TxETRA

Comments of

The Texas Electric Transportation Resources Alliance

to the

Texas Commission on Environmental Quality

Regarding the

Texas VW Settlement Funding Plan

October 8, 2018

Texas Electric Transportation Resources Alliance

"Creating the Policies that Pave the Way for the Electrification of Transportation in Texas"

TxETRA is a new nonprofit organization founded in April 2018 to accelerate electric transportation in Texas. We are comprised of electric energy vehicle manufacturers, industry leaders, developers, distributors, producers, utilities, as well as environmental and transportation equity groups. Our mission is to "guide and accelerate the adoption of electrical transportation in all its forms, in the most cost-effective way, providing maximum benefit to the citizens of Texas."

Board of Directors

Michael Osborne	Board Chair
Yannis Banks	Austin MEASURE, Board of Directors
Joseph Barletta	SmartCharge America
Suzanne Bertin	Executive Director, Texas Advanced Energy Business Alliance
Bill Bojorquez	V.P., Hunt Energy
Janis Bookout	EarthX / TxETRA Board Treasurer
Rob Borowski	Sustainability Officer, Capital Metro
Roger Duncan	Research Fellow, Energy Institute, UT Austin
Cary Ferchill	Chair, Austin Electric Utility Commission
Bobby Hill	V.P. of Sales, BYD America
Bill Kahn	Peterbilt Motor Company
Rick Luna	Interim Director, Technology & Product Innovation, CPS Energy*
Jackie Sargent	Austin Energy - Gen Manager
Adrian Shelley	Director, Public Citizen Texas
Buzz Smith	Sales Rep, Classic Chevrolet
Charles Zeller	Co-Founder, Climate Science Legal Defense Fund
Tom "Smitty" Smith	Executive Director

*CPS is submitting their own additional comments.

Executive Summary

The Texas Electric Vehicle Transportation Alliance (TxETRA) appreciates the opportunity to comment on the Texas plan for disbursement of the VW settlement funds.

Bloomberg New Energy Finance predicts that "the EV revolution is going to hit the car market even harder and faster than [we] predicted a year ago," and as such, have recently revised their projection of the EV market share in 2040 from 35% of all new car sales to 54%. Other technology and market-watchers offer similarly optimistic projections. Texas can be a major player in this transportation revolution, but we must be ready with the necessary infrastructure in place.

In the summer of 2018, TxETRA formed a Charging Infrastructure Committee (CIC) of stakeholders to develop a plan for EV charging infrastructure that allows EV owners to travel from one end of the state to the other. In addition to other resources, the CIC referenced the following maps to provide a foundation for mapping our recommendations:

- Texas Highway Map
- ERCOT Electricity Distribution Map
- Electrify America Charging Station Plan

Since "range anxiety" has been identified as the #1 obstacle to purchasing an electric vehicle, we recommend a network of **Direct Current Fast Charging (DCFC) stations** to accelerate the use of zero emissions electric vehicles in order to build consumer confidence and support for long-distance intra-city travel.

While of our comments will be oriented toward suggestions for **how and where to fund the initial stations** that will result in a complete EV charging infrastructure network for Texas, we also include a low-income equity recommendation that **25% of the charging funds to be set aside for low-income** communities in multi-family units and nearby, street-side locations.

Finally, we recommend **increasing the heavy-duty vehicle reimbursement from 60% to 80% as a "tipping point" incentive** to reduce diesel emissions achieved by industry transition to vehicle electrification.

We believe that with the thoughtful deployment, of a combination of **VW** Settlement funding, **Texas Emissions Reduction Program (TERP)** grants, and the **Electrify America** charging infrastructure, it should be possible to locate chargers at key locations that enable EV owners to get from one end of the state to another on interstate and primary highways. Our proposal suggests locations at a maximum distance of less than 70-120 miles as a first phase by 2021 and approximately every 50 miles by 2023.

It is our hope that this plan can guide the TCEQ funding decisions on where fund to charging station in a more thoughtful way than might occur if grants are based solely on a first come - first served basis.

TxETRA Recommendations

(See Page 13 for Recommendation Justifications)

RECOMMENDATION #1 – Coordination with other Charging Station Providers

Use the VW Settlement Funds to augment future charging station plans already proposed by other parties such as Electrify America, individual Texas service area utility providers, and Texas Emissions Reduction Program (TERP) grants.

RECOMMENDATION #2 - Frequency

Install EV charging facilities every 70-120 miles by 2021, and every 50 miles, by 2023.

RECOMMENDATION #3 - Location

Install EV charging facilities where power line and distribution system capacity is adequate. Applicants must demonstrate adequate distribution grid electrical capability prior to TCEQ disbursement of funds.

RECOMMENDATION #4 – Co-Location for Convenience and Maximum Utilization

Charging stations should co-located with facilities that provide enough traffic and amenities to ensure maximum utilization of the charging facilities. Examples include large gasoline retailers, restaurants, big-box grocery and retail stores, and other convenient outlets, parks and roadside attractions.

RECOMMENDATION #5 – Accessibility and Viability.

Charging companies shall provide locations that are well-lit and well maintained and accessible 24 hours a day.

RECOMMENDATION #6 – Charging Voltage Level

Install Direct Current Fast Charging (DCFC) on Interstate and Principle Highways.

RECOMMENDATION #7 - Charging Station Network Type

Require Networked "Smart" Charging Stations for all locations that are easy to locate using prevalent mobile apps

RECOMMENDATION #8 – Charging Point Protocol

Require Open Charge Point Protocol (OCPP) networked charging to ensure the ability to communicate with any system, regardless of vendor.

RECOMMENDATION #9 - Charger Connector Port Standards for Inter-Connectability and Inter-Operability

Require dual standard DCFC stations that support both CCS and CHAdeMO connectors to serve the greatest number of electric vehicles.

RECOMMENDATION #10 – Site Design Recommendations

Install all electrical infrastructure systems to account for at least four 150kW DCFC station stalls. To protect TCEQ's investment, the agency should partially fund oversized conduit, electric boxes and transformer pads to account for future increases in the number of chargers and later upgrades for heavy duty charging stations.

RECOMMENDATION #11 – Consumer Protections and Pricing

Charging companies should disclose the price to charge to customers prior to purchase including any variations of price based on time of use, utility company demand, peak power charges, etc.

RECOMMENDATION #12 - Protecting Stranded Assets in Case of Charging Company Bankruptcy

TCEQ should develop with a mechanism to assure protect its investment in the case that a charging company goes bankrupt.

RECOMMENDATION #13 – Long-Term Leases for Charging Stations

The TCEQ should allow long-term leases to suffice and the grantee should provide TCEQ with a copy of the provisional agreement.

RECOMMENDATION #14 - Funding Equity

Reserve a 25% Charging Infrastructure Set-Aside for multi-family apartment complexes, street-side charging units, and public facilities in low-income communities.

RECOMMENDATION #15 - Heavy Duty Vehicle Reimbursement

The Heavy-Duty Vehicle reimbursement should be increased from 60% to 80% to provide a "tipping point" incentive for the trucking industry to convert electrification, thereby reducing diesel emissions significantly.

