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

ONCOR ELECTRIC DELIVERY COMPANY LLC'S
<u>RESPONSE TO QUESTIONS</u>

TO THE HONORABLE PUBLIC UTILITY COMMISSION OF TEXAS:

COMES NOW Oncor Electric Delivery Company LLC ("Oncor") and files this its Response to the Questions published by the Staff of the Public Utility Commission of Texas ("PUC" or "Commission") on December 13, 2019.

I. INTRODUCTION

The Commission is seeking information about future electric vehicle ("EVs") deployment and the possible impact on the electric grid. In responding to the questions below, Oncor would stress that multiple credible sources of growth estimates indicate a wide potential range for EV growth between now and 2050. This high degree of uncertainty would indicate that any estimates will most certainly be wrong, and quite possibly wrong by a large amount in either direction. Despite ambiguity in the definition of terms used in third party studies (*e.g.*, are multi-family (apartment) chargers personal or commercial?), Oncor has chosen sources which seem reasonable despite significant variance. In the following responses, Oncor will present data from a variety of sources in an attempt to demonstrate the range of possible futures. However, data and projections are available essentially only for personal vehicle adoption. While a few transit buses have been placed into service in Texas, most medium duty and heavy duty trucks and school buses are not expected to be widely available until 2021 or later. In addition, future adoption will be determined by a variety of factors outside the control or influence of Oncor or the Commission, such as: changes in offerings of the Original Equipment Manufacturers ("OEMs") of cars and trucks; changes in the cost of generation fuels; the results of national elections; and various world events. For example, a nationwide ban on fracking for natural gas and oil could dramatically increase EV adoption in the nation and our state. Tesla Motors, despite legislatively imposed restrictions on selling its vehicles in Texas currently constitutes 84% of the battery electric vehicles registered in the Oncor service area according to Texas Department of Motor Vehicle ("DMV") registration data, and a legislative change to existing motor vehicle sales laws could significantly increase

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Tesla's sales in Texas. Finally, unknown impacts to the electric grid from EV charging could result from new battery chemistries and types under development, as new battery technologies reduce EV usage of the presently dominant lithium-ion technology. These examples help illustrate that future EV adoption rates, and the possible impacts of EVs on the electric grid, remain highly uncertain.

To assist the Commission, Oncor has included as Appendix 1 a Glossary of terms used herein, and as Appendix 2 a Bibliography of the sources cited.

II. RESPONSES TO QUESTIONS

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).

Personal EVs.

Oncor began tracking the monthly growth of EVs within its service territory early in 2018. Electric vehicle counts for both Plug-in Hybrid ("PHEV") and Battery Electric Vehicles ("BEV") – collectively referred to as Plug-in EVs ("PEVs") – were obtained from the Texas Department of Motor Vehicles ("DMV") registration data. MJ Bradley & Associates ("MJB&A") conducted a study for Oncor and Tesla Motors on EVs in the Oncor service area in September 2018.[1] MJB&A forecast a composite (higher growth rates in the short term, then lower growth rates in the longer term) 38% yearly growth rate for EVs in the Oncor service territory through 2030, which forecast has become the basis for Oncor's internal planning growth projections. The corresponding projected growth is plotted in Figure 1, with the projected 2030 total EV count reaching 575,000, or a 6.68% penetration in the Oncor service area.

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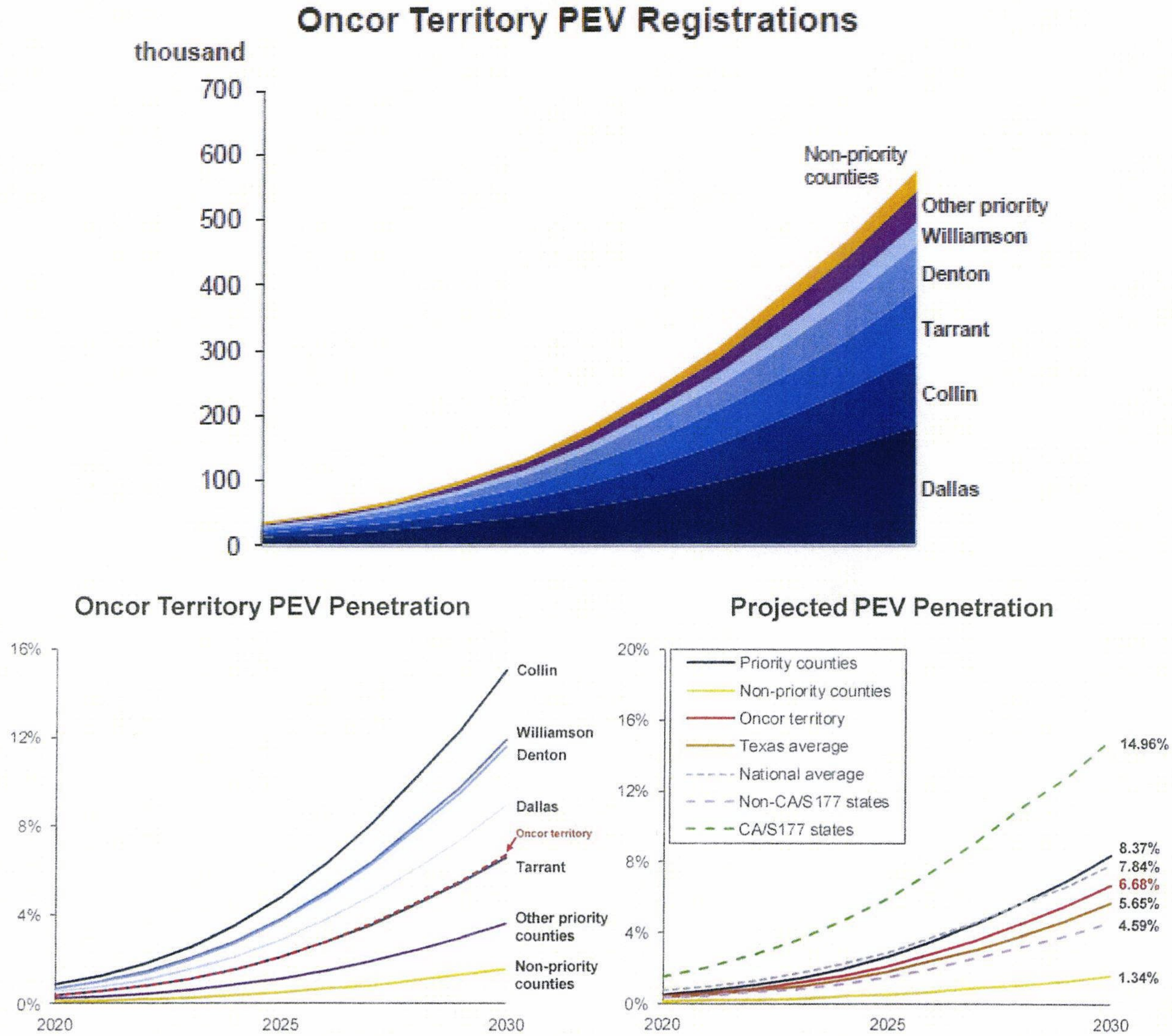
1 M.J. Bradley & Associates, Texas PEV Market Analysis, February 2019. *See* Appendix 4 (chapters containing forward-looking financial projections and possible future studies omitted).

Figure 1 – Oncor Projected PEV Penetration: Total and by County[2]



The North Central Texas Council of Governments ("NCTCOG") monitors EV growth for the entire state of Texas based on DMV data that is only available to governmental entities.[3] As set out below in Figure 2, NCTCOG's state-wide EV projection reaches 683,000 vehicles in 2030, for a 2.26% cumulative penetration rate of total vehicles in Texas. The NCTCOG study indicates that at the end of 2019 the EVs registered in the Oncor territory account for roughly 33% of the total statewide penetration.

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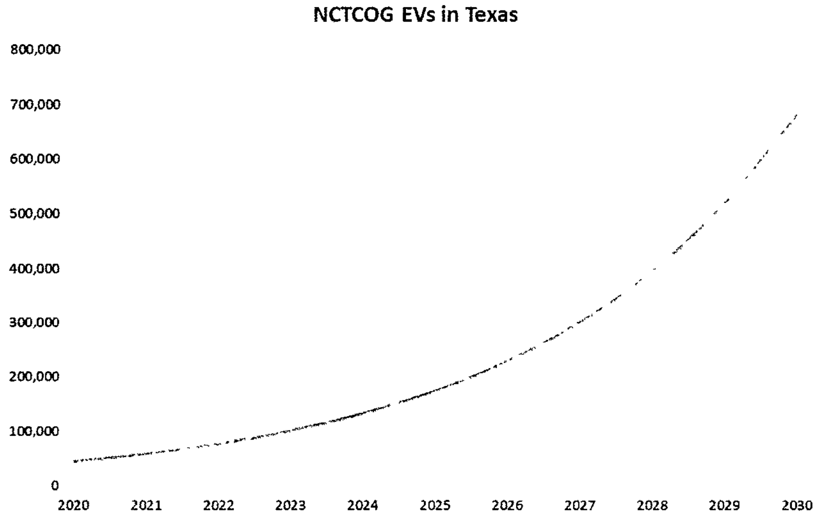
2 *Id.*, pp. 16, 17.

3 Electric Vehicles North Texas (https://www.dfwcleancities.org/evnt).

Figure 2 – NCTCOG EV Projections



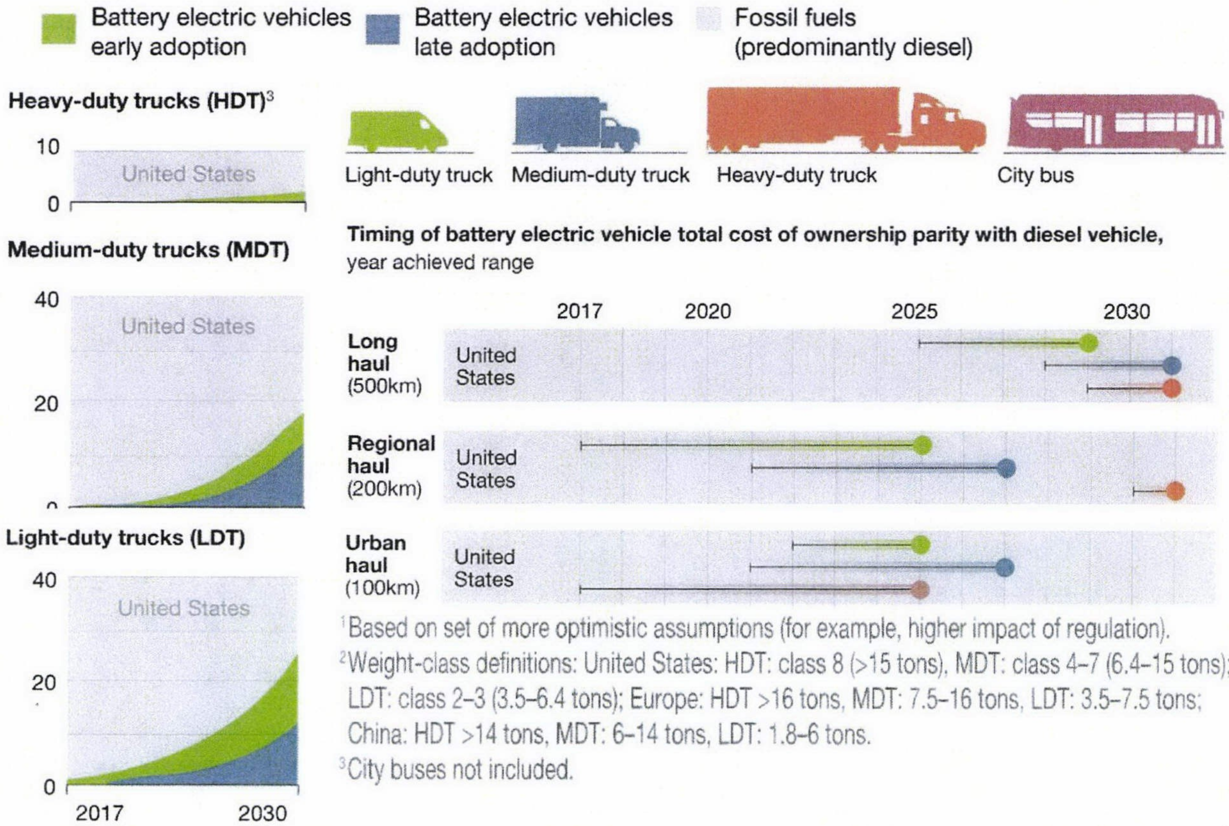
Oncor would note that these projections do not contemplate inducements to EV adoption that are not currently in the market. For example, with respect to charging station installations, there are underserved areas comprising lower income and/or multi-family residential neighborhoods. One factor that many different sources have identified that is a barrier to EV adoption is the lack of widespread availability of public charging infrastructure. Since multiple sources have identified that between 80-85% of all EV charging takes place at home, when a prospective EV owner is a renter or is in a lower income bracket, they may not have access to, or the ability to purchase and install, a residential charger. Should national, state, or local policies change, such as to incent charging station installation in such areas, then the EV adoption rate could be greater than currently forecast.

Commercial EVs

At this time Oncor is not utilizing any specific projection of commercial (fleet) EV adoption rates. Oncor would note that, as set out below in Figure 3,[4] very few commercial vehicles are currently being produced, and no medium- or heavy-duty vehicles are projected to enter the market until the end of 2021 and 2024, respectively. Thus, due to the lack of any existing commercial EV penetration rate data, Oncor currently is not forecasting fleet impacts.

[4] McKinsey & Company, "What's sparking electric-vehicle adoption in the truck industry?" September 2017 (available at https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/whats-sparking-electric-vehicle-adoption-in-the-truck-industry).

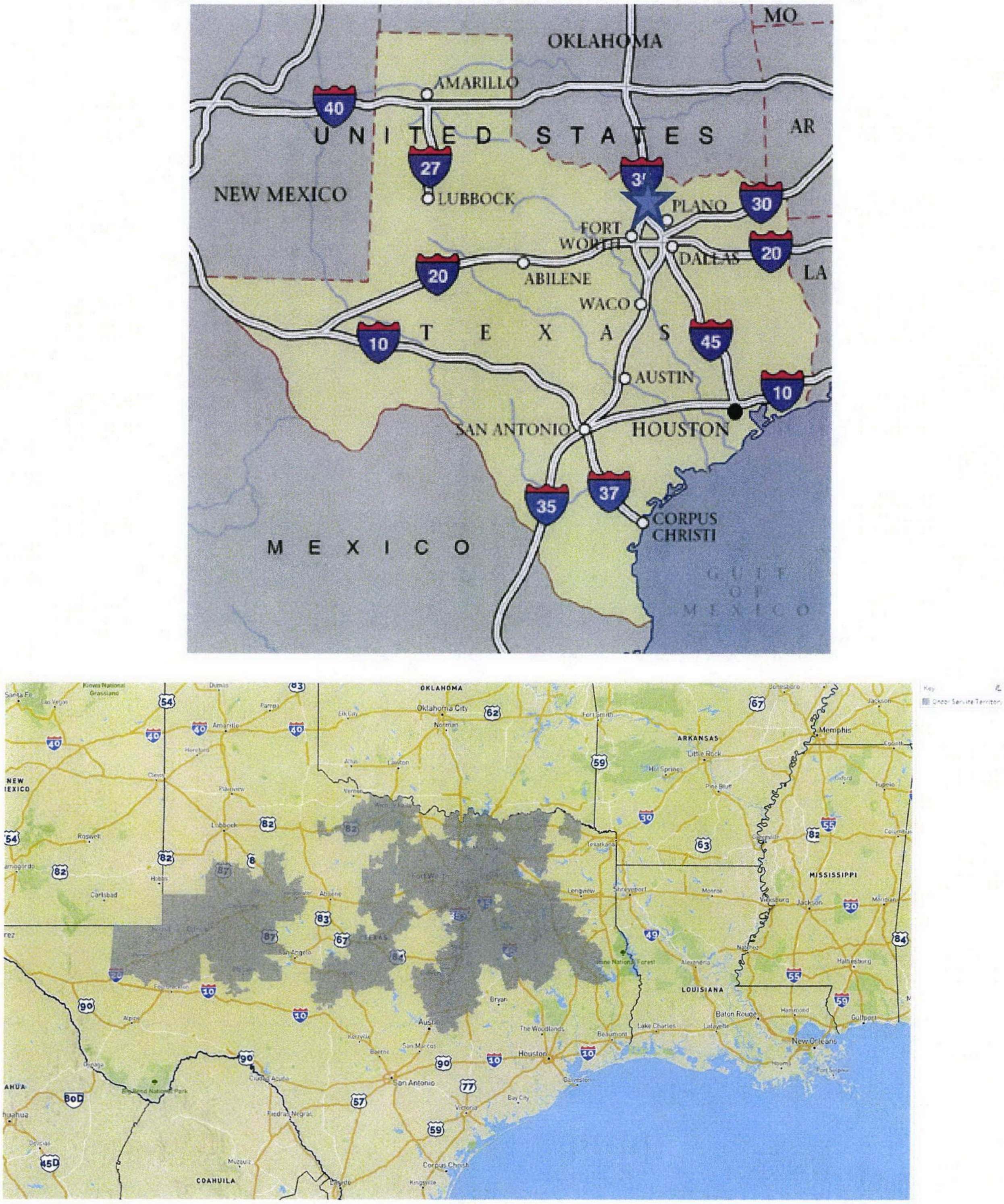
Figure 3 – Heavy, Medium and Light Duty Truck Adoption Timeline



Despite being unable at this time to project reasonable future commercial EV adoption rates, Oncor has determined that fleet electrification has the potential to be the greatest single transmission and distribution capital expenditure driver for Oncor resulting from EV adoption. Oncor has drawn this conclusion based upon the following factors. First, Texas currently accounts for approximately 13.0% of all freight movement in the United States, which is approximately equal to the next two states (California and Florida) combined.[5] Fleetseek, a commercial fleet data source, identified approximately 22,600 fleets in the Oncor service area. Second, this freight movement follows the interstates, which mostly intersect in the Dallas/Ft. Worth ("DFW") Metroplex, as shown in the map in Figure 4:

[5] US Department of Transportation, Federal Highway Administration, Freight Analysis Framework Version 4, Summary Statistics, "Weight/Value for shipments Within, From and To State by Mode" 2018 (https://faf.ornl.gov/fafweb/FUT.aspx).

