products offered by REPs can work together to ensure charging takes place during times that are optimal for the transmission system. Given the limited impact to peak demand, EV charging is not expected to have a significant impact on the transmission system. The change in system demand will likely have an impact of the dispatch pattern of existing generation resources increasing utilization outside of peak hours. It is possible mass adoption of EV-to-grid capabilities could decrease the need for transmission upgrades in a similar way to distributed generation.

c. The anticipated impact of electric vehicle charging stations on long-term system planning at the regional transmission organization level, given a widespread adoption scenario.

Evaluating the potential impact of mass EV adoption in the ERCOT market should be a priority for ERCOT in their biennial LTSA process. The high EV adoption scenario

in the 2018 LTSA was informative and should be expanded to include adoption and consumption characteristics of vehicle classes, differing charging technologies, and EV-to-grid capabilities. The recurring nature of the LTSA will allow ERCOT and stakeholders to refine scenarios and analysis as EV adoption rates and charging demand evolve. Understanding impacts to resource adequacy and the transmission and distribution system will be important aspects for stakeholders. Since EV charging patterns are expected to be mainly focused during non-peak hours minimizing impacts to the transmission system, there isn't an apparent need to change the transmission planning process.

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?**

NRG provided sources to potential impacts to energy and peak demand stemming from EV charging in the response to question 2. NRG anticipates differing impacts to peak demand compared to energy consumption. Since EV charging patterns are expected to be mainly focused during non-peak hours, there is not an apparent need to make changes to ERCOT's long-term peak load forecast as more modest growth trends will naturally flow into ERCOT's peak demand forecasting methodology. However, the consumption of electricity for EV charging could result in a larger increase to ERCOT's long-term energy consumption forecast. Because ERCOT's long-term forecast mainly relies on historical weather and growth drivers, it will likely understate growth in future EV charging consumption. A new growth driver for EV premise count could be added in an attempt to estimate future EV charging impacts but it would likely be inaccurate. In addition, it may not be readily apparent from consumption data that an EV has been added to a household. NRG defers to the load forecasting experts at ERCOT to determine whether it would be possible to include a useful EV component to their long-term load forecast process.

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

In 2012, NRG and the University of Delaware (UD) conducted a demonstration project to prove out technology to support EV-to-grid (V2G) capabilities.[29] The four-year research

[29] Business Wire, *NRG Energy, University of Delaware Announce eV2g(sm) Initiative to Develop Electric Vehicle-to-Grid Technology*, Sept. 26, 2011, https://www.businesswire.com/news/home/20110926005420/en/NRG-Energy-University-Delaware-Announce-eV2g-sm (last visited Jan. 24, 2020).

partnership between NRG and UD led to a successful commercial demonstration of V2G technology at a UD campus location in collaboration with BMW and PJM.[30] The aggregation of EVs into a single resource with joint dispatch technology allow for V2G resources to replicate the capabilities of battery energy storage resources including the provision of system frequency response products. It is also envisioned that aggregated V2G resources can be price responsive and contribute to system capacity during scarcity events. ERCOT and stakeholders have embarked on a process to develop and implement operational and market rules for battery energy resources on the transmission and distribution system.[31] NRG looks forward to participating in that stakeholder process and expects to identify rules necessary to enable V2G capabilities.

Other examples of V2G research projects include:

- Nissan and EDF Group partnered to accelerate EV adoption and grid integration across Europe. Nissan is responsible for the sale of V2G compatible electric vehicles and EDF Group is responsible for V2G charging solutions as of Sept 18, 2019.[32]
- EDF and California-based startup Nuvve launched a V2G joint venture, Dreev, in May of 2019, with a focus on business customers and fleet owners. At the time of launch, Dreev was targeting several hundred installations before the end of this year. [33]
- Honda and Nuvve agreed to demonstrate benefits of V2G technology with 50 EVs at the University of California San Diego campus testing demand charge management, frequency regulation, and renewable energy capacity firming.[34]

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[30] Abagail Scout, *Plugging Renewables into Global Grid,* University of Delaware, Dec. 15, 2016, https://www.udel.edu/udaily/2016/december/vehicle-to-grid-technology-startup/ (last visited Jan. 24, 2020).

[31] The Battery Energy Storage Task Force (BESTF) was formed in 2019 and reports to ERCOT's Technical Advisory Committee (TAC).

[32] John Parnell, *Vehicle-to-Grid Technology Puts Businesses in Driver's Seat of EV Revolution,* gtm:, Sept. 19, 2019, https://www.greentechmedia.com/articles/read/vehicle-to-grid-technology-puts-businesses-in-drivers-seat-of-ev-revolution (last visited Jan. 24, 2020).

[33] Nuvve, https://nuvve.com/technology/ (last visited Jan. 24, 2020); Dreev, http://www.dreev.com/edf-launches-dreev-its-new-subsidiary-to-turn-innovative-smart-charging-solutions-into-a-reality/ (last visited Jan. 24, 2020).

[34] Cision PR Newswire, *Nuvve Corporation and Honda are Collaborating to Demonstrate the Benefits of Vehicle Integration (VGI),* Apr. 25, 2019, https://www.prnewswire.com/news-releases/nuvve-corporation-and-honda-are-collaborating-to-demonstrate-the-benefits-of-vehicle-grid-integration-vgi-300837982.html (last visited Jan. 24, 2020).

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.

A streamlined and standardized permitting process across all TDSPs would allow for easier development of charging facilities both at the residential and commercial level. TDSPs play a crucial role to provide facilities extensions and the necessary supporting infrastructure to support EV charging. Simplifying and standardizing the process to interconnect such facilities would allow for more timely installation. Once installed, the operation of the charging station and interaction with the customer from a retail electric perspective should be conducted by a competitive entity, not a regulated utility. While not within the purview of the Commission, consistent permitting requirements within city ordinances would also improve the process for installing EV charging equipment.

A best practice for engineering analysis and cost assessment related to the addition of large EV charging equipment may generally follow existing TDSP procedures like large motor starting currents and abnormal loads which require a thorough review. As an example, CenterPoint Energy Service Standards Section 500.1 requires a review for a new motor over 250hp (~186.5kW).[35] If the distribution system is not adequate to accommodate that addition, the customer may be charged for any required upgrades or may be required to modify their equipment to limit the "detrimental effects." A similar requirement and review process may be necessary for EV charging stations over a certain kW limit. The EV customer (e.g. charging company or consumer) would be required to pay for any TDSP upgrades or modify their equipment with power management software to limit the overall impact to the distribution system.

Another consideration for best practices in EV charging includes proper handling and disposal of used batteries. Safety systems should be considered during charging, disposal, and storage that could prevent fires. Processes for discarding used batteries should include recycling programs to minimize waste and impact on the environment.

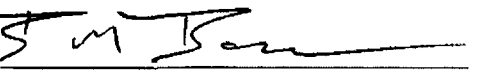
III. CONCLUSION

NRG appreciates the opportunity to comment on the questions set forth by the Commission, and the Commission's consideration of these important and developing issues

[35] CenterPoint Energy, *Service Standards* at 64-65 (Sections 500.1 and 500.2), Sept. 7, 2018, https://www.centerpointenergy.com/en-us/Documents/Service-Standards.pdf (last visited Jan. 24, 2020).

regarding EVs. NRG looks forward to participating in this project and assisting the Commission in evaluating impacts of EVs and potential solutions.

Respectfully submitted,

By: 

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