RECOMMENDATION #16 – Minimum DCFCs and Futureproofing

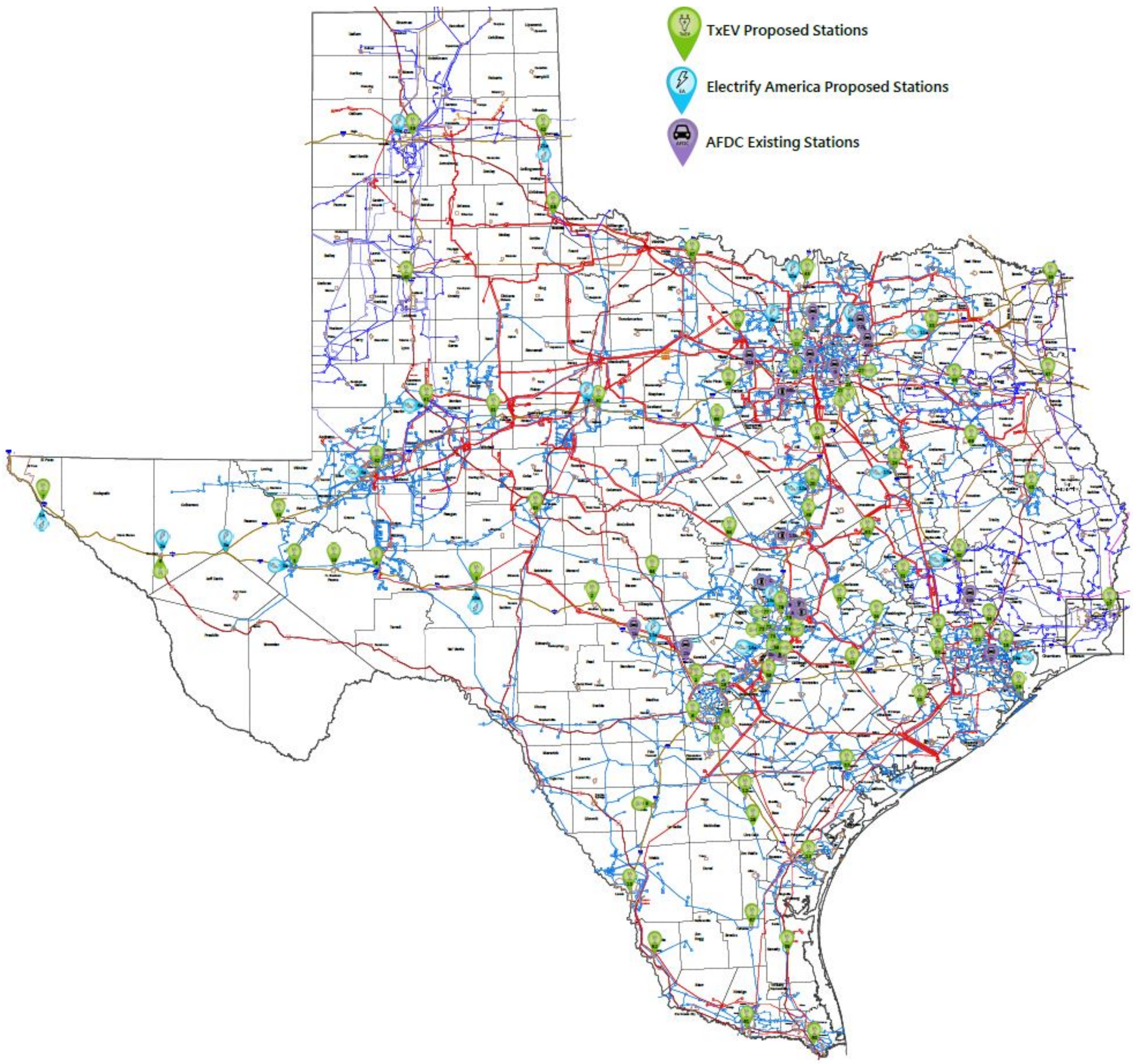
Require charging stations to have a minimum of four 150 kW DCFC chargers with pads and conduit sized to enable stations be upgraded in the future to accommodate the demand of four additional 350-kW DCFC chargers which can serve the needs of future light and heavy-duty vehicles and/or be paired with stationary storage.

TxETRA Proposed Charging Station Locations

The map and corresponding EV proposed locations on the following pages are based on available transmission infrastructure in Texas in close proximity to the principal highways and in approximate places where the distribution system and grid is adequate to handle the additional load for DCFC fast chargers.

TxETRA recommends that charging stations be placed in the general vicinity of the locations indicated in this map which can be referenced by TCEQ when evaluating submitted proposals to build the stations. These proposed locations are selected to assure maximum usage the charging stations and to ensure charging drivers proximity to amenities such as restaurants and other roadside attractions. This phase of our study suggests locations for light duty charging stations only. We hope to develop similar maps for heavy duty charging infrastructure in the future.

Because of the potential for large loads per charging station discussed in recommendation #16 of this report (600 kW to 2,000 kW at a future point in time), TxETRA did not review distribution networks (i.e., under 35 kV) in Texas. While distribution networks could potentially carry the full demand of a DCFC, rural towns at the end of distribution networks could easily experience system overloads requiring costly upgrades to the grid. To avoid distribution-only areas, the map includes charging stations in places where either 69kV or 138kV stations (or both) are present. Additional coordination with the individual transmission and distribution companies will be required to ensure the installer meets both goals of adequate electrical capacity and the proximity to amenities described in this report.

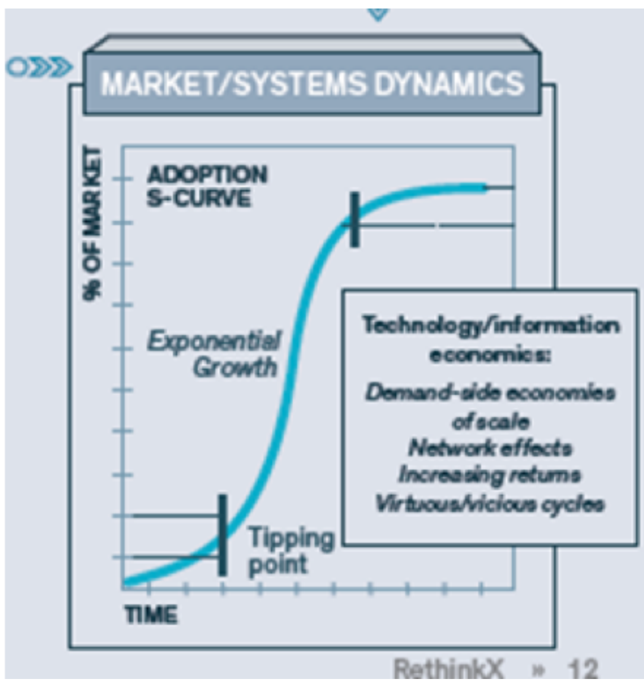

TxEV Proposed Stations
Electrify America Proposed Stations
AFDC Existing Stations

Station No.	City	Highway	Power Line / Substation
1	San Antonio	10	138 kV / UTSA_BTP
2	Junction	10	69 kV / JUNCTION2A
3	Ozona	10	138 kV / FdRan4A
4	Ft. Stockton	10	138 kV / SIRIUS_8
5	Ft. Stockton	10	138 kV / REROCK_8
6	Van Horn	10	69 kV / Van Horn
7	Socorro	10	69 kV / Socorro
8	San Antonio	35	138 kV / Somerset
9	Cotulla	35	138 kV / Cotulla4A
10	Laredo	35	138 kV / StNino4A
11	San Antonio	37	138 kV / Brauning_E
12	Three Rivers	37	138 kV / ThreeRi4A
13	Corpus Christi	37	138 kV / Citgo_no4A
14	San Antonio	10	138 kV / Converse
15	Schulenburg	10	138 kV / L_Schule8_1Y
16	Houston	10	138 kV / Barnes 138X
17	Orange	10	SPP 138 / Orange
18	San Antonio	35	138 kV / Fratt
19	Ft. Stockton	10	138 kV / FtSt4A
20	Waco	35	138 kV / Waco_Mm21_8
21	Dallas	35E	138 kV / WATMLL_W8
22	Fort Worth	35W	138 kV / Klr_Mag2_T8
23	Dallas	45	138 kV / SSWT2_8
24	Buffalo	45	138 kV / FairWPod_8
25	Conroe	45	138 kV / Bertwd138A
26	Galveston	45	138 kV / AmocoOil_6_8
27	Dallas	20	138 kV / BchSpg1T_8
28	George West	59	138 kV / GeWst4A
29	Mineral Wells	20	138 kV / Lipan_8
30	Abilene	20	138 kV / Abea4A
31	Colorado City	20	138 kV / Saltmine
32	Odessa	20	138 kV / Grandvew8
33	Pecos	20	69 kV / TNPecos0
34	Kingwood	59	138 kV / Kingwd138A
35	Sulphur Springs	30	138 kV / SulSp_SS1_8
36	Texarkana	30	SPP 138 / Bann
37	Wichita Falls	287	138 kV / FisherRd_8
38	Childress	287	138 kV / CHLD4A
39	Amarillo	27	SSP 230 / E. Plant
40	Lubbock	27	115 kV / North (future station)
41	Howard	87	138 kV / SUKoch