Figure 4 – Texas Freight Corridors and Oncor Service Territory



Third, the EV "hot spots" maps provided below in response to Question No. 3 (Figures 8-11) shows a concentration of warehousing and logistics centers for the products moving through and into the region, and thus any fleet charging stations will likely also be clustered near each other.

Fourth, while current logistics depots typically have loads in the 150-250 kW range, Level 2 overnight or DC Fast Charging (operating 24 hours a day) for fleets could easily require 3-40 MW of capacity for each facility. Providing service to even a single such facility could require significant investment and, based on the likelihood that these fleet charging facilities will be clustered near each other, numerous clustered facilities will almost certainly require substantial investment for Oncor to effectively provide the capacity required to charge the fleets.

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.)

As stated in response to Question No. 1, Oncor has not identified credible forecasts of commercial short-haul fleets and buses or commercial long haul electric vehicles. Thus, set out below are the data available for personal EVs, and certain usage information of one Oncor commercial short-haul EV fleet operator.

Personal EVs

The MJB&A Analysis projects 575,000 personal EVs in the Oncor service area by 2030, for a 6.68% penetration level of personal light duty vehicles (autos and pickup trucks) in use.[6] The 2030 projected incremental load in the Oncor service territory for EV charging ranges from 37 MW to 1,000 MW throughout the day for a typical weekday. The MJB&A Analysis looked at two different charging scenarios: "baseline" and "managed." As set out below in Figure 5, baseline charging – convenience charging upon arrival at home or work – could add roughly 590 MW to the peak load hour (5:00 p.m.). Under the managed charging scenario – charging at off-peak hours, generally in the middle of the night – the added load to the peak hour would be reduced to 205 MW. The projected 2030 incremental charging load would add ~0.6% to ~2% to the actual 2017 peak load.

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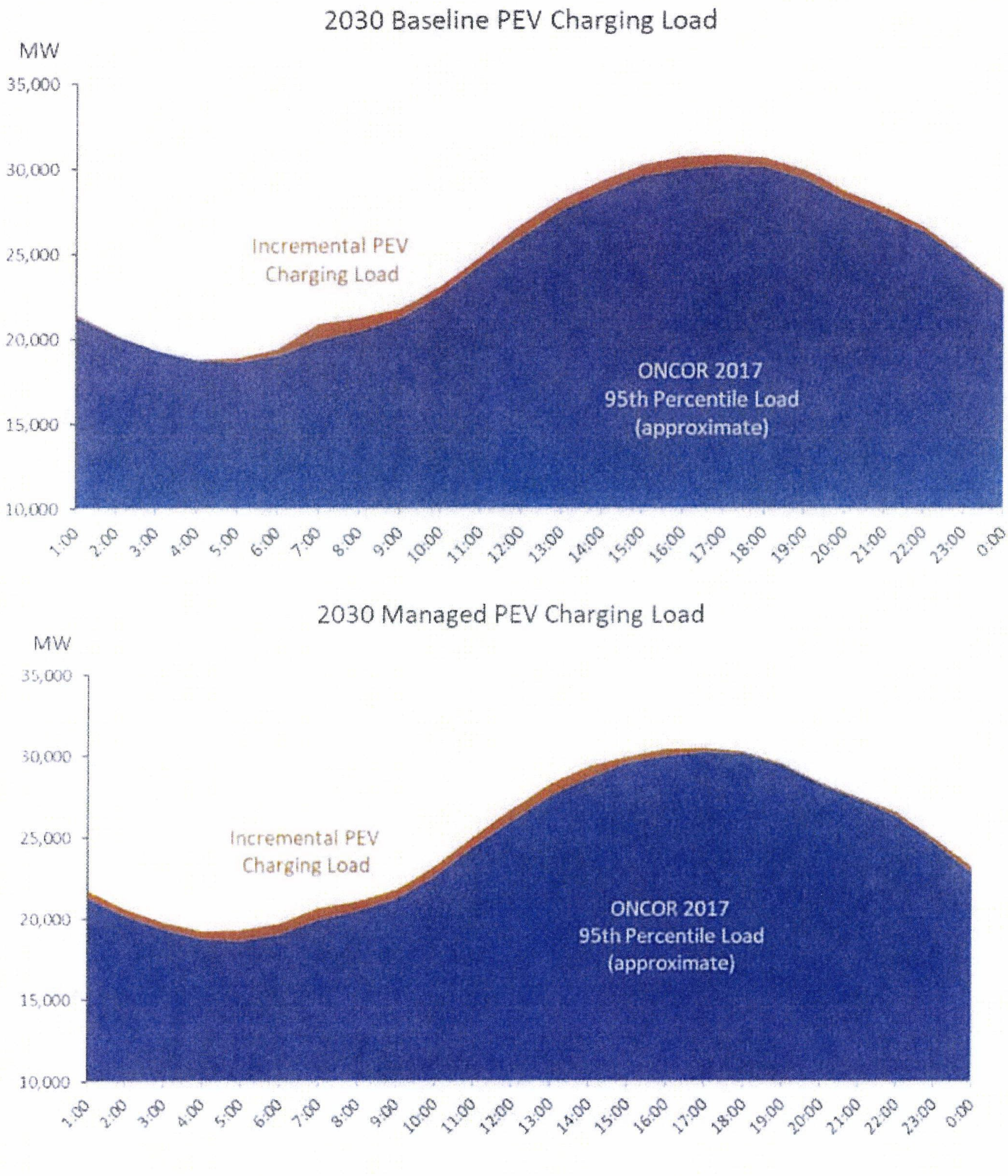
6 MJB&A Analysis, pp. 16, 17.

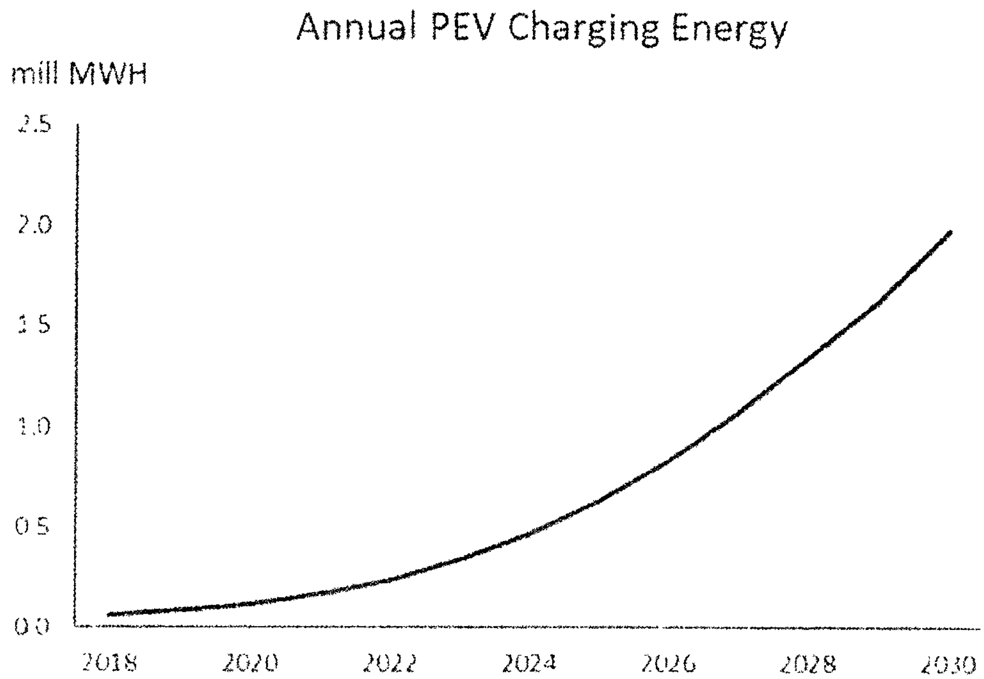
Figure 5 – MJB&A Projected 2030 Baseline and Managed EV Charging Loads[7]



7 MJB&A Analysis, p. 22.

Figure 6, below, then sets out the annual charging energy required for the projected incremental loads:

Figure 6 – Projected Annual Electric Vehicle Charging Energy[8]

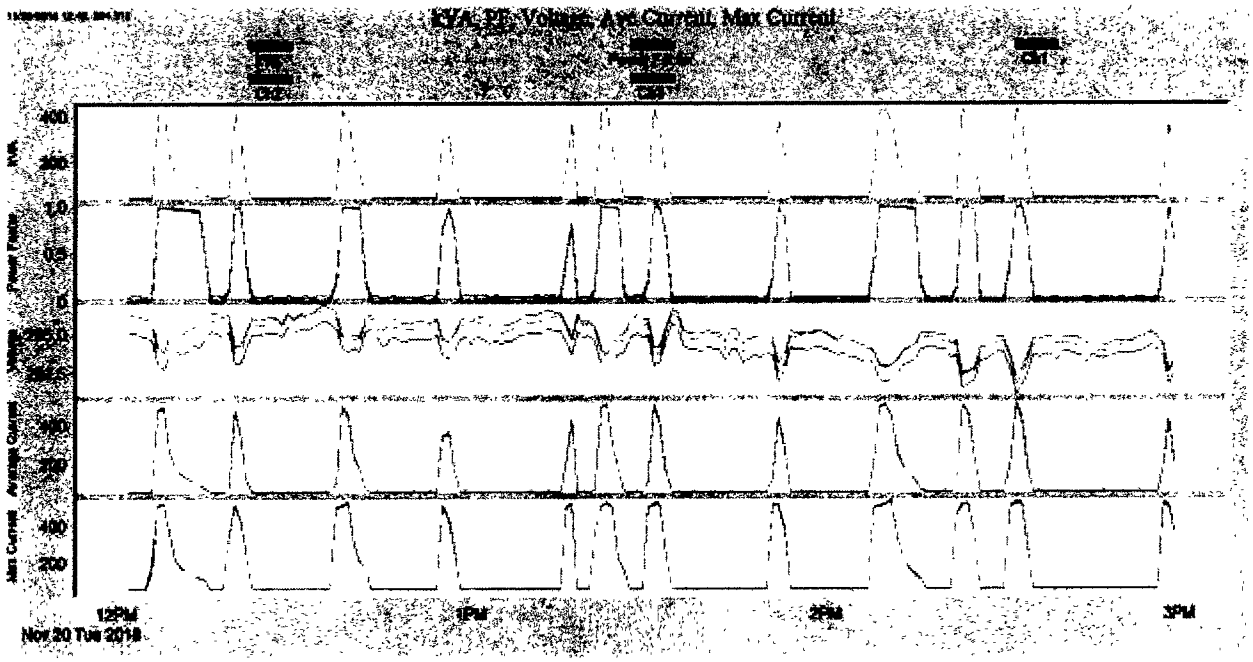


Commercial EVs

In an attempt to better understand the load profile and impact of EVs on our system Oncor conducted a study of a single commercial customer's loads and charging in 2018. This customer used a single 400 kVA, 480 V, 3Φ charger to charge three (3) separate vehicles, with a maximum recorded load of 400 kVA and a charge duration of about 15 minutes. Figure 7 shows the data for November 20, 2018:

[8] MJB&A Analysis, p. 22.

Figure 7 – Commercial Charging Load Profile Example



Oncor will continue to review the data as additional commercial charging stations are installed in our service area.

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.

Personal EVs

Oncor has identified 47 ZIP codes in the Dallas, Fort Worth, North Dallas Suburbs, and Round Rock areas that make up four general "hot spots" for personal EV charging. These areas – set out in Figures 8 and 9, below – were determined based on the EV registration rates.

Figure 8 – DFW Personal EV Hotspots

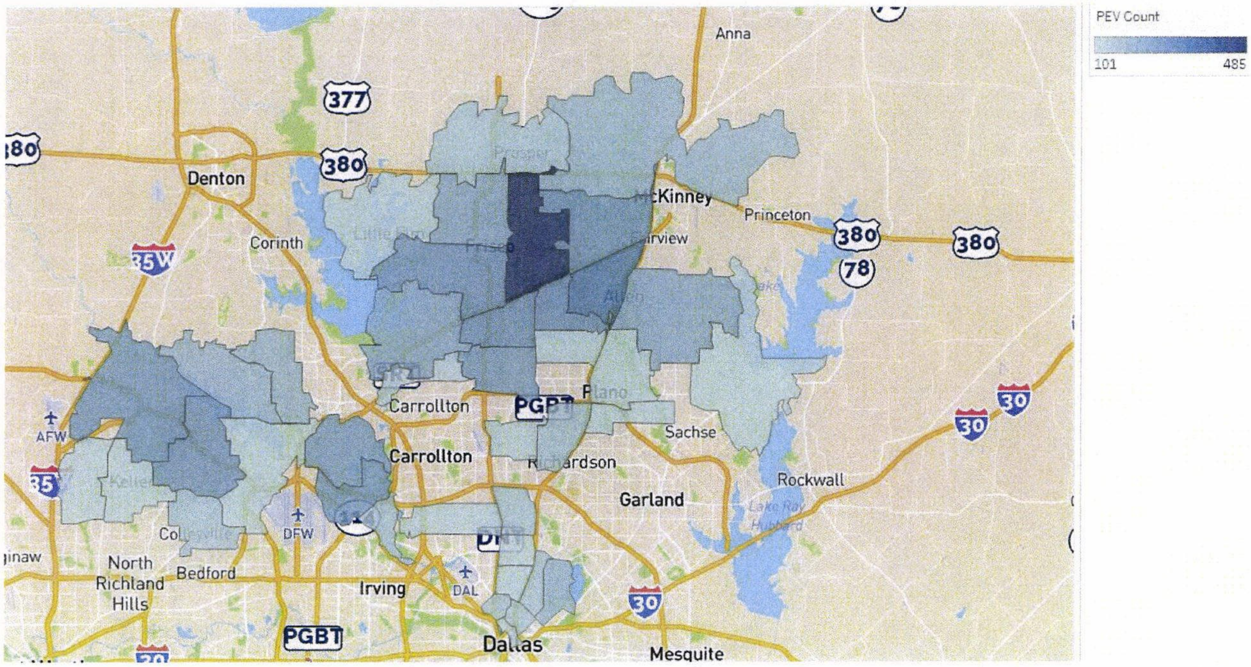
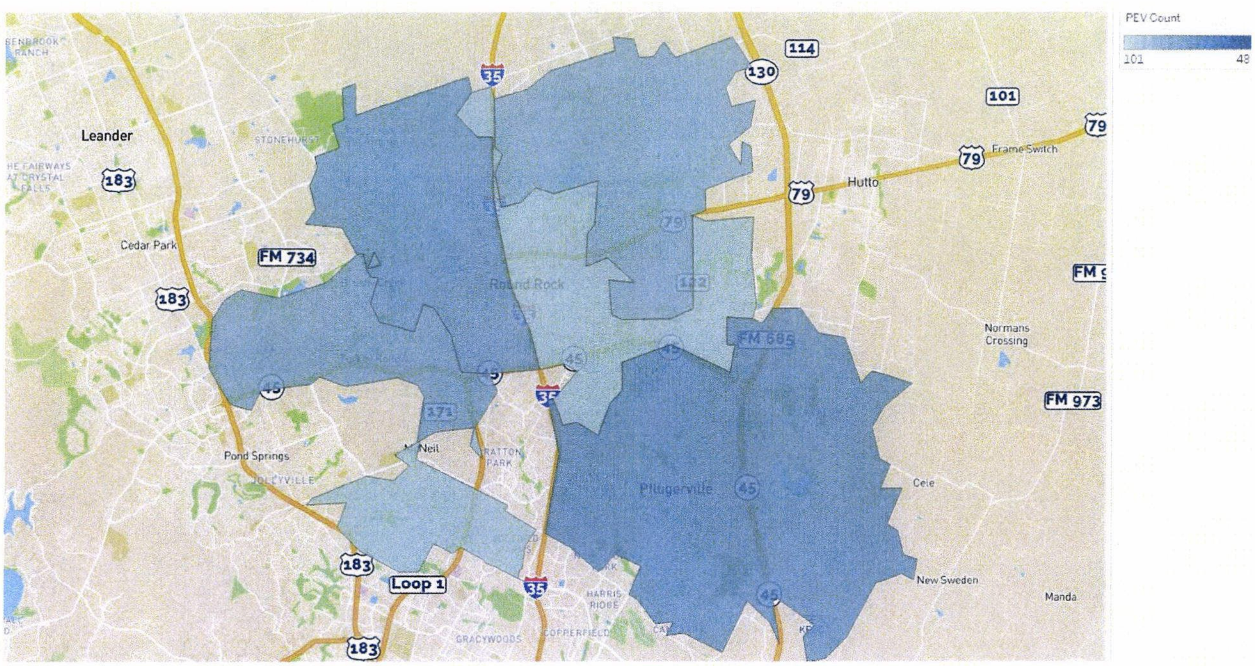


Figure 9 – Round Rock Area Personal EV Hotspots



Commercial EVs

Oncor has identified 92 ZIP codes that make up the following eight anticipated "hot spots" for commercial vehicle charging:

1. Alliance Airport (airport and surrounding industrial park);

2. DFW Airport (and surrounding areas);
3. State Highway 161 (south of the DFW Airport area);
4. Interstate 20 & Interstate 45 intersection;
5. State Highway 121 (Plano/Frisco border);
6. Interstate 635 (north Dallas);
7. Round Rock; and
8. Waco.

These locations were chosen based upon: high concentrations of medium- and heavy-duty Vehicle Identification Numbers (FleetSeek.com 2018); Foreign Free Trade Zones (Office of the Governor Economic Development & Tourism 2015); high concentrations of Oncor commercial customers, distribution centers, public transit, and warehousing (TomTom database 2019); school bus depots (Texas Education Agency 2019); and internal Oncor data. These "hot spots," developed using Oncor's Green Fleet Tool, are shown below in Figures 10 and 11:

Figure 10 – DFW Commercial Fleet Hotspots

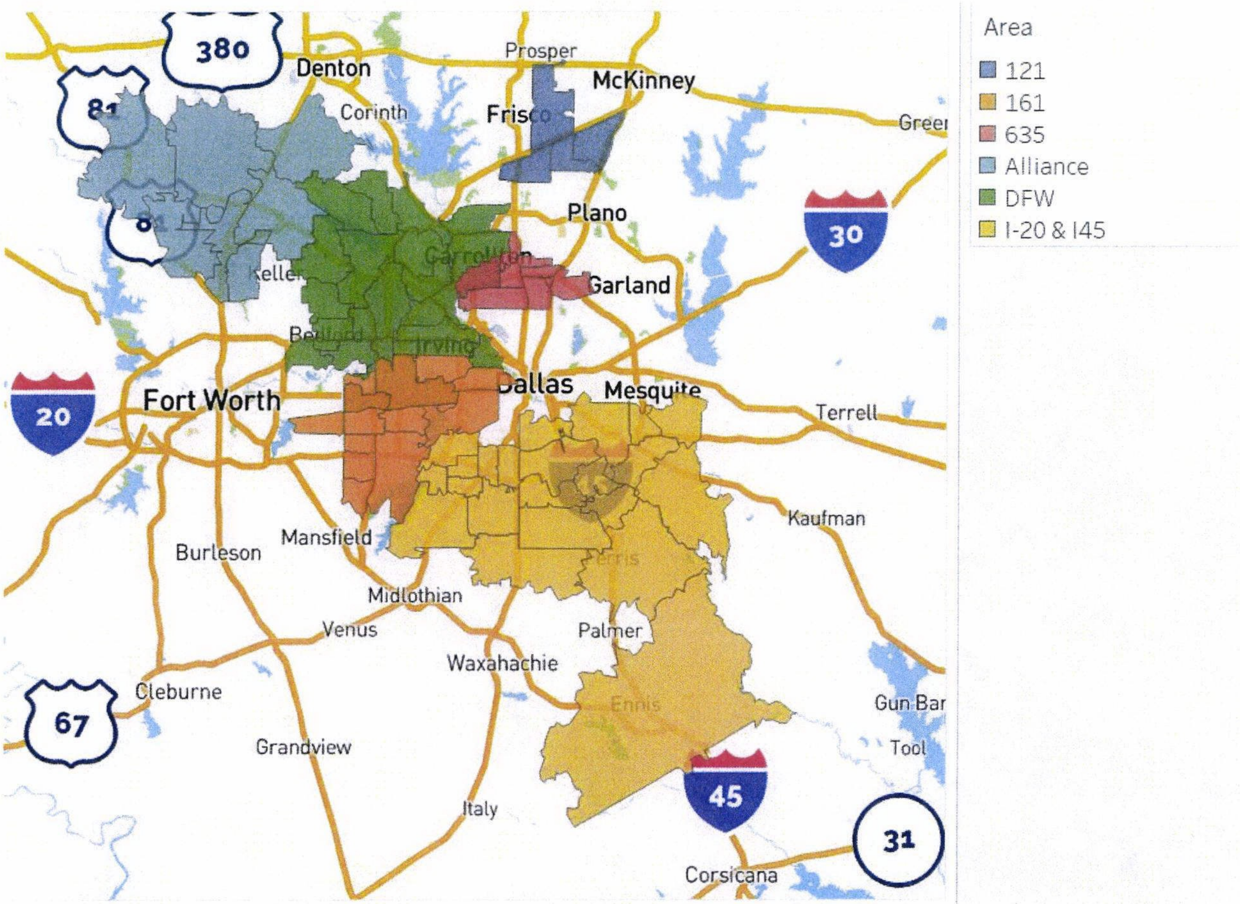
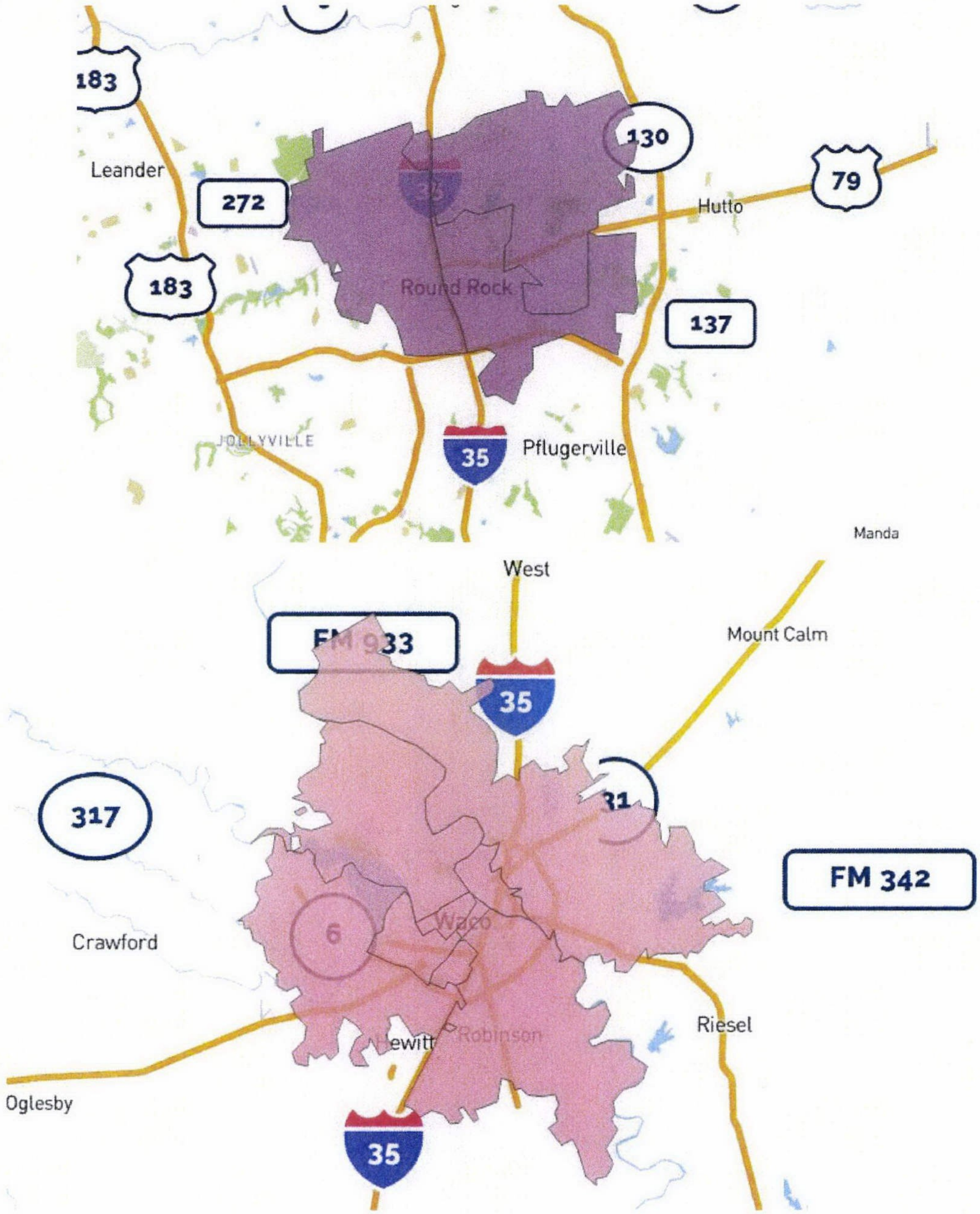


Figure 11 – Round Rock and Waco Commercial Fleet Hotspots



At this point in our analysis Oncor has only delineated between personal EVs and commercial EVs, and has not yet attempted to differentiate between short-haul and long-haul commercial EVs.

Appendix 3 contains the full ZIP code list for both personal and commercial "hot spots."

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 (i.e., personal, commercial short-haul including fleets and buses, and commercial long-haul electric vehicles).

Oncor has observed public charging station profiles for public charging for Tesla, EVgo, Blink and others by virtue of having meter data for those charging locations. However, we have not formulated these observations into an analysis. MJB&A projected the required Public and Workplace Charge Ports needed in the Oncor Service Territory, which is set out in Figure 14 in response to Question No. 6.a. At this time Oncor has not identified third party sources or undertaken specific studies that differentiate the various types of electric vehicle charging stations that map to class of vehicle. The data that Oncor does possess is set out below in Figure 12, is taken from the Department of Energy, does not include residential or private commercial chargers, and does not project growth.

Figure 12 – Relative Breakdown of Charger Types: US, Texas and Oncor[9]

US vs Texas Public EV Stations and Chargers

Texas	Total # of Stations	EV Level 1 EVSE	EV Level 2 EVSE	EV DC Fast Charger Count	Total Chargers
Rest of US	25,676	2,630	66,986	12,031	81,647
Texas	1,377	104	3,279	637	4,020
Grand Total	27,053	2,734	70,265	12,668	85,667

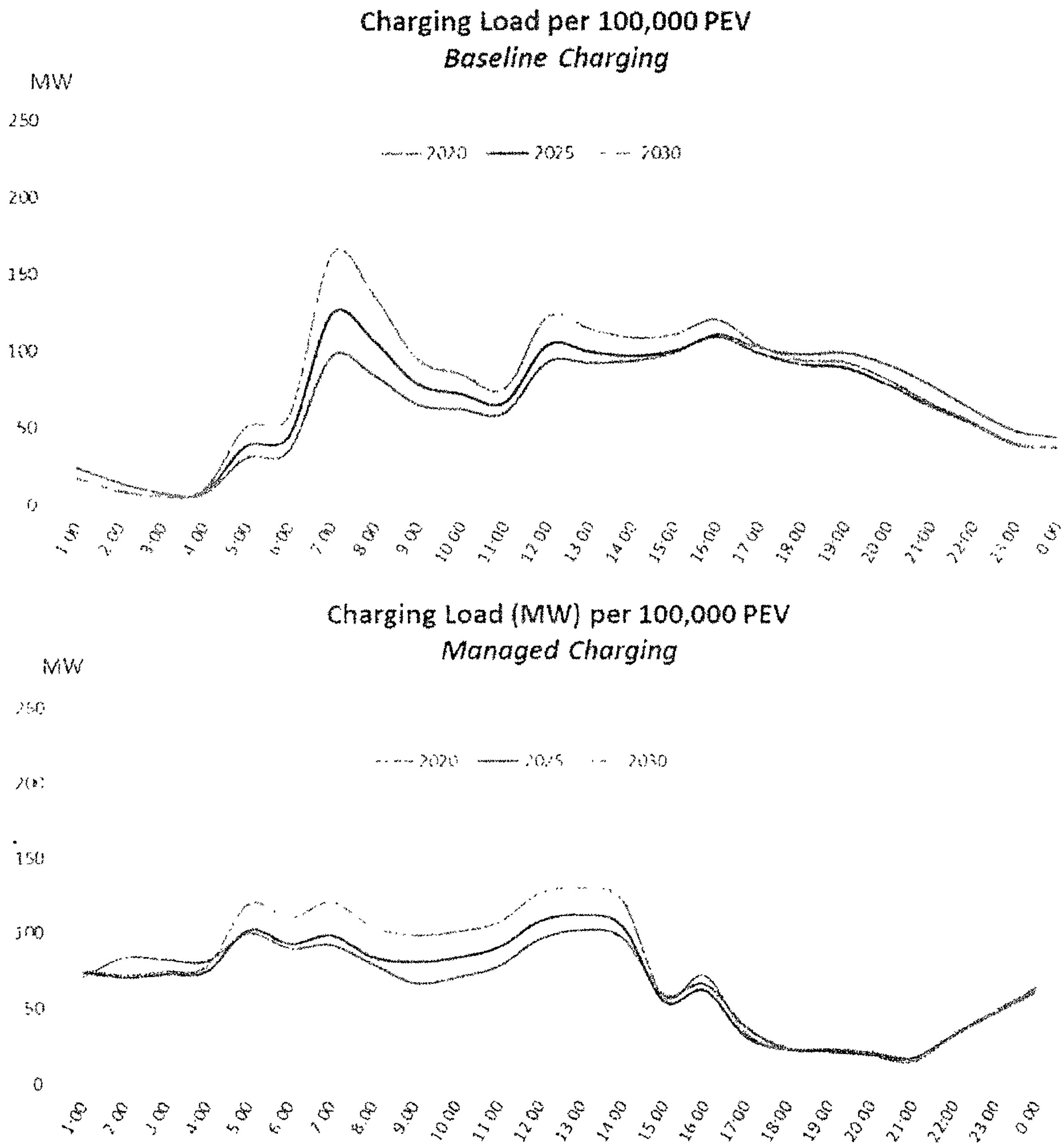
Oncor vs Rest of Texas Public Stations and Chargers

Rest of Texas	841	65	2,080	355	2,500
Oncor	536	39	1,199	282	1,520
Grand Total	1,377	104	3,279	637	4,020

The relevant data Oncor does have regarding charging loads is from the MJB&A Analysis. The MJB&A data is for charging load profile per 100,000 EVs across a 24 hour period, for a combination of home and public charging at the defined baseline and managed charging scenarios, and are set out below in Figure 13. Baseline charging assumes charging starts as soon as a vehicle arrives at home (starting at approximately 3:00 - 5:00 p.m.) or at work (starting at approximately 7:00 – 9:00 a.m.). These arrival times are based on the 2018 National Household Travel Survey (Texas data for year 2017). Managed charging delays 80% of home charging such that it starts between 10:00 p.m. and 4:00 a.m., and spreads public charging throughout the day. The study also assumes that: (1) for single family homes, 90% of charging is done at home; (2) for multiple unit dwellings approximately 60% of charging is done at home; and (3) approximately 80% of total charging is done at home, while 20% is public charging. Oncor would note that the load per EV increases over time due to assumed increased use of DC Fast Charging for public charging.

9 United States Department of Energy. 2020. "Alternative Fuels Data Center." *https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC*.

Figure 13 – Charging Load per 100,000 EVs: Baseline and Managed Charging[10]



Oncor would add a caveat with respect to the data in these charts. As stated earlier, in the baseline scenario the early-morning charging peak represents workplace charging. This early morning peak is based on data from 2018, which reflects much shorter-range vehicles as predominant in the market than at present. If this study were conducted with current charging data, Oncor believes that it would most likely look very different, as it would reflect the much

10 MJB&A Analysis, p. 21.

greater proportion of EVs in service today that are charged at home (approximately 80-85%), as those vehicles' longer range allows them to make a round trip or multiple round trips on a single charge.

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?

Argonne National Laboratories is conducting feasibility research for an Industry Working Group to explore fast charge networks as large as 3MW DC. This could lead to loads from 10MW-30MW at truck stops assuming an appropriate number of stations and ports. A prototype facility is operational in Iowa.[11]

Wireless charging is being slowly rolled out for EVs. Wireless DC fast charging is also emerging as an option. For example, Oslo, Norway will this year start installing DC fast charging at all city taxi stands. Without having to find and then connect to a charger, EV taxis will receive an opportunistic charge with no other change in behavior. Another proposed vehicle charging technology is to embed the charging infrastructure in a roadway. If such charging were constant it could create situations where charging load would mirror traffic, with the highest period being during rush hour and other peak times. However, this type of charging technology is currently cost prohibitive without further breakthroughs.[12]

Low power DC fast charging became commercially available starting about a year ago. This type of charging is taking the place of Level 2 AC charging. Due to its recent introduction, Oncor is unable to project whether this type of charging will become widely implemented and, if so, how that might impact the grid.

Robotic charging and portable fast charging are also technologies being developed, but these are more of a delivery method rather than a different type of technology, and thus should not significantly impact the grid as compared to current charging technologies. Finally, some commercial entities are experimenting with chargers associated with solar/storage, which could reduce grid usage.[13]

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[11] U.S. DOE Clean Cities Webinar; Ted Bohn with Argonne National Lab; "Multi-port, 1+MW Charging System for Medium- and Heavy-Duty EVs: What We Know and What Is on the Horizon?", 2020.

[12] Green Tech Media; https://www.greentechmedia.com/articles/read/wireless-ev-chargings-first-roadblock-no-cars.

[13] U.S. DOE Clean Cities Webinar; Ted Bohn with Argonne National Lab; "Multi-port, 1+MW Charging System for Medium- and Heavy-Duty EVs: What We Know and What Is on the Horizon?", 2020.

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;

Personal charging

While the Oncor system EV penetration is projected to be 6.68% in 2030, it is likely that there will be clustering of EVs in residential areas that could result in higher penetration levels within a subdivision. Oncor is conducting a review of residential charging in subdivisions that have both underground distribution lines and higher penetrations of EVs. The preliminary analysis focuses solely on EV charging and does ***not*** take into account any other factors that could mitigate the effects of EV charging, *e.g.*, rooftop solar, behind-the-meter energy storage, etc. Assuming a subdivision EV penetration rate of 25% and on-peak charging, preliminary analyses indicate no loading issues for underground riser fuses or primary cables. Low voltage and secondary cable and service issues were identified less than 1% of the time and could be addressed by changing out small cables to larger cables. While average transformer overloads ranged from 10-25% for on-peak charging and up to 15% for off-peak charging, these percentages would apply to an extremely small number of subdivisions that could experience a 25% EV penetration rate. The typical solution for such overloading would be to replace the existing transformer with a larger transformer. As a part of our ongoing reliability analytics, Oncor monitors meter voltage levels and transformer loading through its Advanced Metering System data on a regular basis and proactively responds as necessary.