42	Shamrock	40	SPP 138 / Shamrock
43	Gainsville	35	138 kV / Gainvl_e_8
44	Fort Worth	35W	138 kV / AlCon2_8
45	Cleburne	35W	138 kV / Lillian8
46	Tyler	20	138 kV / TylerNW_8
47	Marshall	20	SPP 138 / SE Marshall
48	Hillsboro	35	69 kV / Hillboro1_9
49	Temple	35	138 kV / Temp_Pec_8
50	Huntsville	45	SPP 138 / Goree
51	College Station	6 & 21	SPP 138 / Speedway
52	Waller	6 & 290	138 kV / Hockly138D
53	Houston	10	138 kV / Foster138X
54	Brenham	290	138 kV / L_Salem_8_1Y
55	Wharton	59	138 kV / CBEC_1_8
56	San Marcos	35	138 kV / LRohr81Y
57	Victoria	59	138 kV / V_DupSw4A
58	Seguin	10	138 kV / L_Seguin8_1Y
59	Kenedy	77	138 kV / Armstron4A
60	Brownsville	77	138 kV / MidTown
61	Pharr	83	138 kV / Bentsen
62	Zapata	83	138 kV / Zapata4A
63	San Angelo	87	138 kV / Sast4A
64	Mason	87	138 kV / LFortMa81N
65	Robertson	79	138 kV / HamndSw
66	Jacksonville	79	138 kV / Dialvill8
67	Falfurrias	281	138 kV / Falfur4A
68	Lampasas	281	138 kV / LLampasas81Y
69	Stephenville	281	138 kV / Stphnvil8
70	Jacksboro	281	138 kV / Joplin
71	Lexington	77	138 kV / Llexing81Y
72	Austin	35	138 kV / BurlMb2
73	Austin	35	138 kV / LHiCros81Y
74	Austin	35	138 kV / PilotKb
75	Austin	35	138 kV/ Slaughter
76	Austin	35	138 kV / Mueller
77	Austin	35	138 kV / Northl13
78	Austin	35	138 kV / Cameron

Background

When Will EV's Be at the Tipping Point? EVs already cost less to own and operate than internal combustion engines. The *International Energy Agency (IEA)* predicts "electric vehicles will grow from 3 million to 125 million by 2030," while *Bloomberg Financial Services says* the electric vehicle tipping point could be as soon as 2025. By then EVs will cost less to buy than internal combustion engine vehicles (ICEs). Most analysts predict that somewhere **between 2029-2040, the majority of U.S. vehicles sold will be electric**. This will affect electric demand and create unique challenges of meeting mobile load and offer interesting opportunities for using vehicle batteries for storage. Value streams for **energy stored in vehicle batteries may include demand charge reduction**, peak load reduction, energy arbitrage, price responsive opportunities, voltage support, and congestion management. Below is a chart reflecting *Bloomberg's* rapid-growth part of the technology-adoption S-curve.



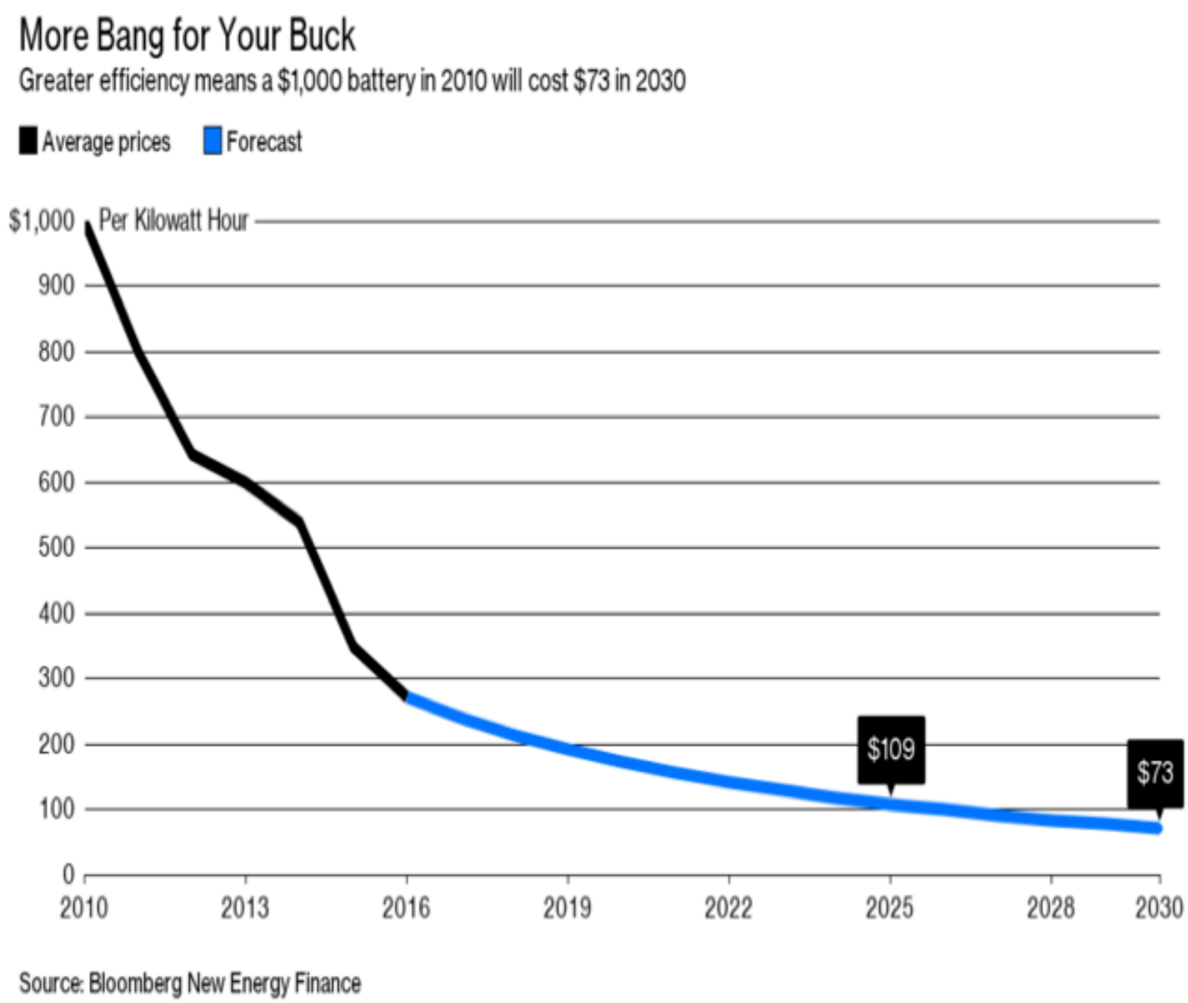
Based on other historical technology changes, transformation could occur in 15 years or Less. Some examples are:

- Automobiles – from horses and buggies
- TV – from Radio
- Digital Cameras – from Manual cameras.
- Mobil/Smart Phones – from wired home phones
- Microwave ovens – from conventional ovens
- Laptop and Tablet Computers – evolving from typewriters, then mainframes, to desktop PCs,
  Renewable Energy – from fossil fuels

Some analysts project a far more rapid adoption of EVs. A November 2017 study by the *Boston Consulting Group* predicted “Electrified Vehicles to Take Half of Global Auto Market by 2030.” *National Geographic* wrote in September 2017 that, “Electric Cars May Rule the World’s Roads by 2040” -- *Rethink X*, an independent think tank, is even more bullish, saying “Most U.S. vehicles will be electric by 2030, just 13 years from now.”

After 2025, falling battery prices and rising consumer demand based on TCO will drive rapidly increasing sales of all electrified vehicles, and especially BEVs. The adoption of electrified vehicles for shared mobility will accelerate because their higher mileage will result in more rapid payback of the investment.

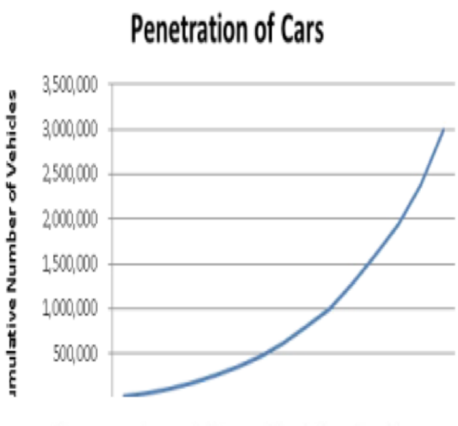
The real take-off for EVs will occur in the second half of the 2020’s. This will be due to plunging lithium-ion battery prices, which are set to fall by more than 43% by 2022 and 70% by 2030. Between 2010 and 2016, lithium ion battery costs plummeted by 75%. It is forecast that by 2030, those same battery prices will drop by 93%.

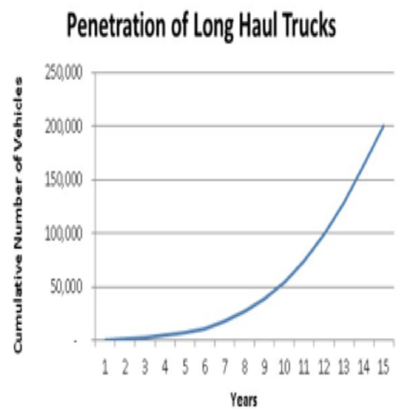


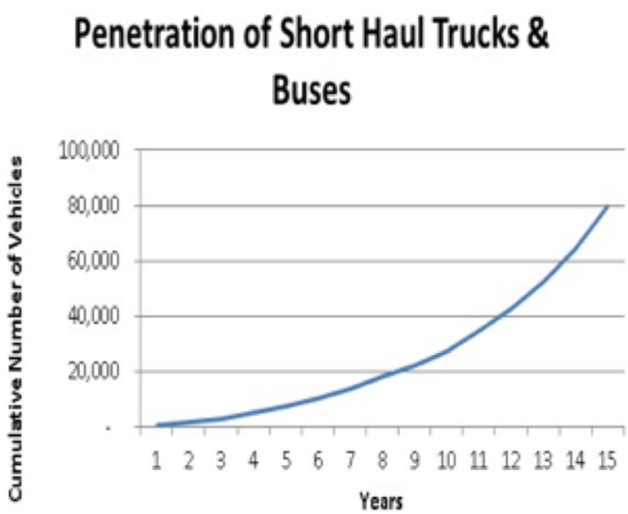
Moreover, **ERCOT**'s 2033 **Long Term System Analysis June 2018** draft suggests in its **Emerging Technology Scenario** that EVs will increase load by 18,940 MW by 2033 - mainly at night.

Type	Number of Vehicles	Per Day Vehicle Charging	Total Capacity Increase
Cars	3,000,000	20 kWh	5,940 MW
Short Haul/Buses	80,000	350 kWh	2,800 MW
Long Haul Trucks	200,000	600 kWh	10,200 MW

year	Cars	Long haul trucks	Short haul/buses
2019	20,000	500	500
2020	55,000	1,500	1,500
2021	105,000	3,000	3,000
2022	170,000	5,000	5,000
2023	250,000	7,500	7,500
2024	350,000	11,000	10,500
2025	475,000	18,000	14,000
2026	620,000	27,000	18,000
2027	795,000	39,000	22,500
2028	1,005,000	54,000	27,500
2029	1,280,000	74,000	34,500
2030	1,590,000	99,000	42,500
2031	1,940,000	129,000	52,500
2032	2,390,000	164,000	64,500
2033	3,000,000	200,000	80,000







Electrification Reduces Emissions.

80% of EVs charge at night when the wind power blows. Manufacturers expect EV car batteries will be used to reduce peak. Accordingly, “peaker plants” that emit rich emissions of NOx and VOCs would run less. Based on this, the **North Central Texas Council of Governments** predicts the **DFW** area could reach attainment even with the elimination of the Obama-era MPG standard. Similarly, a **University of Houston** study predicts the **Houston-Galveston** area could see a 2/3 reduction in NOx and PM from BAU in heavy duty truck emissions if heavy-duty trucks were electrified.

TxETRA Recommendations
(with Justifications)

RECOMMENDATION #1 – Coordination with other Charging Station Providers

Use the VW Settlement Funds to augment future charging station plans by other parties such as Electrify America, individual Texas service area utility providers, and Texas Emissions Reduction Program (TERP) grants.

It is our recommendation to use VW Settlement funding to 'fill in the gaps' of existing and future charging station proposals. By coordinating placement of the sites with these other parties, the TCEQ should be able to locate chargers at key locations that enable EV owners to get from one end of the state to another on interstate and primary highways.

RECOMMENDATION #2 - Frequency

Install EV charging facilities every 70-120 miles by 2021, and every 50 miles, by 2023.

"Range anxiety" has been identified as the #1 obstacle to purchasing an electric vehicle. TxETRA's preliminary poll results show that EV owners and potential buyers would feel comfortable with the above frequency of charging stations.

RECOMMENDATION #3 - Location

Install EV charging facilities where power line and distribution system capacity is adequate. Applicants must demonstrate adequate distribution grid electrical capability prior to TCEQ disbursement of funds.

We have mapped locations where there are 69 kV and 138 kV lines, which are recommended to assure that adequate capacity is available. Applicants must demonstrate adequate distribution grid electrical capability prior to TCEQ disbursement of funds.

RECOMMENDATION #4 - Co-Location for Convenience and Maximum Utilization

Charging stations should co-located with facilities that provide enough traffic and amenities to ensure maximum utilization of the charging facilities. Examples include large gasoline retailers, restaurants, big-box grocery and retail stores, and other convenient outlets, parks and roadside attractions.

When siting EV charging infrastructure, the duration of charging must be considered. Vehicle owners are used to gasoline vehicle refueling which takes less than ten minutes. Electric vehicle charging takes anywhere 30 minutes to 8 hours, depending on the type of charger in use.

Interesting and innovative intercity DCFC examples could be envisioned at restaurants along the highways (e.g. Cracker Barrel) or mega-sized fueling stations such as Buc-EE's (https://www.buc-ees.com/articles.php). The intercity PEV driver can easily spend 30 minutes for food, restroom, stretching ones' legs after a long period of highway driving. In order to improve the economics of DCFC, the footprint of these locations is also typically large enough to provide higher volumes of sales, sufficient area to install stationary storage, backup generators, and rooftop PV, and be a large enough load to potentially warrant demand charge management systems.

Co-locating refueling stations with just a convenience store can be a discouraging experience as in many cases, these stores do not have seating nor activities to make 15-30 minutes of waiting comfortable or enjoyable. The objective of these stores is to refuel their customers' gasoline/Diesel vehicle quickly at a rate that encourages them to come into the store to buy higher margin goods and but then quickly leave.

Other ideal locations would be at state or local parks or high-volume private amusements near the highways (like InnerSpace Caverns) where EV users can get exercise or find amusement while their cars are charging.

RECOMMENDATION #5 – Accessibility and Viability

Charging companies shall provide locations and access to 24-hour charging stations through "open standard". This will enable commonly used apps accessible by mobile devices to share location and availability data .

RECOMMENDATION #6– Charging Voltage Level

Install Direct Current Fast Charging (DCFC) on Interstate and Principle Highways.