For the general distribution system, load increases associated with residential EV charging are expected to be distributed over a larger geographic area. As with any other source of increased demand, increased demand due to EV charging would simply tend to accelerate infrastructure upgrades in comparison to current plans. However, the installation of charging stations in rural areas along major highways could require Oncor to install new distribution infrastructure, with the required new infrastructure being site dependent.

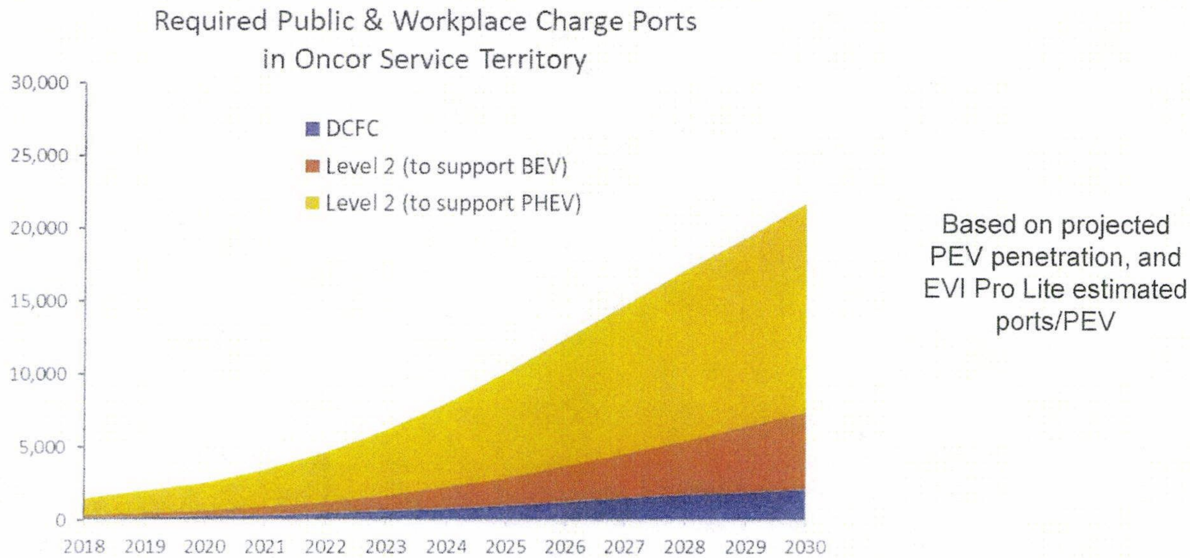
Commercial Charging

(1) Public and Workplace Charging

As part of their Analysis, MJB&A did a forecast of required Public and Workplace Charge Ports needed in the Oncor service territory, set out below in Figure 14. The assumptions used in developing this forecast included: (1) required DC Fast Charge ports increase from 224 today to

2,193 in 2030, to support the projected 575,000 EVs in the Oncor service territory; (2) EVI Pro Lite estimates that ~9 public and workplace Level 2 charge ports will be required for each DC Fast Charge port – growing to more than 19,500 ports needed in the Oncor service territory by 2030; and (3) that most Level 2 ports are required to support PHEVs, with the estimated total being sensitive to modeling assumptions about how motivated PHEV owners will be to maximize electric miles.

Figure 14 – MJB&A Projected Public and Workplace Charging Ports Needed In Oncor[14]



(2) Fleet charging

Typically, office warehouses are clustered in areas along major highways, railports, non-passenger airport operations, and free trade zone areas. Load densities in these areas today are not high as the majority of the building footprint is dedicated to warehousing, which typically includes lighting and general ventilation loads. According to the Argonne National Lab study, additional charging loads per fleet vehicle are claimed to range from 150 kW off-peak to up to 3 MW for DC fast charge on-peak. Current fleet operations may not represent future operations as fleet operators evaluate and potentially alter their current operations to maximize any economic benefits from transitioning to EVs. Once a customer seeks new service, or upgraded service to an existing location, and executes a contract with Oncor, the resources and efforts necessary to serve large added loads at the distribution and substation level generally fall into one of four categories:

14 MJB&A Analysis, p. 20.

- Only distribution feeder and customer onsite activities are involved;
- existing substation transformers must be replaced with larger units, or additional transformers installed;
- a new substation is required, but a certificate of convenience and necessity ("CCN") is not required; or
- a new substation is required, for which a CCN must be obtained.

The amount of load that will trigger a need for substation related work will vary based on the proximity of that load to, and the available capacity at, the existing nearby substations. For expansions and upgrades at existing substations, substation transformer delivery is typically the longest lead time item. When establishing new substations, additional variables can impact the timeline for serving the customer, including availability of land, permitting and zoning activities, and transmission line modifications. Additionally, if a CCN is required, the CCN routing and regulatory process and procurement of land/right-of-way factor into the timeline. From a reliability perspective, the clustering of multiple, large EV charger loads associated with warehouse areas will require the installation of new substations in close proximity. In many cases, siting substations within these new dense load areas will require new transmission infrastructure.

To better understand the Oncor system impacts of individual customer fleet electrification, Oncor is developing a "Green Fleets" tool to enable the identification of existing substation capacity to serve growing fleet loads, and determine at the earliest point of inquiry what system upgrades may be needed to provide sufficient capacity to handle new customer fleet-generated loads. In discussions with OEMs and fleet leasing companies, it is anticipated that fleet owners and operators will transition their fleets over 5-10 year periods, depending on their operational requirements. These transition periods will enable Oncor to plan for the largest system impacts, but will require early investment in land and potential infrastructure to enable yearly incremental load growth at specific sites.

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

The increase in load due to fleet charging will most likely be concentrated in the hot spots identified in the response to Question No. 3. Smaller conductors will need to be upgraded and/or additional infrastructure proposed in these areas. Fleet charging, depending on patterns needed to serve a specific type of operation, is expected to result in the highest concentration of load and creation of new load centers, triggering the need for:

- replacing existing substation transformers with larger transformers;
- adding new transformers at existing substations;
- adding new substations where transmission sources are available; and/or
- adding new substations in areas that require a new transmission source.

The above conditions may require upgrading (reconductoring or rebuilding) of existing transmission circuits, or the addition of new transmission circuits either in existing right-of-way or in new right-of-way.

Load increases associated with residential charging are expected to be distributed over a larger geographic area, with such increased demand tending to accelerate transmission infrastructure upgrades in comparison to current plans.

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.

ERCOT conducts and releases a Long Term System Assessment ("LTSA") in December of even-numbered years. The LTSA provides an evaluation of the potential needs of ERCOT's extra-high voltage (345-kV) system in the 10-15-year planning horizon. In the 2018 LTSA, ERCOT conducted studies regarding EV as an "Emerging Technologies" scenario. ERCOT performed sensitivity analysis on this scenario, and analyzed its impact on load and Solar Generation and other resource development in ERCOT. The 2020 LTSA should be released in December of 2020 and Oncor is uncertain how EV will be addressed in it. Please refer to ERCOT for further information.

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 the impact?

For personal vehicles the MJB&A Analysis is the reference point Oncor has selected for internal planning purposes. Their estimated impacts on energy and peak demand have been depicted above in Figures 6 and 7. The anticipated increase in energy by 2030 is roughly 2 million MWh annually. With respect to fleets, given the highly uncertain adoption rate for such fleets, and that no production vehicles are currently available and are not projected to enter the market until the end of 2021, Oncor is currently not estimating or including fleet impacts in its forecasts.

Going forward, any changes to energy and peak demand forecasts to incorporate the impact of EV charging – whether personal, public or fleet – will be considered at such time as more definition of the impacts can be ascertained.

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

One potential capability by which EVs could participate in the wholesale energy market comes from using an EV to perform energy arbitrage by coupling low-cost charging times (usually off-peak when wind and solar generation is high) with sales into the market during shortages. Effectively, both the stored energy in EVs, and their potential to store energy from excesses (or even to have energy 'reserved' for later application to predicted shortages), can become another forecasted energy market element.

In certain locations in the US – Dominion Energy in Virginia being a major example – electric school buses are being purchased expressly as a reserve energy source for the schools themselves.[15] Such an application of electric school buses would be a rational approach in Texas, as schools are predominantly out of session for roughly 2½ months during the summer, and any activities that do take place are not centered during the summer ERCOT load peaks (4:30-6:30 p.m. during June-September afternoons), which is after the majority of the buses' normal period of use. Further, given that EVs can be moved to any local point of interconnection to mitigate an outage on a high value feeder (*i.e.*, hospital, emergency responders, command centers, etc.), the nature of the "market" during such outage mitigation and emergency services needs to be considered. In any event, EVs with either larger battery capacity or when aggregated could be considered "resources" during a major emergency, even if they are not moved to any particular feeder.

While the technologies to allow electric vehicle participation in wholesale electricity markets may exist, integration of these capabilities into the wholesale electricity markets would likely require changes to market rules, protocols, and guides.

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?

Oncor applies the same methodology to all non-residential customer requests including all electric charging stations with the following guidance:

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[15] Axios, "Electric school buses are batteries for the grid." January 10, 2020.

a. Facilities siting of commercial (non-residential) vehicle charging stations shall consider transformer proximity and distances to loading equipment in order to reduce delivery voltage inconsistencies.

b. Due to the typically large and expanding load requirements, pad mount transformation is the preferred equipment to be selected when serving commercial (non-residential) vehicle charging sites. Safe and accessible pad placements shall be included in the site design and facilities planning phases.

Oncor will continue to monitor the increase in public EV charging stations on its system, and may add to or change current design standards, best practices, and siting requirements if it determines it is appropriate or necessary to do so.

III. PRAYER

WHEREFORE, PREMISES CONSIDERED, Oncor requests the Commission to consider the above Responses and incorporate them in this proceeding.

Respectfully submitted,

Oncor Electric Delivery Company LLC

Howard V. Fisher
State Bar No. 07051500

Senior Counsel
1616 Woodall Rodgers Frwy, Suite 6065
Dallas, Texas 75202
howard.fisher@oncor.com
(214) 486-3026
(214) 486-3221 (Facsimile)

CERTIFICATE OF SERVICE

It is hereby certified that a copy of the foregoing has been hand delivered to the Staff of the Public Utility Commission on this the 3rd day of February, 2020.

Appendix 1 – Glossary

Baseline charging - convenience charging at arrival at home and/or at work.

BEV – Battery Electric Vehicle – operates without an internal combustion engine.

DCFC – Direct Current Fast Charger – an EV charger favored for public charging.

Depot Charging – overnight charging of a local or regional haul freight truck or bus.

Charging port – an individual charging cable attached to an EV charger.

Charging station – a commercial charging place with multiple charging ports for cars or trucks.

Commercial charging – public charging not associated with an individual vehicle.

EV – Electric Vehicle, whether plug-in hybrid ("PHEV") or battery electric ("BEV"). For the purposes of this Response, this term does not include hybrid vehicles that do not plug in to the grid (*e.g.,* the Toyota Prius), but some general literature does include them within the definition of "electric vehicle."

EVSE – Electric Vehicle Support Equipment – electric vehicle chargers.

Fleet charging – the particular requirements to charge fleets of vehicles (buses, cars or trucks).

Highway charging – commercial charging station along a major highway for cars or trucks.

Level 1 charger – an EV charger that operates at 110 volts (trickle charge).

Level 2 charger – an EV charger that operates at 220 volts – favored for home charging.

LTSA – Long Term System Assessment – an analysis of potential grid operations by ERCOT.

Managed charging – charging at off-peak hours, generally in the middle of the night.

MJB&A – M.J. Bradley and Associates.

NCTCOG – North Central Texas Council of Governments.

OEMs – Original Equipment Manufacturers – automobile/truck manufacturing companies

and/or EV charger manufacturers.

Off-peak charging – charging an electric vehicle at times other than during the highest demand periods of the day.

Peak charging – charging a vehicle during the highest demand times of the day.

Personal charging – generally, an individually owned light duty vehicle charged at home or work.

PEV – Plug-in Electric Vehicles –this term includes PHEVs and BEVs, but not hybrids that do not charge from the grid.

PHEV – Plug-in Hybrid Electric Vehicle – a vehicle that has both an electric and a combustion engine.

Wireless charging – uses inductive coupling to transfer electricity to an EV without a cable.

Appendix 2 – Bibliography:

Axios, "Electric school buses are batteries for the grid" January 10, 2020

Electric Vehicles North Texas (https://www.dfwcleancities.org/EVNT)

Green Tech Media; https://www.greentechmedia.com/articles/read/wireless-ev-chargings-first-roadblock-no-cars

McKinsey & Co. "What's sparking electric-vehicle adoption in the truck industry?" September 2017 (https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/whats-sparking-electric-vehicle-adoption-in-the-truck-industry)

M.J. Bradley and Associates, Texas PEV Market Analysis, February 2019

United States Department of Energy, 2020. "Alternative Fuels Data Center." *https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC*.

United States Department of Energy Clean Cities Webinar; Ted Bohn, Argonne National Lab; "Multi-port, 1+MW Charging System for Medium- and Heavy-Duty EVs: What We Know and What Is on the Horizon?" 2020

Appendix 3 – Hotspot Locations by ZIP Code

Personal EV Hotspot Locations

Area	ZIP Code		Area	ZIP Code
Dallas	75019		North Dallas Suburbs	75002
Dallas	75039		North Dallas Suburbs	75010
Dallas	75063		North Dallas Suburbs	75013
Dallas	75201		North Dallas Suburbs	75023
Dallas	75204		North Dallas Suburbs	75024
Dallas	75205		North Dallas Suburbs	75025
Dallas	75206		North Dallas Suburbs	75033
Dallas	75214		North Dallas Suburbs	75034
Dallas	75219		North Dallas Suburbs	75035
Dallas	75225		North Dallas Suburbs	75056
Dallas	75229		North Dallas Suburbs	75068
Dallas	75230		North Dallas Suburbs	75070
Fort Worth	75022		North Dallas Suburbs	75071
Fort Worth	75028		North Dallas Suburbs	75072
Fort Worth	76034		North Dallas Suburbs	75074
Fort Worth	76051		North Dallas Suburbs	75078
Fort Worth	76092		North Dallas Suburbs	75080
Fort Worth	76244		North Dallas Suburbs	75082
Fort Worth	76248		North Dallas Suburbs	75093
Fort Worth	76262		North Dallas Suburbs	75098
			North Dallas Suburbs	75248
			Round Rock	78660
			Round Rock	78664
			Round Rock	78665
			Round Rock	78681
			Round Rock	78717
			Round Rock	78727

Fleet EV Hotspot Locations

Area	ZIP Code		Area	ZIP Code		Area	ZIP Code
Alliance Airport	76052		Interstate 20 & Interstate 45	75104		Round Rock	78664
Alliance Airport	76078		Interstate 20 & Interstate 45	75115		Round Rock	78665
Alliance Airport	76177		Interstate 20 & Interstate 45	75116		Round Rock	78681
Alliance Airport	76226		Interstate 20 & Interstate 45	75119		State Highway 121	75013
Alliance Airport	76244		Interstate 20 & Interstate 45	75125		State Highway 121	75024
Alliance Airport	76247		Interstate 20 & Interstate 45	75134		State Highway 121	75025
Alliance Airport	76262		Interstate 20 & Interstate 45	75137		State Highway 121	75035
DFW Airport	75006		Interstate 20 & Interstate 45	75141		State Highway 161	75050
DFW Airport	75007		Interstate 20 & Interstate 45	75146		State Highway 161	75051
DFW Airport	75019		Interstate 20 & Interstate 45	75154		State Highway 161	75052
DFW Airport	75022		Interstate 20 & Interstate 45	75159		State Highway 161	75060
DFW Airport	75028		Interstate 20 & Interstate 45	75172		State Highway 161	75211
DFW Airport	75038		Interstate 20 & Interstate 45	75180		State Highway 161	75212
DFW Airport	75039		Interstate 20 & Interstate 45	75181		State Highway 161	76002
DFW Airport	75050		Interstate 20 & Interstate 45	75216		State Highway 161	76006
DFW Airport	75061		Interstate 20 & Interstate 45	75217		State Highway 161	76010
DFW Airport	75062		Interstate 20 & Interstate 45	75232		State Highway 161	76011
DFW Airport	75063		Interstate 20 & Interstate 45	75236		State Highway 161	76013
DFW Airport	75067		Interstate 20 & Interstate 45	75237		State Highway 161	76014
DFW Airport	75234		Interstate 20 & Interstate 45	75241		State Highway 161	76018
DFW Airport	75247		Interstate 20 & Interstate 45	75249		Waco	76701
DFW Airport	75261		Interstate 20 & Interstate 45	75253		Waco	76704
DFW Airport	76011		Interstate 635	75001		Waco	76705
DFW Airport	76021		Interstate 635	75229		Waco	76706
DFW Airport	76022		Interstate 635	75230		Waco	76707
DFW Airport	76034		Interstate 635	75234		Waco	76708
DFW Airport	76039		Interstate 635	75240		Waco	76710
DFW Airport	76040		Interstate 635	75243		Waco	76711
DFW Airport	76051		Interstate 635	75244		Waco	76712
DFW Airport	76053		Interstate 635	75251			
DFW Airport	76092		Interstate 635	75254			
DFW Airport	76155						