There are 3 types or levels of Electric Vehicles (EV) chargers. Below:

Level 1 Charging – *110/120 Volts AC*
Range Per Charging Hour: 3-6 mi.
Typical Time / Full Charge: 14-90 hrs

Level 2 Charging – *208/240 Volts AC*
Range Per Charging Hour: 15-30 mi.
Typical Time / Full Charge: 3-9 hrs

Level 3 Charging – *208/480 Volts DC*
Range Per Charging Hour: 100-200 mi.
Typical Time / Full Charge: 10-45 mins

The installation and expansion of DCFC charging infrastructure is critical to not only accelerating the adoption of electric vehicles, but also allowing the possibility for such clean vehicles to travel across the Texas and reduce emissions. This also "future proofs" the TCEQ's investment allowing for later station upgrades or expansion to include heavy-duty vehicles.

RECOMMENDATION #7- Charging Station Network Type

Require Networked ("Smart") Charging Stations for all locations.

There are 2 types of charging stations: networked ("smart"), and non-networked ("dumb"). Networked stations can track energy usage, monetize and control access to stations. Non-networked stations do not, as they only supply power to the end user. Mixing these types of within a portfolio could prove to be difficult to manage. See further details below:

Networked

Pros:

- Tracks energy usage, time of use, kilowatts, expense, etc.
- Allows utility companies take control of time and rates of charge for demand usage and for grid reliability purposes
- Can digitally advertise locations, availability and real-time rates/updates to consumers
- Can monitor the station status for real-time updates and speedy maintenance time
- Can access to multiple users for easy administrative control and usability
- Can provide support when troubleshooting/repairing inoperable stations when multiple layers of management and ownership are involved.

Cons:

- More expensive, due to weatherized enclosures and commercial grade materials/technology
- Requires ongoing network fees

Non-Networked

Pros:

- Cheaper
- Ability to secure the station, although limited, usually behind gated access points.

Cons:

- No ability to track energy usage, time of use, kilowatts, expense, etc.
- Limited access control

RECOMMENDATION #8 – Charging Point Protocol

Require Open Charge Point Protocol (OCPP) networked charging.

There are 2 different types of networked charging stations. An Open Charge Point Protocol (OCPP) network and a Closed Off network. An OCPP network gives you the ability to use different network providers to manage and control your charging station assets, while the Closed Off network is owned and operated by the charging station manufacturer. We do not recommend mixing these types of within a portfolio.

OCPP

Pros:

- Flexibility in choosing your network provider.
- Open API allows easy integration with other applications like customer rewards/loyalty apps.
- Allows you to switch network providers without changing out the station if provider goes out of business.
- Managed charging for Vehicle to Grid V2G operability (this allows for better management of the load on the grid)
- Enables demand charging & usage via monitoring and managing capabilities
- Easy ownership of several OEMs when monitoring all assets under one dashboard
- Metrics for monitoring utilization of stations for future scalability needs

Cons:

- Network providers do not have comprehensive integration with charging hardware, which can prove to be difficult when diagnosing problems, addressing warranty issues, or scheduling repairs.

Examples of OCPP Networks:

- Greenlots https://greenlots.com/
- EVconnect https://www.evconnect.com/
- EVgo https://www.evgo.com/
- JuiceNET https://emotorwerks.com/products/juicenet-software/juicenet
- SemaConnect https://www.semaconnect.com/

In addition to open networks, there are a few **Software-as-a-Service (SaaS) platform networks** that are architected to support EV industry communication standards such as OCPP, SAE J1772, 15118, and OpenADR as well as other API-based communications and control systems.

Closed Off Network

Pros:

- One company handles the station manufacturing and station networking.
- One company to diagnose problems, address warranty issues, and schedule repairs.

Cons:

- If manufacturer goes out of business, you would have no choice but to replace all stations.
- If manufacturer raises networking fees you would have no choice in switching over to competitors - without replacing all charging stations inside the portfolio.

Examples of Closed off Networks:

- ChargePoint https://www.chargepoint.com/
- Tesla https://www.tesla.com/supercharger

RECOMMENDATION #9 – Charger Connector Port Standards for Inter-Connectability and Inter-Operability

Require dual standard DCFC stations that support both CCS and CHAdeMO connectors to serve the greatest number of electric vehicles.

Every electric vehicle (EV), has a charging port. Some have only one (e.g. Tesla), while others may have two separate ports (e.g. the Nissan LEAF with standard SAE J1772 + CHAdeMO). Some even have a combined charging port set-up, (e.g. Chevrolet BOLT with standard SAE J1772 & CCS). It's important to know what types of connectors are included for the massive amounts of EVs currently on the marketplace and to know how each individual differs to the other regarding operability.

LEVEL 1, 2 & 3 Connectors

The Society of Automotive Engineers' (SAE) is the institution that currently sets the standard for EV charging operability and standards world-wide. The SAE J1772 connector was specifically designed to hold as the industry's standard for all EV charging via Level 1 & Level 2 charging. It is currently embraced and being used by every EV Original Equipment Manufacturer (OEM), with the exception to Tesla. SAE's standard is the Combined Charging System (CCS). This dual connector operability holds much added value and connectivity utilization to EV customers world-wide electing to use either Level 1, 2 or 3 charging systems

The **"connector war"** is usually defined as the EV charging connectivity difference between these two different types of set-ups. **Tesla vs. SAE (Society of Automotive Engineers**. Every EV on the market world-wide, with exception to Tesla, possesses the standard **SAE J1772** connector charging port. Some countries possess varying types of the **J1772** set-up, e.g. Type 1 (US) vs. Type 2 (Europe). Tesla's possess their own charging port standard, the Tesla connector. Thus, the connector war can be seen to be between these two-charging standard, much like that of Microsoft vs. Apple.

In order to really tackle and satisfy all 3 major DCFC connections in America (CCS, CHAdeMO & TESLA) we can simply look into what companies in Europe are doing by investing in stand-alone cylinders alongside each station that hold a single Tesla CHAdeMO adaptor for all Tesla model EVs. Since Tesla is one of the major OEM players in the EV world, and they protect their IP by privatizing their connector type**, this is a perfect solution offering us the ability to satisfy all 3 major DCFC connector standards**

where stations today - or even in the near future - are not being manufactured for all 3 DCFC standards. Adopting this standard can offer TCEQ some level of **protection against stranded assets.**

SAE J1772 & CCS

Inlet\Connector	TYPE 1 	COMBO 1 
TYPE 1 	AC Charging Single Phase	Does not mate
COMBO 1 	AC Charging Single Phase	DC Charging

Tesla connectors are specifically designed and outfitted to only charge Tesla manufactured EVs. Tesla holds their connector technology as proprietary. No other EV can charge on Tesla's charging network other than Teslas. Tesla does manufacture adaptors that couple with their connector, which allow them to use any SAE J1772 charging connector. This dual operability holds much added value and connectivity to Tesla customers and their overall, overarching charging infrastructure access and claim to utility. This Tesla connector handles all 3 charging standards through the same port, Level 1, 2 and 3 charging.

TESLA

LEVEL 3 (DCFC) Connectivity:

In addition to SAE's CCS standard for Level 3 charging and Tesla's Level 3 standard - China (being the largest and most abundant EV marketplace in the world) created their own Level 3 charging standard known as CHAdeMO. **The Asian market**, which includes China, Japan & Korean OEMs**, has embraced the CHAdeMO as the more popular Direct Current Fast Charging (DCFC) standard** as it possesses the ability to not only deliver power to the vehicle, but also allow bi-directly power distribution from the EV's battery pack back to a centralized storage resource or back to the grid which is essential for V2G applications. **This standard is becoming very popular with utility companies world-wide.**

CHAdeMO

Below is a sample product of **a multi-standard dual port DC fast charger.**

This solution will satisfy all 3 major DCFC connector standards and offer TCEQ some level of protection against stranded assets.

Heavy Duty vehicle charging

When it comes to larger industrial sized charging standards or what some would say as the future of electric vehicle & autonomous charging with that of wireless charging there are a few standards inside each that are important to our outlook on operability and standards. SAE's J2954 standard was just locked-in as the industry's standard for wireless charging technologies. There are off-board top-down charging systems across the world delivering public transportation systems, such as e-buses with system's like ABB's OPP charge, etc. There are also some bottom-up pantograph mounted systems as seen on some public e-bus roofs. The electric bus is driven underneath the charging station, which consists of a bipolar catenary. The bus driver starts the charging procedure by raising the pantograph to the catenary, and stops it by lowering the pantograph again. SAE's J3105 overhead e-bus charging systems are compatible with both roof-mounted pantographs as well as inverted pantograph systems, offered by Schunk and other suppliers.

RECOMMENDATION #10 – Site Design Recommendations

Install all electrical infrastructure systems to account for at least four 150kW DCFC station stalls. To protect TCEQ's investment, the agency should partially fund oversized conduit, electric boxes and transformer pads to account for future increases in the number of chargers and later upgrades for heavy duty charging stations.

Sites need to be designed to have the proper electrical infrastructure for stations to operate properly. Understanding how these stations work is key to designing the proper electrical infrastructure. Due to the accelerated adoption of EVs it is important to **design sites for future scalability and expansion of charging stations**. This can reduce future expansion costs considerably with smart planning and design. Future proofing sites should include extended ease of accessibility, installing over-sized conduit, larger transformer pads and installing excess panel capacity. **Ease of access** is important for all around customer satisfaction. Sites should be designed so drivers can easily access stations, getting in and out efficiently.

RECOMMENDATION #11 - Consumer Protections and Pricing

Charging companies should disclose the price to charge to customers prior to purchase including any variations of price based on time of use, utility company demand, peak power charges, etc.

RECOMMENDATION #12 - Protecting Stranded Assets in Case of Charging Company Bankruptcy

TCEQ should develop with a mechanism to assure protect its investment in the case that a charging company goes bankrupt.

This mechanism would assure than successor companies could take over the station so that it does not become a stranded asset. Requiring OCPP can assure that the charging station can be electronically reused.

RECOMMENDATION #13 – Allow Long-Term Leases for Charging Stations

The TCEQ should allow long-term leases to suffice and the grantee should provide TCEQ with a copy of the provisional agreement

Typically, the grantee will own and operate the station that is on a site hosts' property under a long-term use agreement. The grantee may or may not pay to lease the site, but should provide a copy of the provisional land-use agreement to the TCEQ.

RECOMMENDATION #14 - Funding Equity

Reserve a 25% Charging Infrastructure Set-Aside for multi-family apartment complexes, street-side charging units, and public facilities in low-income communities.

Equity should be a core value as we embark on this new electric transportation future, and therefore, we should ensure that charging stations be located equitably across Income classes. **22% of Texans are poor**. Low income communities **have historically been exposed to far higher levels of diesel particulates**, affecting their health at a greater proportion than the general population. More than **50% of low-income families rent**, and a whopping **30.2% of their income goes to transportation contrasted**

to just 13% for average families. Electric vehicles can significantly reduce the transportation costs for this population as studies prove time and again that the **fuel and maintenance costs of owning an EV are about one-third** of that of a conventional gasoline-fueled car. Moreover, a *Consumer Reports* study found that currently significantly **cheaper to buy a used EV** than a similar quality gasoline-fueled car – and *Edmunds* recently reported that the **top five fastest-selling used cars right now are all *Hybrid and Electric vehicles***. Clearly, this is a keenly appropriate time in our state's transportation funding process to provide for low-income accessibility to electric vehicle charging infrastructure.



RECOMMENDATION #15 - Heavy Duty Vehicle Reimbursement

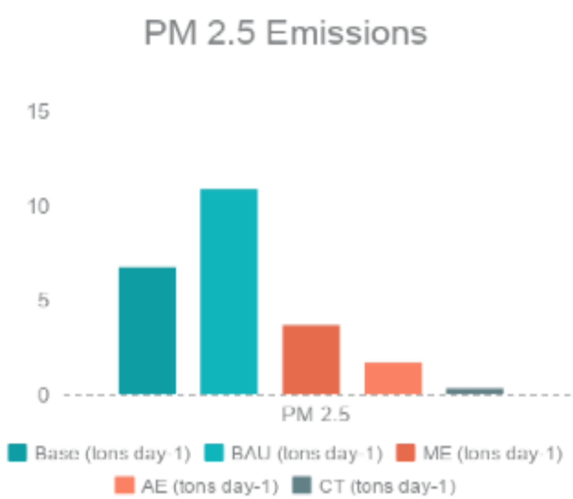
The Heavy-Duty Vehicle reimbursement should be increased from 60% to 80% to provide a "tipping point" incentive large enough for the trucking industry to electrify, thereby reducing diesel emissions significantly.

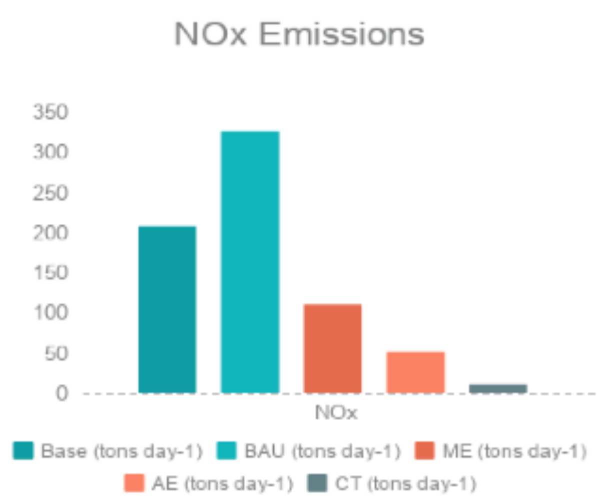
A fleet owner that participates in this program will have to destroy the engines of the vehicles replaced, losing resale value. Increasing the incentive payment to 80% will help offset that lost income stream.

A recent report by *University of Houston* Researchers for *Public Citizen* entitled the Evaluation of the Air Quality Impacts of New Technologies, Emissions Controls and Fleet Electrification in the Houston Metropolitan Area for the Year 2040 found that electrification of the fleet of heavy duty trucks in the Houston areas could have a profound effect on NOx and PM 2.5 emissions in the Houston area. This study demonstrate why investment in electric heavy-duty vehicles is such a wise idea.

The Business As Usual (BAU) case represents a "worst case" scenario with no new technology vehicles being incorporated into the fleet - and without the existing fleet being retrofitted. The Moderate Electrification (ME) case is based on the assumptions of *a Bloomberg New Energy Finance* (BNEF) 2016 report which predicted that 35% of global vehicles would be electric by 2040. The Aggressive Electrification (AE) case assumes a fraction twice that of the ME case (70%). Complete Turnover (CT) represents a scenario where the total fleet comprises either state-of-the-art technology or electric vehicles.

The charts below illustrate the reduction of PM 2.5 and NOx emissions that would result from each scenario.





The chart below illustrates **the reduction of emissions** from each scenario.

Table 2. Episode-average 8-county aggregate on-road mobile emissions in the BASE case and comparative changes for the future scenarios.