Appendix 4 – MJ Bradley and Associates Analysis

Texas PEV Market Analysis

Final Results

February 2019

MJB & A

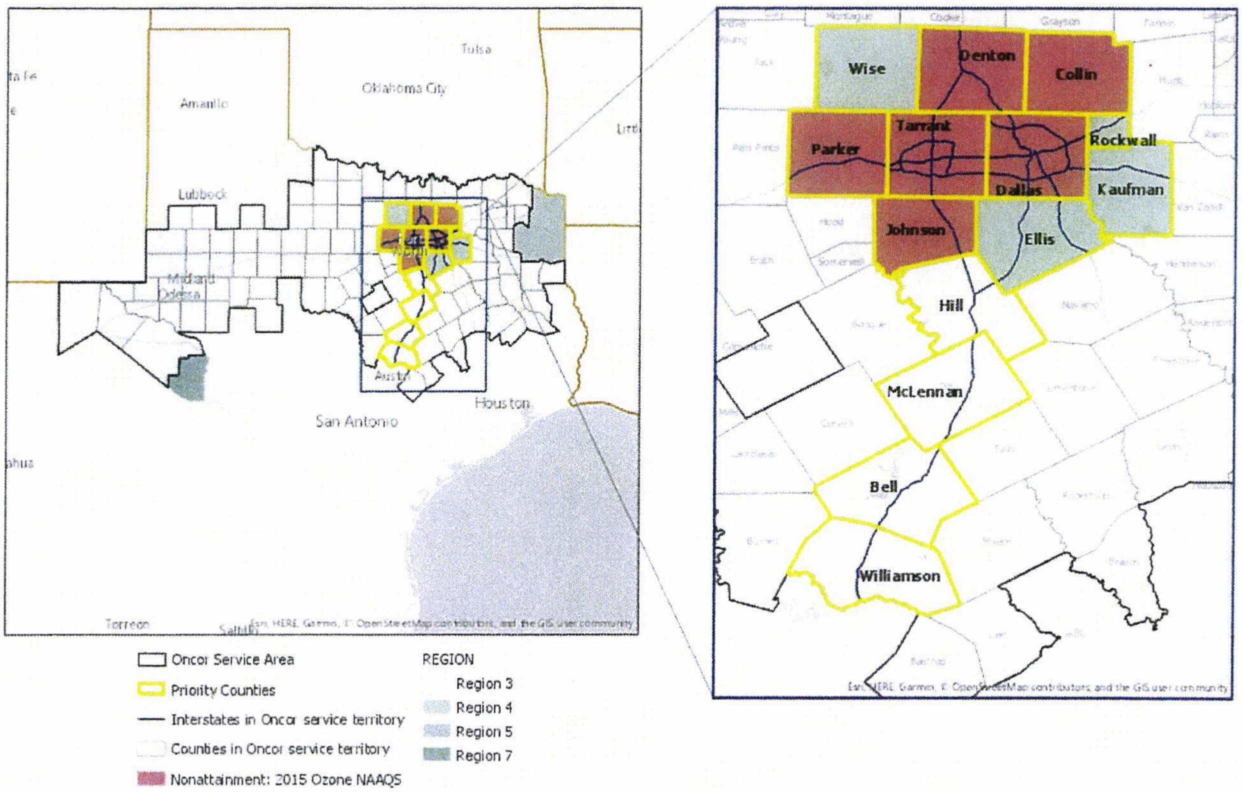
Contents

- Key Spatial Findings
- EV Penetration Projections: National & Texas-Specific Downscaled
- Charging Projections: Infrastructure, Load, and Emissions Impacts

Data Collection & Assessment

Tasks
1 & 2

Geographic Scope of Analysis



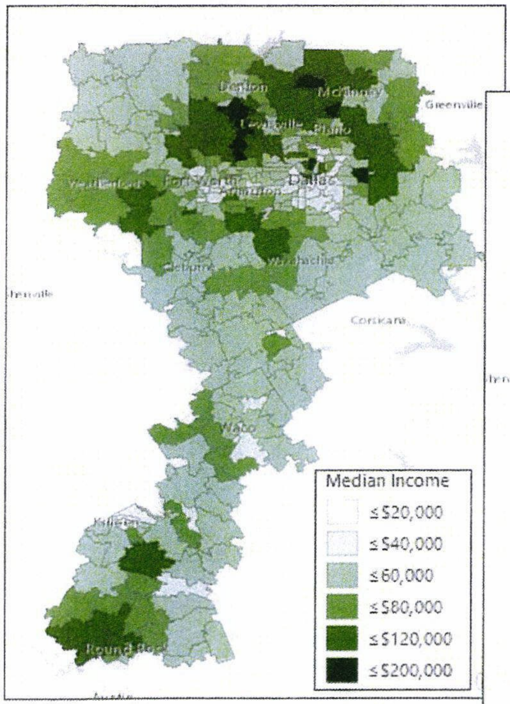
MJB & A

3

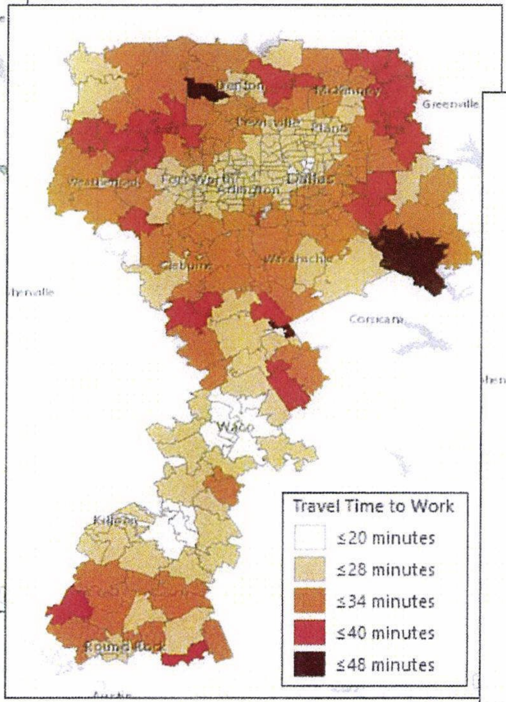
Key Demographics

Tasks
1 & 2

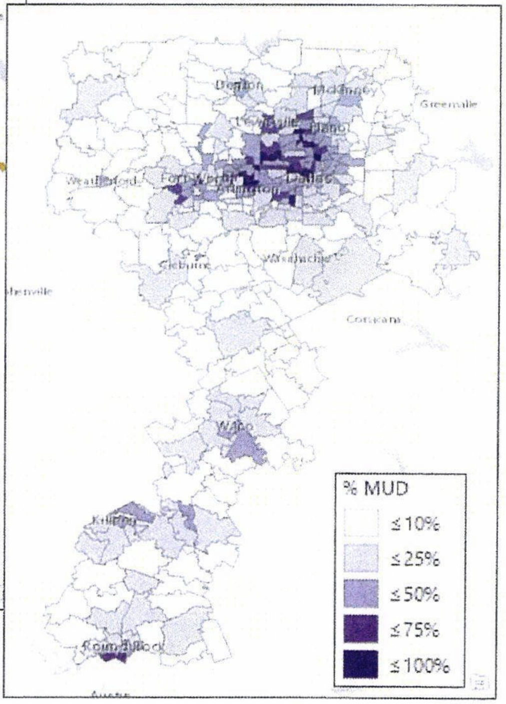
Income



Travel Time



% MUD Housing



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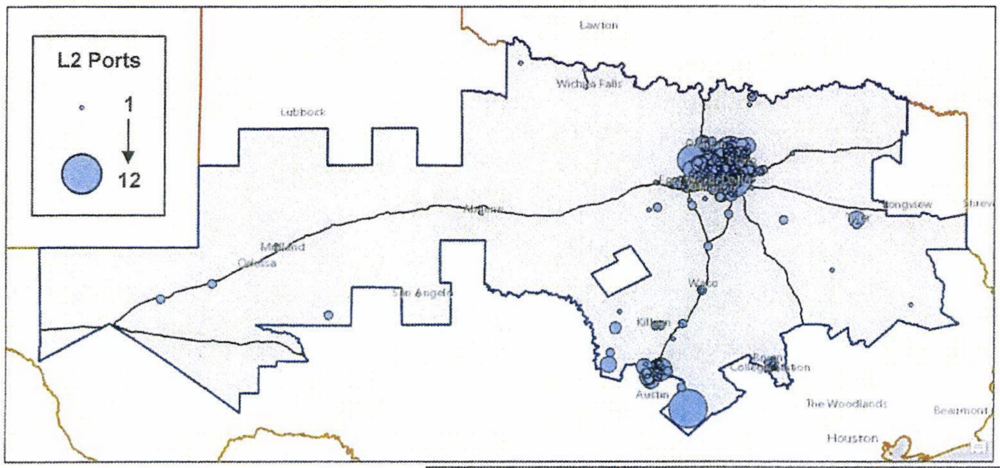
Current EVSE in Oncor Service Territory

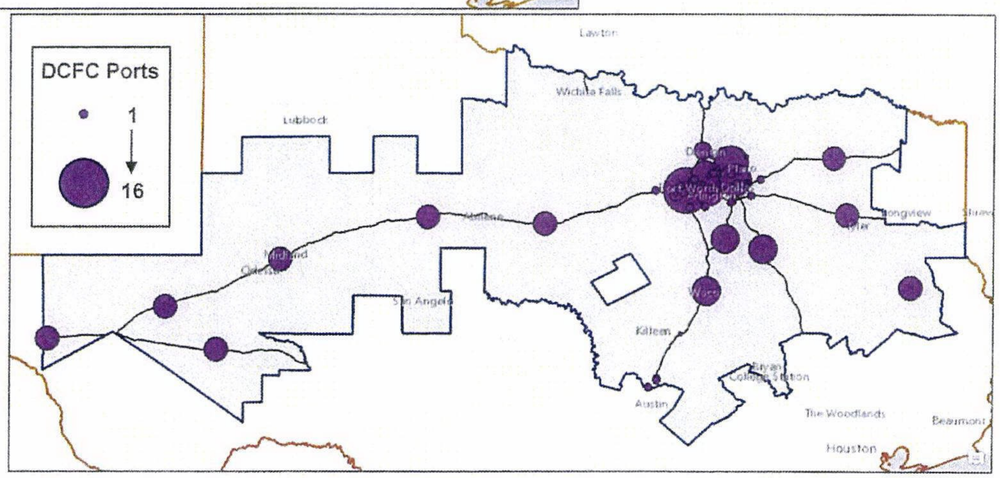
Tasks
1 & 2



Level 2 EVSE*

Stations: 422

Ports: 901



DCFC EVSE*

Stations: 55

Ports: 234

* EVSE counts as of January 17, 2018

Source: Alternative Fuels Data Center

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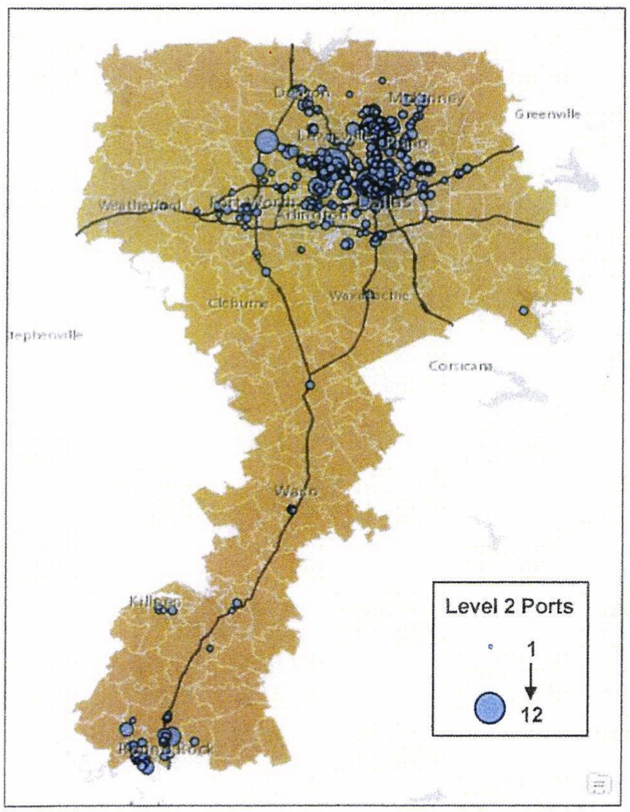
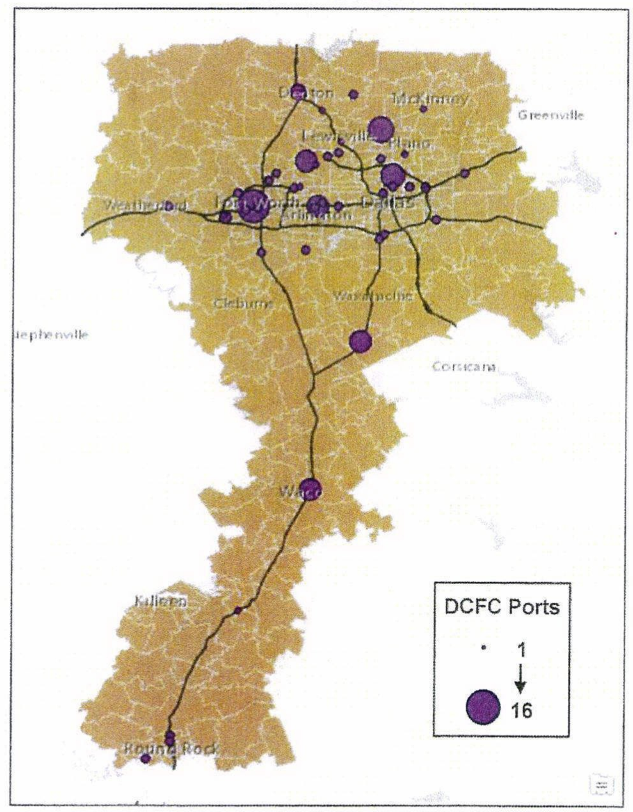
Priority Area

Tasks
1 & 2

Level 2 EVSE



DCFC EVSE



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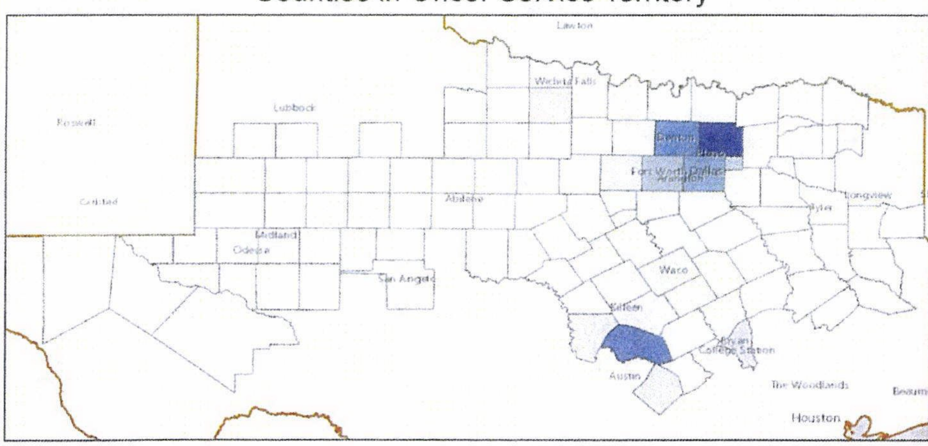
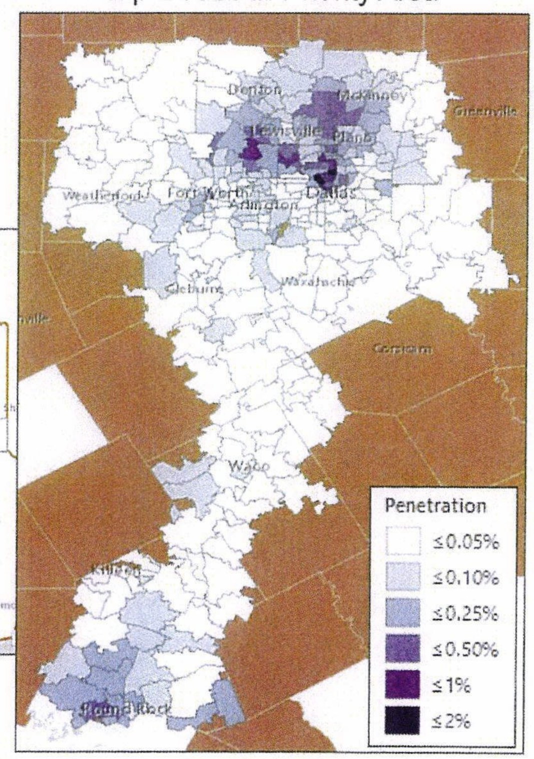
BEV Penetration (% in-use LDVs)

Tasks
1 & 2

Counties in Oncor Service Territory



Zip Codes in Priority Area



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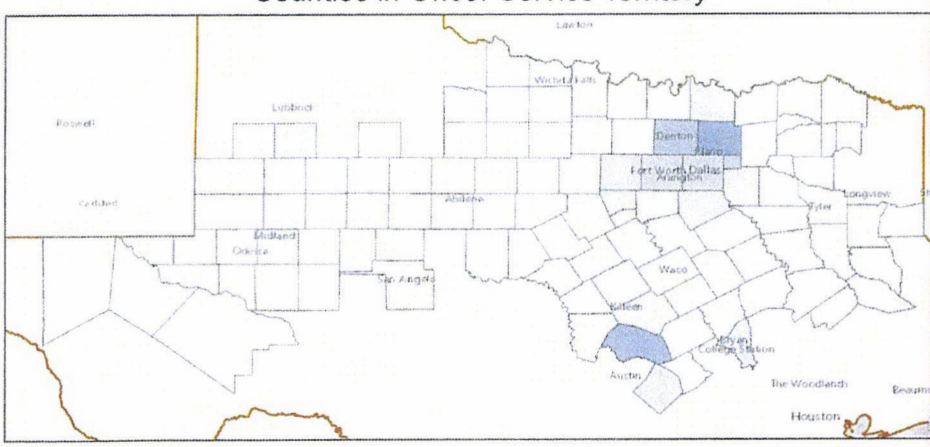
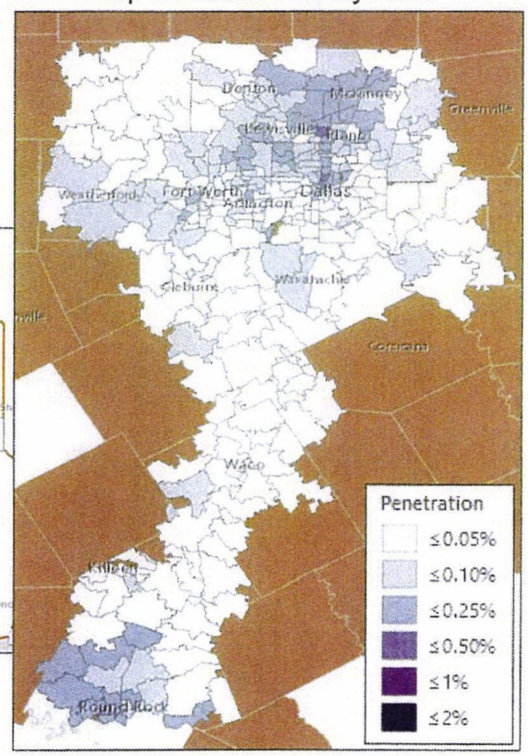
PHEV Penetration (% in-use LDVs)