Species	BASE [tons/day]	Difference to BASE			
		Business as Usual (BAU) %	BAU [tons/day]	Moderate Electrification (ME) %	ME [tons/day]
CO	1220.64	48.6	1813.87	-50.0	610.32
NOx	207.51	56.9	325.58	-47.2	109.57
NH3	5.51	50.8	8.31	-49.2	2.80
SO2	1.69	50.9	2.55	-49.2	0.86
PM10	16.88	55.3	26.21	-47.7	8.83
PM2.5	6.75	61.1	10.87	-45.8	3.66
non-HAP TOGs	72.81	48.3	107.98	-50.1	36.33
Benzene	2.47	46.3	3.61	-50.8	1.22
Formaldehyde	1.66	60.5	2.66	-45.8	0.90
Acetaldehyde	1.15	54.3	1.77	-48.0	0.60
Acrolein	0.11	63.1	0.18	-45.1	0.06
1,3-butadiene	0.44	46.5	0.64	-50.7	0.22
Naphthalene	0.21	58.1	0.33	-46.8	0.11
N2O	3.19	44.5	4.61	-51.4	1.55
CO2	92967.76	52.4	141682.87	-48.7	47692.46
CH4	3.33	54.0	5.13	-46.8	1.77

Species	BASE [tons/day]	Difference to BASE			
		Aggressive Electrification (AE) %	AE. [tons/day]	Complete Turnover (CT) %	CT [tons/day]
CO	1220.64	-76.6	285.63	-95.2	58.59
NOx	207.51	-75.3	51.25	-94.9	10.58
NH3	5.51	-76.2	1.31	-95.1	0.27
SO2	1.69	-76.2	0.40	-95.1	0.08
PM10	16.88	-75.5	4.14	-94.9	0.86
PM2.5	6.75	-74.6	1.71	-94.8	0.35
non-HAP TOGs	72.81	-76.6	17.04	-95.2	3.49
Benzene	2.47	-77.0	0.57	-95.2	0.12
Formaldehyde	1.66	-74.5	0.42	-94.6	0.09
Acetaldehyde	1.15	-75.7	0.28	-94.9	0.06
Acrolein	0.11	-74.3	0.03	-94.7	0.01
1,3-butadiene	0.44	-76.9	0.10	-95.2	0.02
Naphthalene	0.21	-75.1	0.05	-94.9	0.01
N2O	3.19	-77.2	0.73	-95.3	0.15
CO2	92967.76	-76.0	22312.26	-95.0	4648.39
CH4	3.33	-73.9	0.87	-92.9	0.24

21

<u>RECOMMENDATION #16</u> – Minimum DCFCs and "Future-proofing"

Require charging stations to have a minimum of four 150 kW DCFC chargers and fund larger transformer pads and conduit to enable stations to be upgraded in the future to accommodate the demand of four additional 350-kW DCFC chargers which can serve the needs of future light and heavy-duty vehicles and/or be paired with stationary storage.

The DCFC station will connect to the local distribution system in the area through a series of devices which will need to be properly sized to meet the charging demand. Transformer pads and conduit should be oversized to allow for future additional, higher power charging stations to be installed without needing to retrench or pour new pads. Transformers should not be oversized in anticipation of a potential future station upgrade, but rather updated at the time the station is upgraded.

A DCFC station with four 150-kW chargers would have a peak demand of 600 kW and a station with four 350-kW would have peak demand of 1,400-kW (a significant increase in cost of chargers, but not in the conduit and prep labor). Electrify America has announced the deployment of 2,000 350-kW DCFCs by the end of 2019, but vehicles capable of charging at the 350-kW demand (using liquid-cooled cables) are not yet available for sale. 2,000 kW (sufficient for 4x150kW plus 4x350kW) is a significant load addition requiring careful siting and collaboration with the local Transmission and Distribution Provider. For comparison, a large travel center or truck stop may have a maximum demand of 500-kW. The City of Luling, located on IH-10 between San Antonio and Houston, has a population of 5,878 and has a peak electric demand just over 12,000 kW.

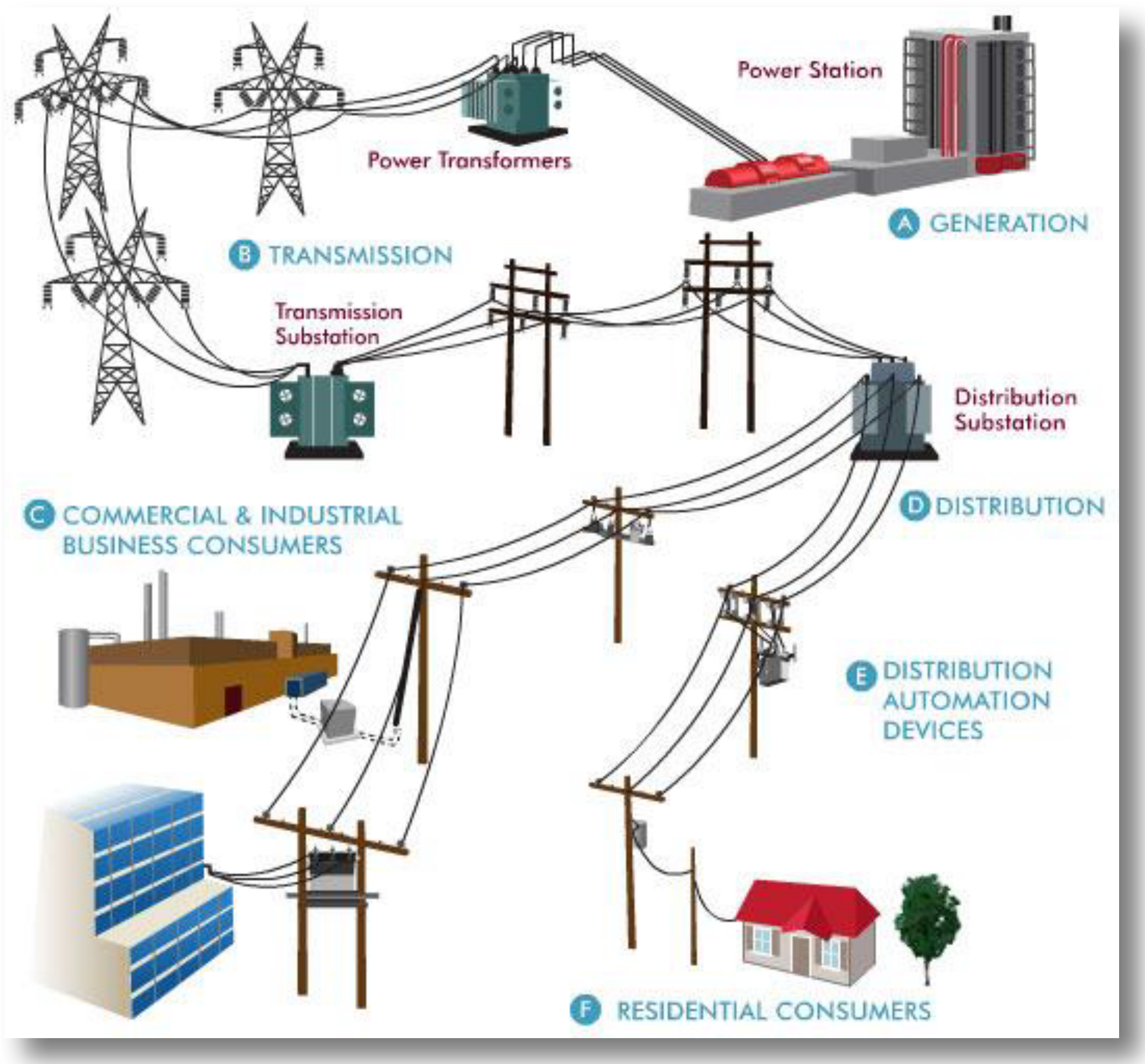
Source for EA Announcement: https://arstechnica.com/cars/2018/04/electrify-america-will-deploy-2000-350kw-fast-chargers-by-the-end-of-2019/

<u>Grid Impact</u>

The grid is used to transport electricity from power plants to electric customers has two major components.

The first component of the ERCOT grid is the transmission system made up of high voltage power lines that transport electricity from power plants to electrical substations located throughout the state. The ERCOT system has over 40,000 miles of electric transmission line operating between 69,000 volts and 345,000 volts. In general, transmission lines operating at higher voltages can carry more power.