Tasks
1 & 2

Counties in Oncor Service Territory



Zip Codes in Priority Area



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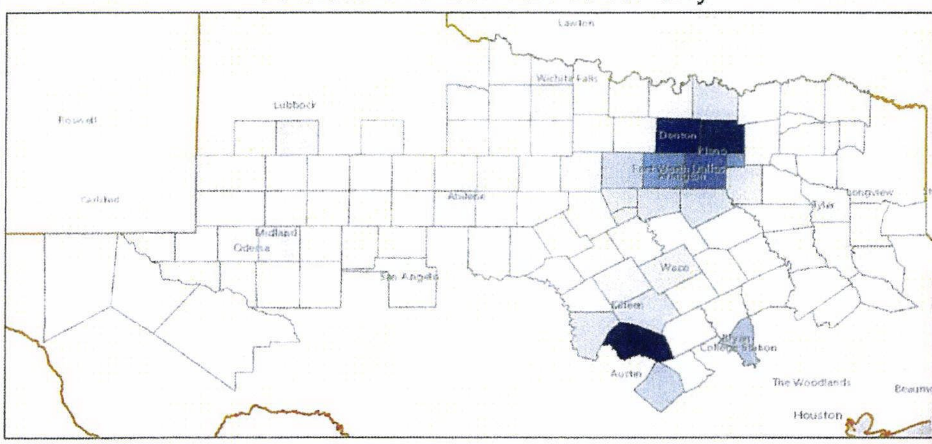
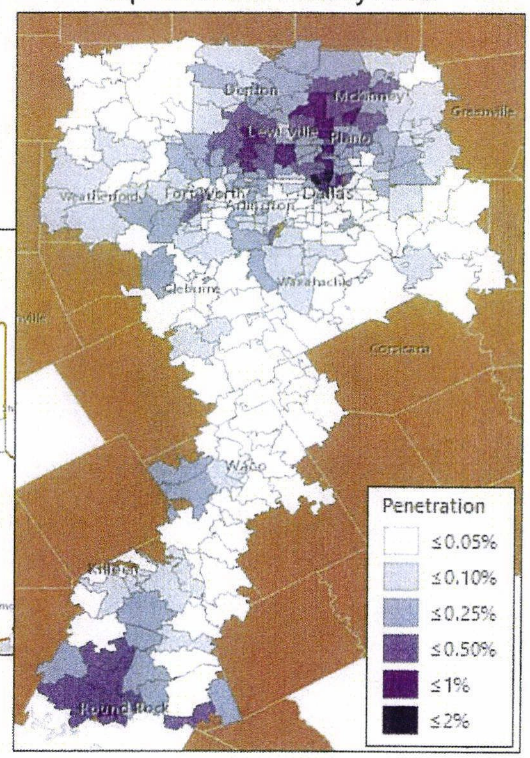
PEV Penetration (% in-use LDVs)

Tasks
1 & 2

Counties in Oncor Service Territory



Zip Codes in Priority Area



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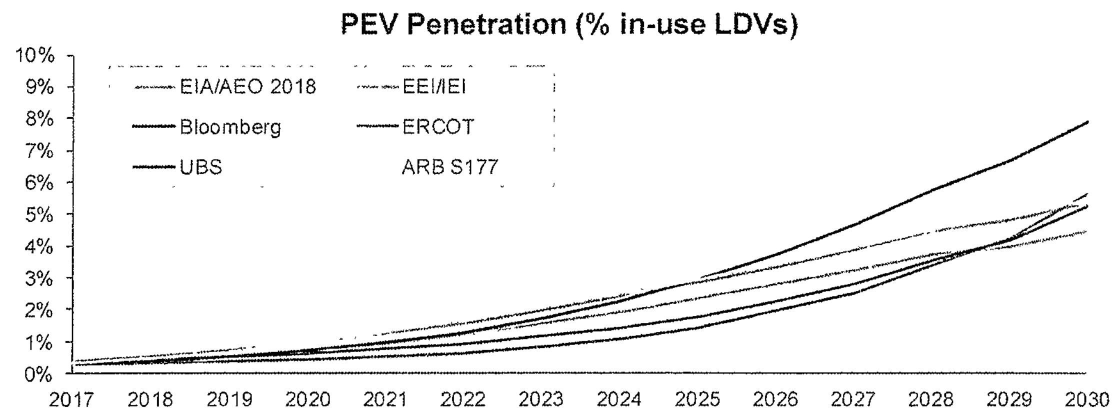
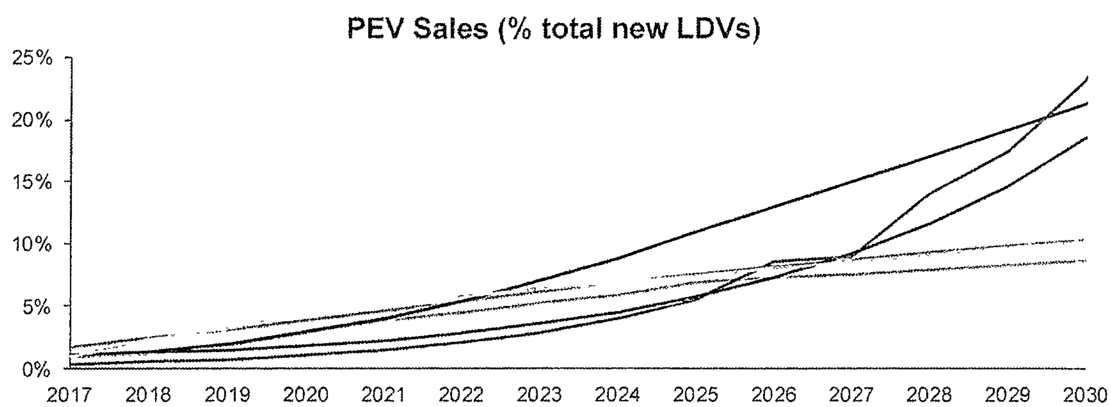
Contents

- Key Spatial Findings
- EV Penetration Projections: National and Texas-Specific Downscaled
- Charging Projections: Infrastructure, Load, and Emissions Impacts

Tasks 2 & 3

PEV Penetration Analysis: National Projections





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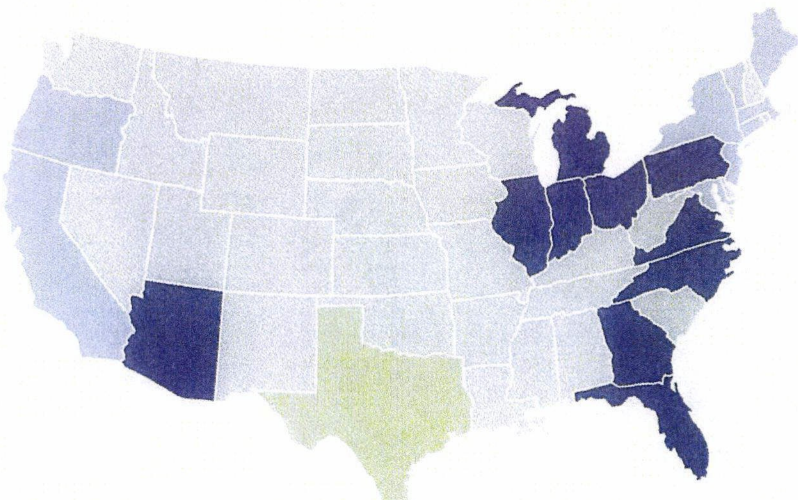
Tasks 2 & 3

PEV Penetration Analysis: Policy Normalization



Analytical Steps

1. Assume S177 States continue at national growth rate, slightly discounted
2. Assess remaining key light duty vehicle states (collectively with S177 States and Texas, cover 70% of U.S. market)
3. Develop metric to analyze where Texas falls in a policy environment compared to remaining states
4. Apply metric to modify PEV growth rates for Texas

Key Policy Categories:

1. EV Purchase Incentives
2. Grant Programs
3. Registration Fee Waivers
4. Transportation Climate Policies
5. Non-Financial Incentives (e.g., HOV and Parking)
6. Fee Waivers & Tax Exemptions
7. Residential PEV Electricity Rates and Programs Charging Infrastructure Incentives
8. Fleet Requirements or Incentives

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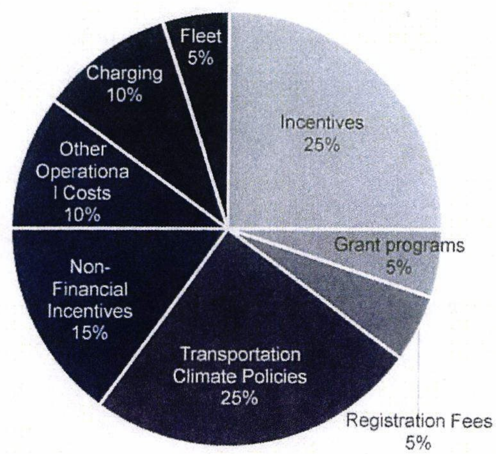
Policy Evaluation Adjustment Factors

Proposed Policy Standardization Key

	Incentives	Grant programs	Registration Fees	Transportation Climate Policies
Min	0	0	-2	0
Max	4	4	2	4
Key	0 = No policies 1 = Policy very smal or limited in sector 4 = Credit > $3,000 (CA Level)	0 = No Grant policies 4 = Grant programs equivalent with EV purchase incentives	-2: Fee >=$200 2: Exemption from Fee	0 = No Climate Policies 1 = REV West or equivalent 4 = TCI Membership + GHG State Goal

	Non-Financial Incentives (HOV and Parking)	Other Operational Costs	Charging	Fleet
Min	0	0	0	0
Max	4	4	4	4
Key	0 = No Policy 1 = Past / Expired Policy 4 = Full HOV Exemption and Existing Parking Allowances	One point for each: 1. License/ Purchase Tax Exemption 2. Emissions Test Exemption, 3. Use Tax Exemption, 4. Insurance Break (half for reductions)	0: No Rebate 2: Rebate of around $500, or larger rebate but limited in scope 3: Rebate > $1,000 statewide +1 point for zoning requirements	0: No requirements 2: Limited or geographically limited requirements 4: Aggressive "Alternative Fuel" Requirements for State Vehicles

Proposed Weighting of Policy Categories



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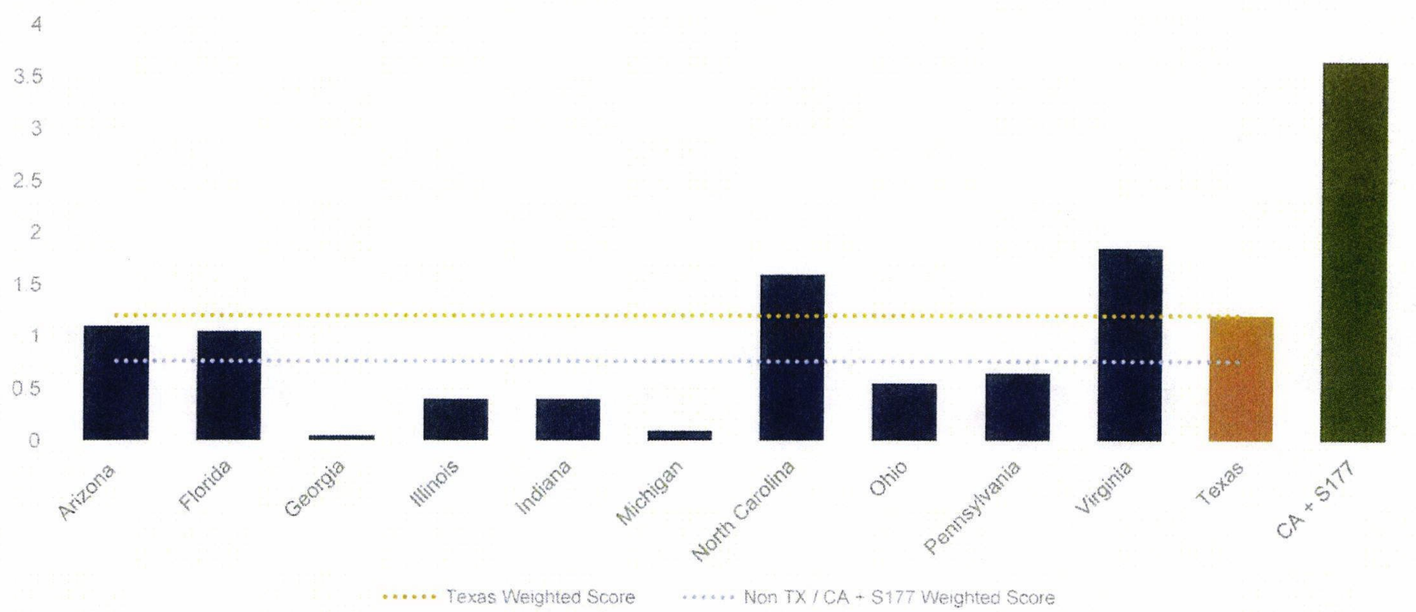
EV Penetration Analysis: Texas Policy Landscape

Tasks 2 & 3

	Incentives	Grant programs	Registration Fees	Transpo. Climate Policies	Non-Financial Incentives	Other Operational Costs	Charging	Fleet
Weights	0.25	0.05	0.05	0.25	0.15	0.1	0.1	0.05
Texas	3	2	0	0	0	1	2	1
	• Rebate for up to $2,500; currently limited to 2,000 vehicles or funding expiration • Additional funding for low emissions vehicles that replace high emitting vehicles for low income families	Funding available for fleet vehicles, heavy duty and school buses, and "Emissions Reductions Incentive Grants" under TERP	N/A	N/A	N/A	Some insurance companies may give discounts for green driving or owning a green vehicle	• Alternative Fueling Facilities Program in the Clean Transportation Zone • "Fleets for the Future" Initiative to facilitate EVSE purchasing	Fleet requirements in Dallas and Texas-wide for agencies with more than 15 vehicles

Policy Adjustment Factors: Comparison

Tasks 2 & 3



Because Texas has a slightly more favorable policy environment than other non-California and Section 177 states, it receives a slightly higher allocation of PEVs than these other states

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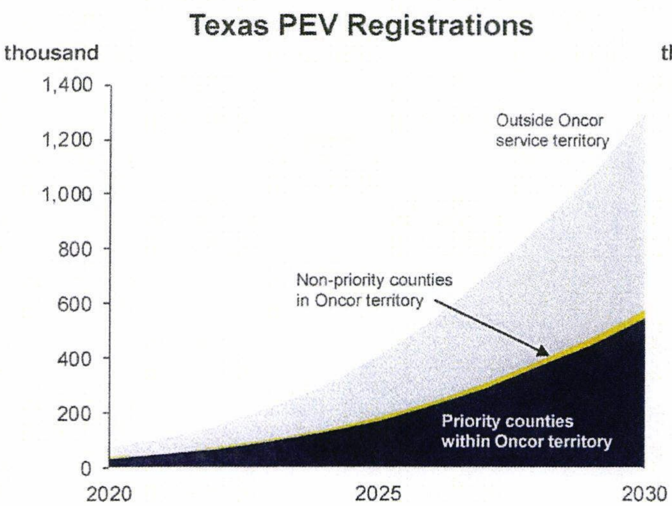
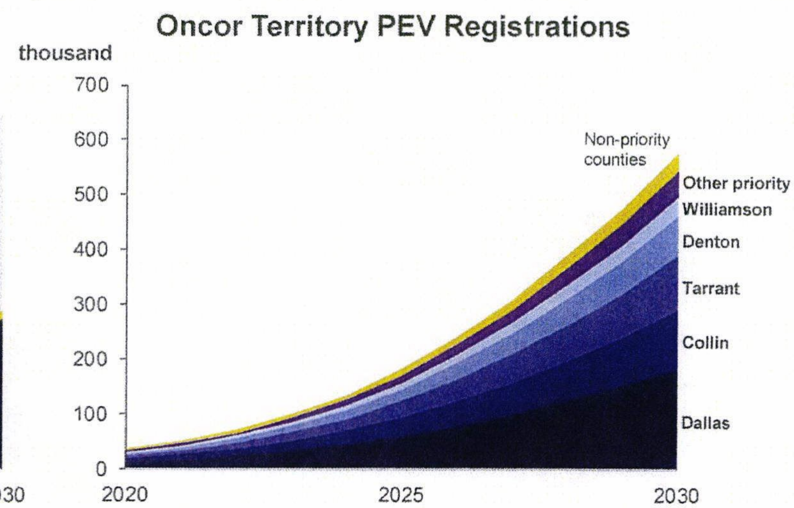
Projected Texas PEVs

Task 3

	Current (Nov. 2018)	2020	2025	2030
Texas	30,870	73,000	408,000	1,310,000
Oncor Service Territory	13,580	32,000	180,000	575,000
Priority Counties	12,850	30,000	170,000	540,000





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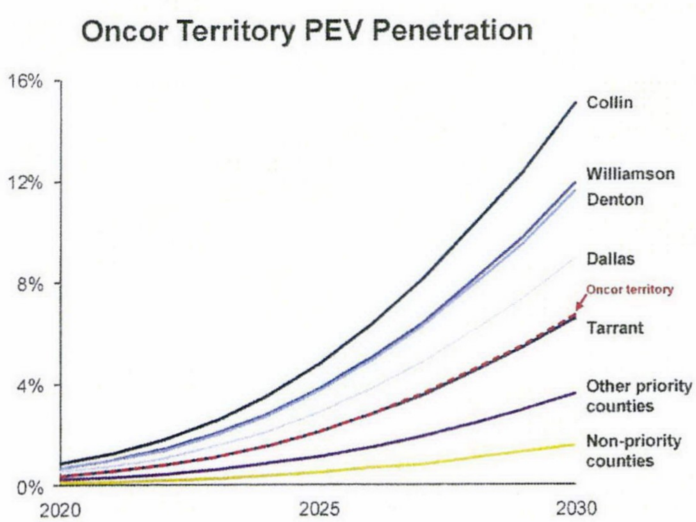
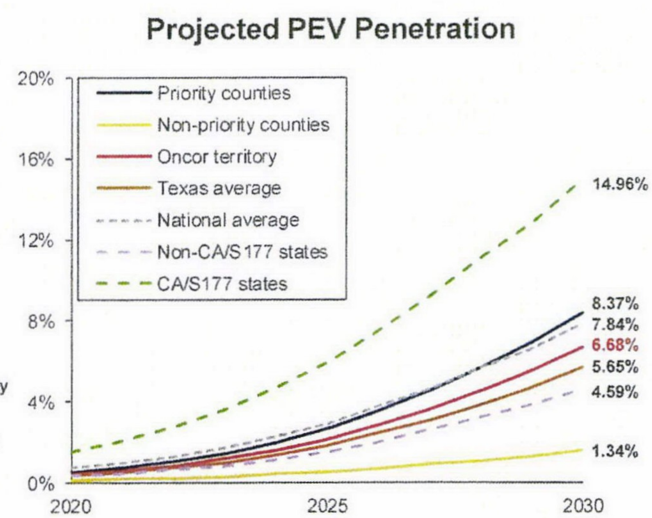
Projected Texas PEV Penetration (% in-use LDVs)

Task 3

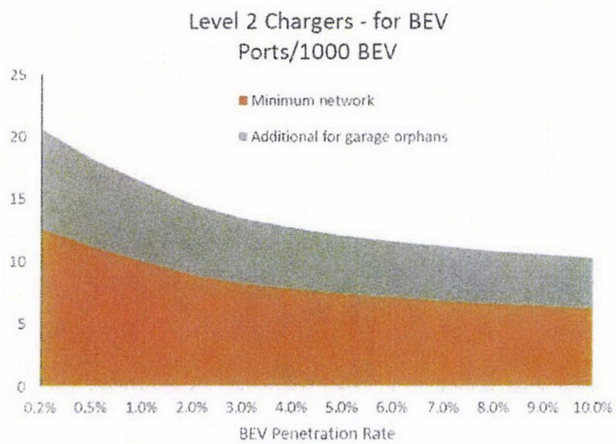
	Current (Nov. 2018)	2020	2025	2030
Texas	0.14%	0.33%	1.79%	5.65%
Oncor Service Territory	0.16%	0.39%	2.12%	6.68%
Priority Counties	0.21%	0.48%	2.66%	8.37%

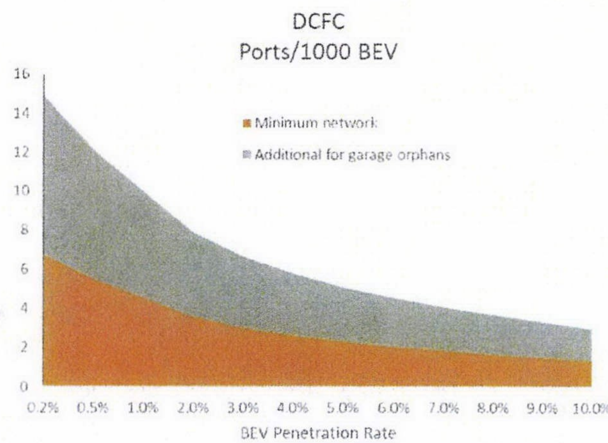


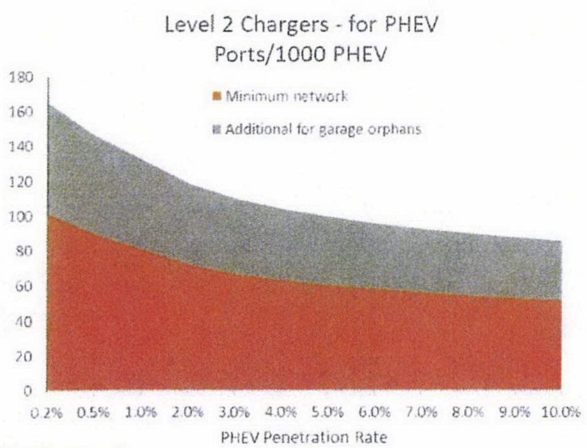


Contents

Texas Charging Infrastructure Requirements







- Used NREL's *EVI Pro Lite* model to estimate required public & workplace charge ports at different levels of penetration, specifically in TX
- Baseline network required to support long distance travel, plus additional ports for PEV owners without access to a "home" charger
- Required level of infrastructure (ports/1000 PEV) declines as penetration increases

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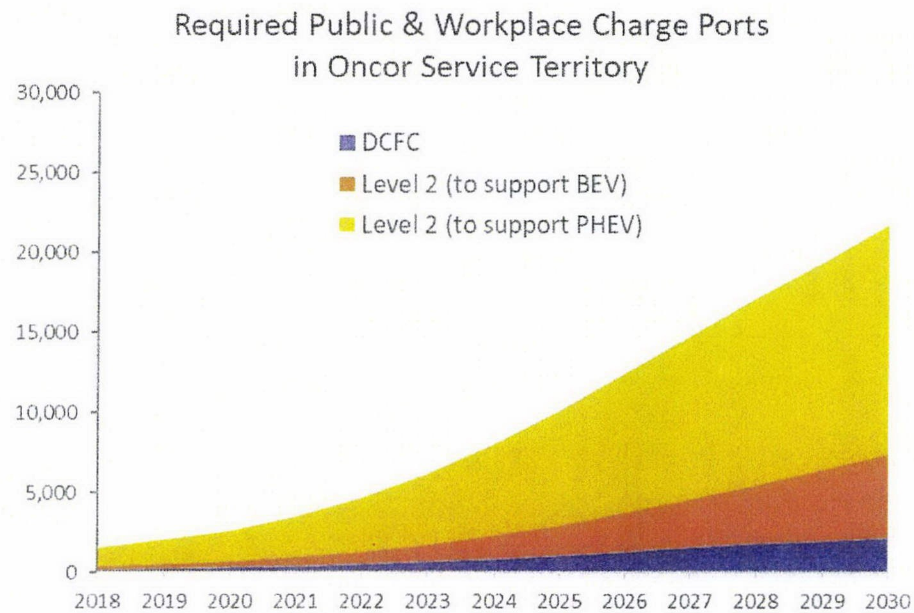
Required Public Chargers in Oncor Service Territory Task 3



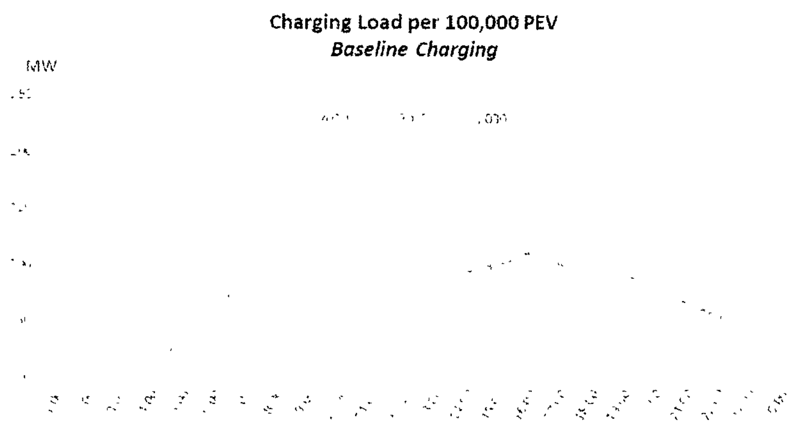
Based on projected PEV penetration, and EVI Pro Lite estimated ports/PEV

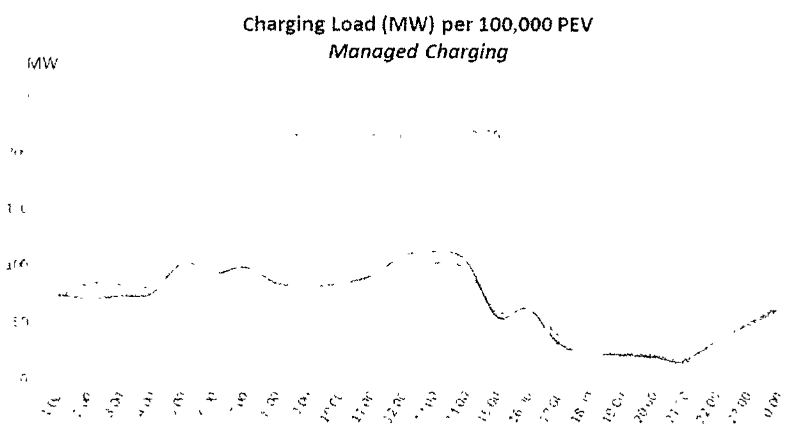
- Required DCFC ports increase from 224 today, to 2,193 in 2030, to support the projected 575,000 plug-in vehicles in the Oncor service territory
- EVI Pro Lite estimates that ~9 public and workplace Level 2 charge ports will be required for each DCFC port – growing to more than 19,500 ports needed in the Oncor service territory by 2030.
- Most Level 2 ports are required to support PHEV; the estimated total is sensitive to modeling assumptions about how motivated PHEV owners are to maximize electric miles

MJB & A

PEV Charging Load Profiles

Tasks 3 & 4



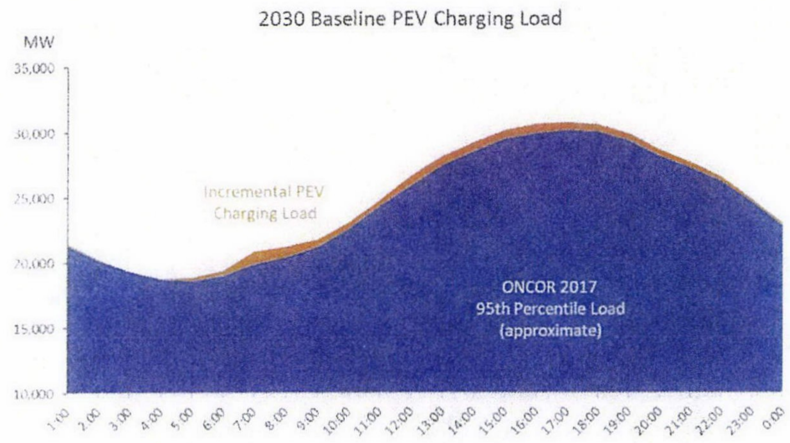


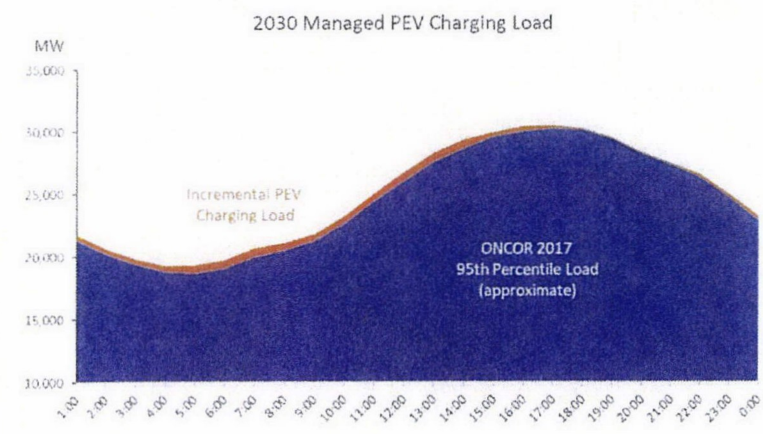
- Baseline charging assumes charging starts as soon as vehicles arrive at home (home charging) or at work (public charging)
  - ✓ Arrival times based on 2018 National Household Travel Survey (TX)
- Managed charging delays 80% of home charging to start between 10 PM and 4 AM, spreads public charging throughout the day
- For single family homes, 90% of charging at home; for multiple unit dwellings only ~60% of charging at home
  - ✓ Approximately 80% of total charging at home, 20% public
- Load per PEV increases over time due to assumed increased use of DCFC for public charging

MJB A

Estimated Charging Load in Oncor Service Territory

Tasks
3 & 4

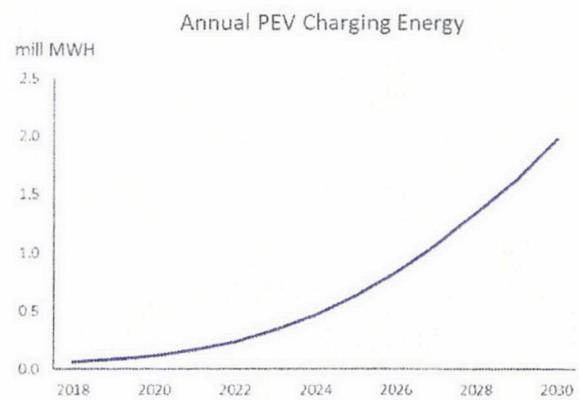




2030 projected incremental load for PEV charging ranges from 37 MW to 1,000 MW throughout the day (typical weekday)

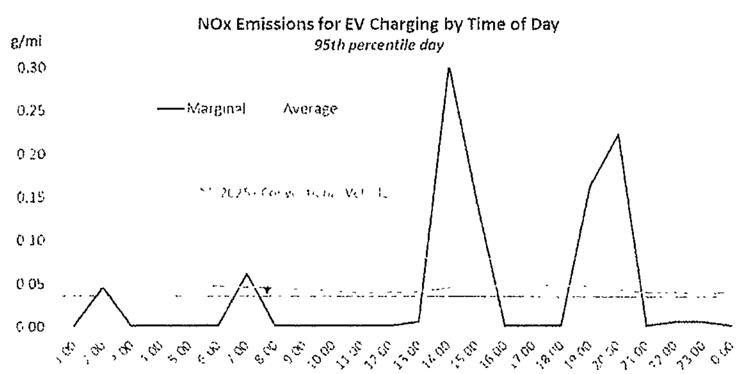
- ✓ Baseline charging adds 590 MW to peak-hour load (5 PM)
- ✓ Managed charging adds 205 MW to peak-hour load (5 PM)

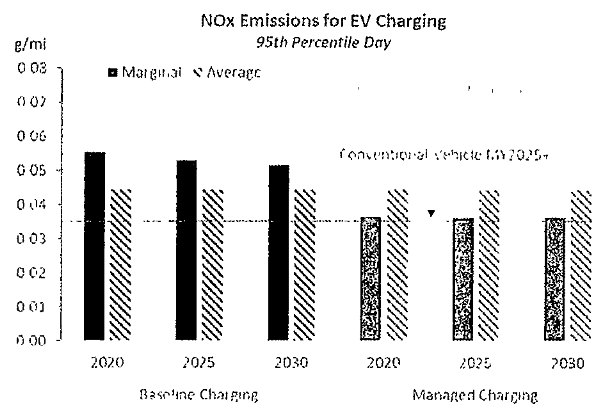
Projected 2030 incremental charging load would add ~0.6% to ~2% to the actual 2017 95th percentile load in the peak hour

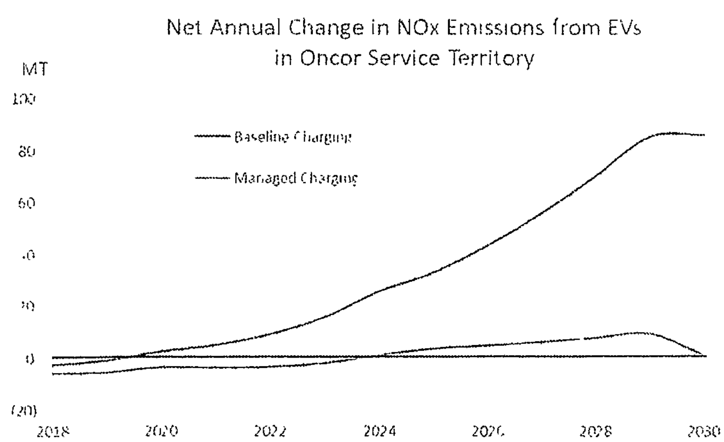


MJB & A

NOx Emissions



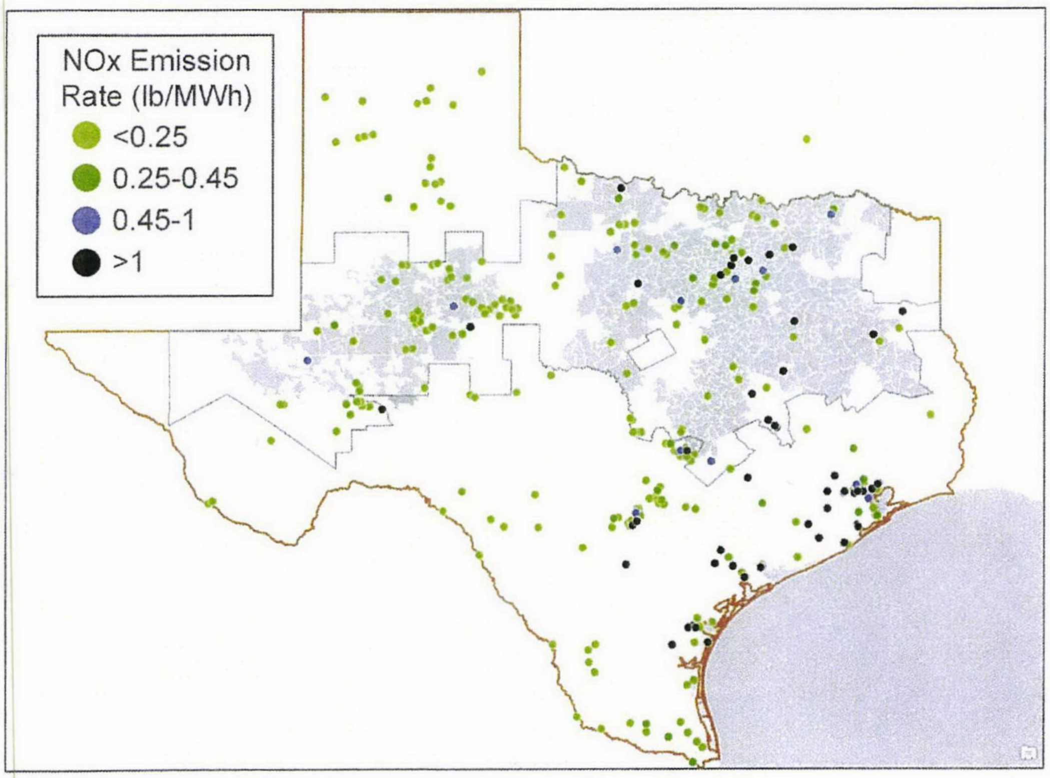




- Based on actual marginal generating units in ERCOT in 2018
- Marginal NOx (g/kWh) is virtually zero in the late evening/early morning, but significantly higher during the day
- Net NOx emissions are lower with managed charging, as PEV load is pushed from late afternoon into the early morning hours

MJB A

Texas Electricity Generation – NOx Emissions



- Generating sources with NOx emissions <0.25 lb/MWh will ensure PEVs always have lower NOx than new conventional vehicles (g/mi)
- PEVs powered by generating sources with NOx emissions 0.25 > lb/MWh <0.45 will have lower NOx than current new conventional vehicles, but will have slightly higher NOx than new conventional vehicles after model year 2025

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For more detail on emissions rates, see Appendix

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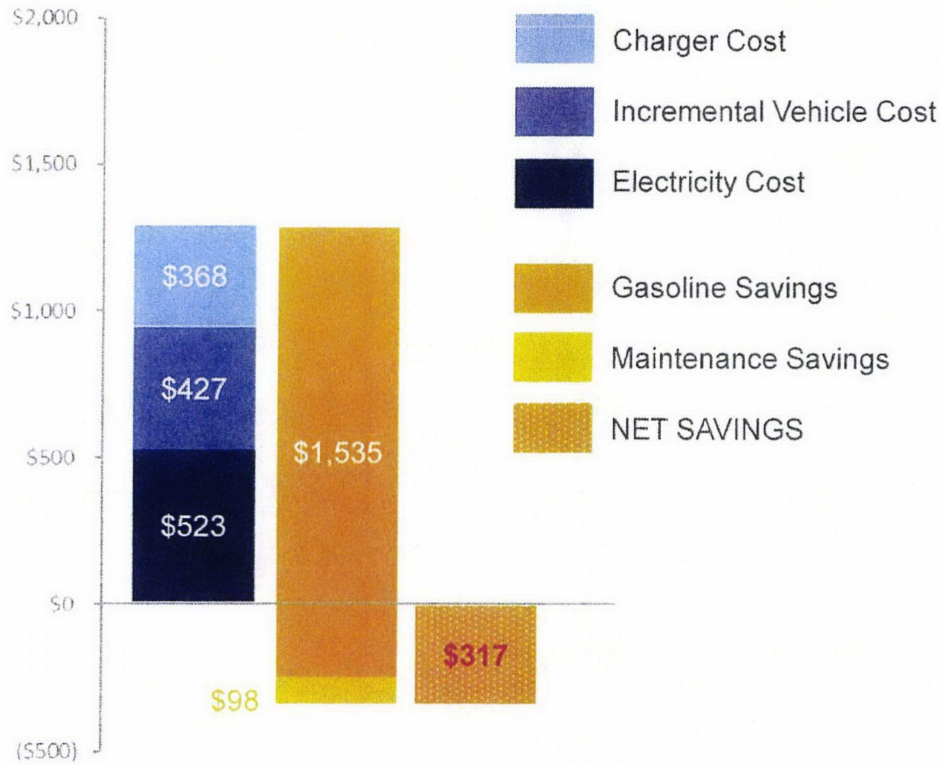
Appendix

2030 Average PEV Owner Savings ($/yr)

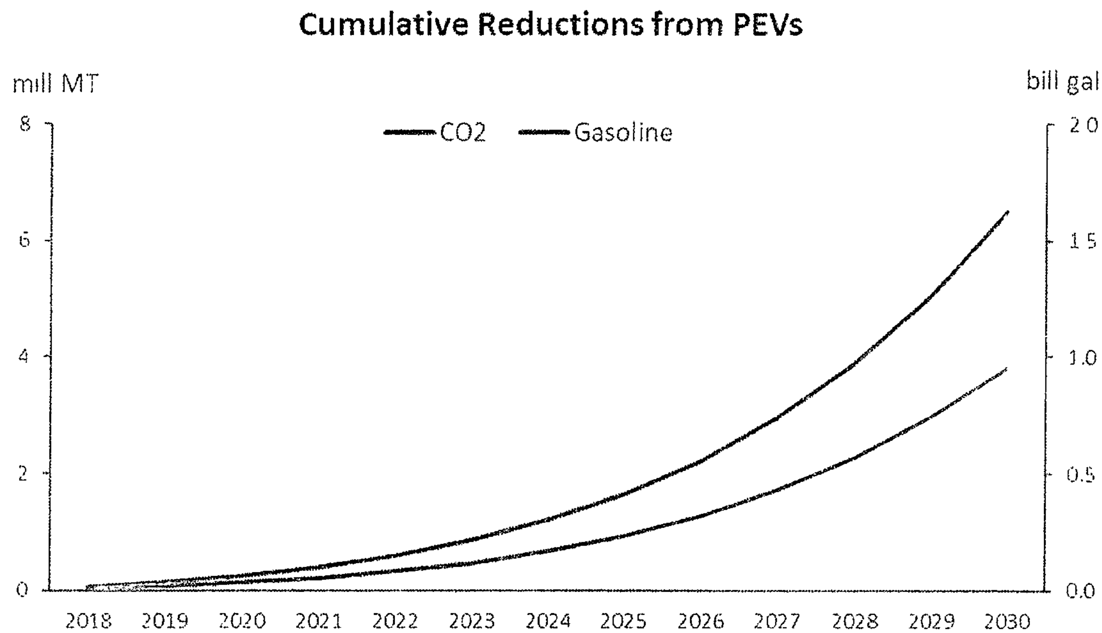
Task 4



MJB & A

GHG & Gasoline Reductions

Task 4



- By 2030, electric vehicles in Oncor's service territory are projected to reduce gasoline use by almost 1 billion gallons compared to continued use of gasoline vehicles
- This will reduce CO_2 emissions by 6.5 million metric tons, net of emissions from generating the electricity used to charge them

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Policy Weighting Adjustments: Score Details

	Incentives	Grant programs	Registration Fees	Transportation Climate Policies	Non-Financial Incentives	Other Operational Costs	Charging	Fleet	Weighted Score
Weights	0.25	0.05	0.05	0.25	0.15	0.1	0.1	0.05	
Arizona	0	0	0	1	2	2.5	2	2	1.1
Florida	1	0	-2	0	3	0.5	4	0	1.05
Georgia	0	0	-2	0	0	1.5	0	0	0.05
Illinois	1	0	0	0	0	1.5	0	0	0.4
Indiana	1	0	-1	0	0	0	2	0	0.4
Michigan	0	0	-1	0	0	1.5	0	0	0.1
North Carolina	0	0	-1	3	2	3	1	4	1.6
Ohio	0	0	0	0	1	1	1	4	0.55
Pennsylvania	2	0	-1	0	0	0	2	0	0.65
Virginia	1	1	-2	4	3	1.5	0	1	1.85
Texas	3	2	0	0	0	1	2	1	1.2
CA + S177	4	2	2	4	3	4	4	4	3.65

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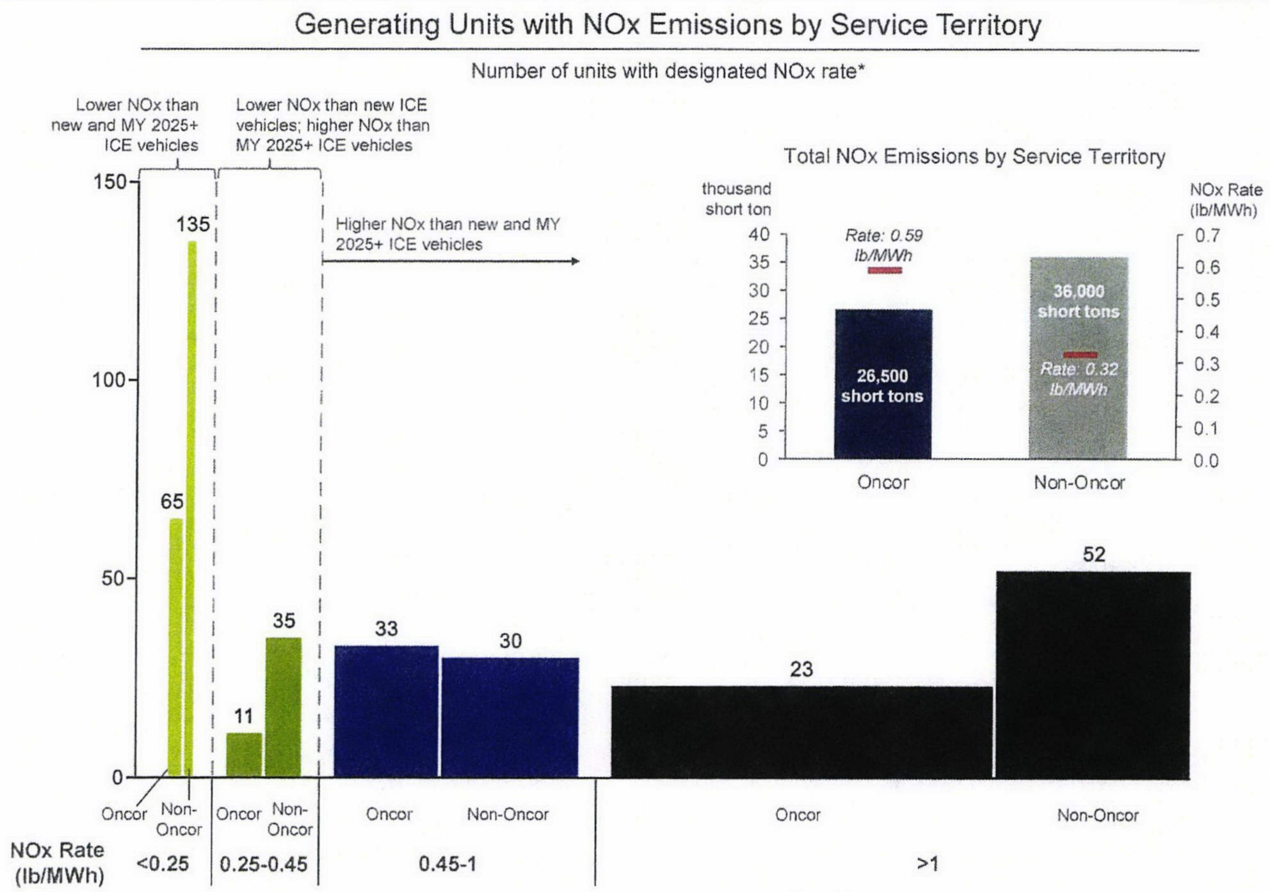
Generating Facilities by Service Territory



*Bar width proportional to average effective NOx rate (lb/MWh) of generating units within each NOx rate designation

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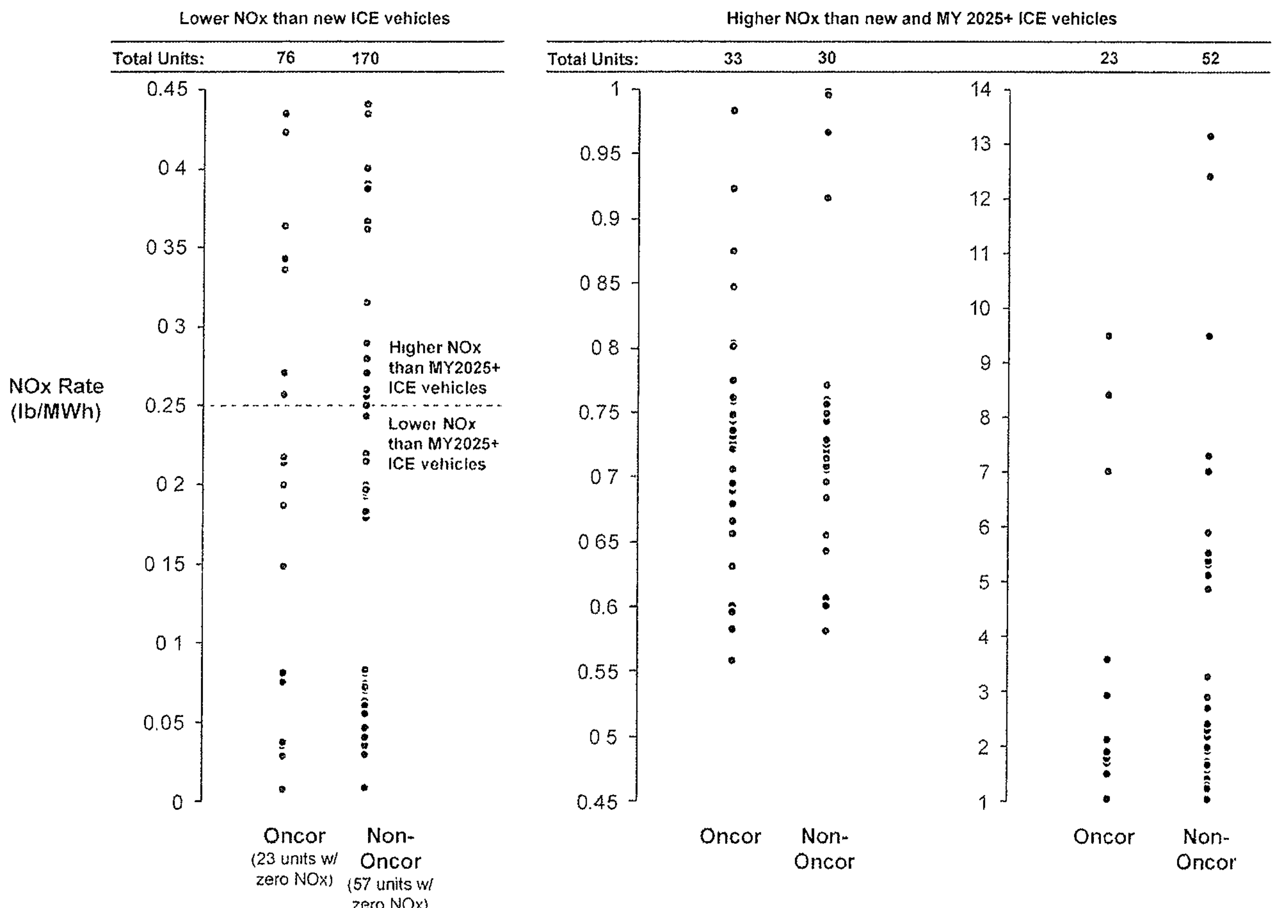
NOx Rate of Generating Units by Service Territory



MJB A

NOx Emissions Calculations

- MJB&A used data on electric generating units in the ERCOT territory to develop a supply curve for Texas
  - ✓ The supply curve is based on economic dispatch – i.e. that low cost units ($/MWh) would be dispatched before higher cost units
  - ✓ All coal-fired units with an announced retirement date were removed, and not included in the supply curve
  - ✓ For each unit, MJB&A calculated a NOx emissions rate (lb/MWh) in addition to operating cost ($/MWh)
  - ✓ Data on individual generating units was taken from the ABB Ability™ Velocity Suite
- Using the supply curve, and actual ERCOT daily load (MW) for 2017, MJB&A calculated an average and marginal NOx emissions rate (lb/MWh) by time of day for the 2017 annual and monthly 95th percentile days
- Using an in-house PEV charging model MJB&A calculated the incremental PEV charging load in the Oncor service territory, by time of day, for a 'typical weekday"
  - ✓ The charging model accounts for the number and type of plug-in vehicles charging (BEV, PHEV), projected daily energy use per vehicle (kWh/day), charging location (home, public), distribution of charge start times, and average charge rate (kW)
  - ✓ The assumed number of vehicles charging is based on modeled PEV penetration scenarios
  - ✓ Distribution of charge start times is based on home and work arrival times reported by Texas residents in 2018 National Household Travel Survey.
- Using the estimated PEV charging load (MW) by time of day, and the marginal and average NOx emissions rates (lb/MWh) by time of day on the 2017 95th percentile day, MJB&A calculated marginal and average emission rates for PEV charging in the Oncor service territory (g/kWh and g/mi)
  - ✓ Created estimates for 2020, 2025, and 2030 based on assumed increases in PEV penetration
  - ✓ Created estimates for "baseline charging" and "managed off-peak charging"
- For comparison, estimated average NOx emissions (g/mi) from new, conventional vehicles was taken from EPA's Motor Vehicle Emissions Simulator (MOVES) model.