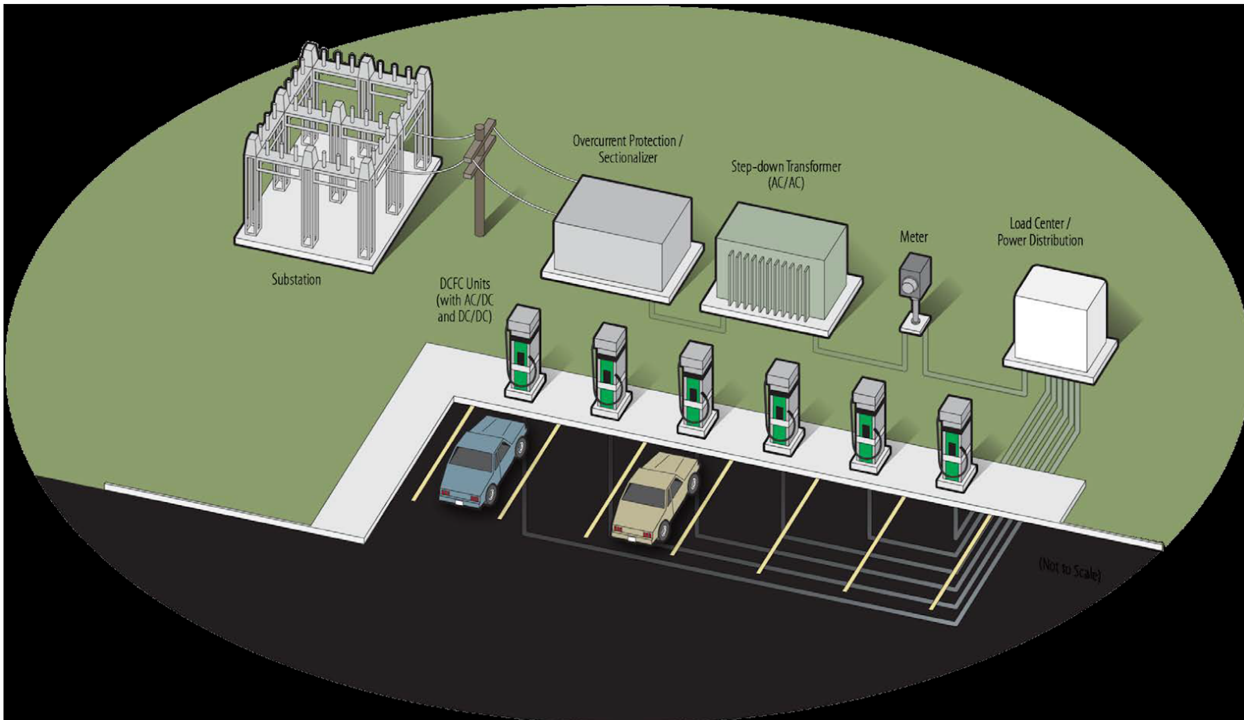
At electrical substations, the high voltage power on transmission system is lowered and delivered to electric customers across the second major component of the grid called the distribution system. In urban areas, some distribution systems can operate at voltages as high as 35,000 volts but most distribution systems in ERCOT are designed to operate at 25,000 volts or 12,500 volts. Distribution lines serving DCFC stations will need to have three separate wires or phases to carry power and a neutral or ground wire on the same pole or in the same conduit.



Source: ONCOR

The impact that DCFC stations will have on the grid will be different for light duty vehicles such as cars and heavy-duty vehicles such as trucks. The impacts to the grid will also vary based upon the number of DCFC stations in a particular location and the charging time for the vehicles.

The DCFC station will connect to the local distribution system in the area through a series of devices which will need to be properly sized to meet the charging demand. A DCFC station with six 50-kW chargers would have a peak demand of 300 kW and a station with six 150-kW would have peak demand of 900-kW. For comparison, a large travel center or truck stop may have a maximum demand of 500-kW. The City of Luling, located on IH-10 between San Antonio and Houston, has a population of 5,878 and has a peak electric demand just over 12,000 kW.



Source: Idaho National Laboratory

Level 1 and 2 charging has minimal grid impacts, but stations of multiple high power DCFC can present challenges to the distribution system in some cases. Typically, these deployments will require some distribution system upgrades to deploy including transformers and conduit. In some locations, the local substation may need to be upgraded. When siting DCFC stations an analysis of the power availability should always be an early step and a requirement for applicants

EV charging equipment often has charge management capabilities. Utilities can develop programs to utilize the ability to curtail load from DCFC to help balance the grid in certain circumstances. EV charging infrastructure developers should inquire with the site's electricity provider to learn about and comply with any such programs.

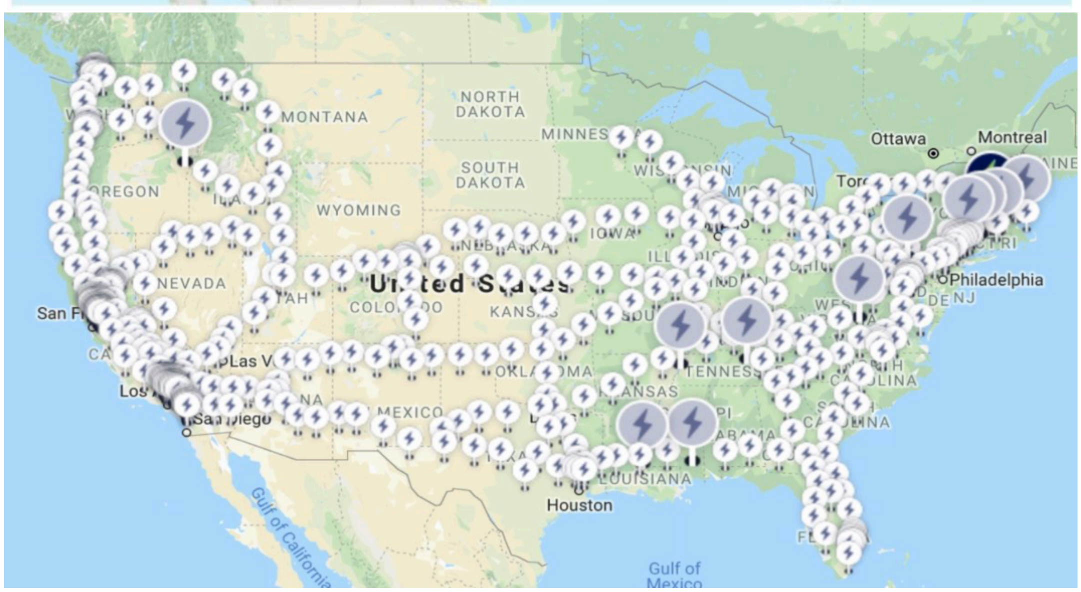
Electrify America Plan

These maps show where Electrify America is planing their to put chargers.

- **<u>First Phase</u>**
  I -35 Corridor and Houston

  <u>Second Phase along Interstates</u>
  Estimated 64 stations
  About 77miles apart –max 120 miles

Appendix A: Map of Designated EV Corridors



Approximate Locations by Electrify America

Location	TxETRA Plan	TxEV Station No.	EA No.
Socorro	Yes	7	1a
Van Horn	Yes	6	2a
Intersection of Hwy20 and Hwy10	No	-	3a
Odessa	Yes	32	4a
Ft. Stockton	Yes	5	5a
Howard	Yes	41	6a
Abilene	Yes	30	7a
Decatur	No	-	8a
Collin	No	-	9a
Gainsville	Yes	43	10a
Sulphur Springs	Yes	35	11a
Waco	Yes	20	12a
Round Rock	Yes	19	13a
San Marcos	Yes	56	14a
Kernville	No	-	15a
Ozona	Yes	3	16a
Buffalo	Yes	24	17a
Huntsville	Yes	50	18a
Houston	Yes	16	19a
Amarillo	Yes	39	20a
Shamrock	Yes	42	21a

Other Texas charging programs that offer Level 3 DCFC charging include, **Tesla, EVgo, Austin Energy,** and **Blink.**

Cost Estimates:

TxETRA estimates the cost of a four 150kW DCFC station is approximately $250,000. With 78 stations recommended in this report, the required funds to complete this phase of EV infrastructure coverage would total $19.5 Million. **Assuming a 50/50 split between VW funds and private investment, VW funds would cover $9.75 Million for the DCFC infrastructure.**

The charging infrastructure set-aside for multi-family apartment complexes, street-side charging units, and public facilities in low-income communities in **recommendation #14 would amount to $7.6 Million.** With $30.4 Million of VW funds available, there would be **$13.05 Million ($30.4 - $9.75 -$7.6 Million) available for additional DCFC stations or for other purposes.**

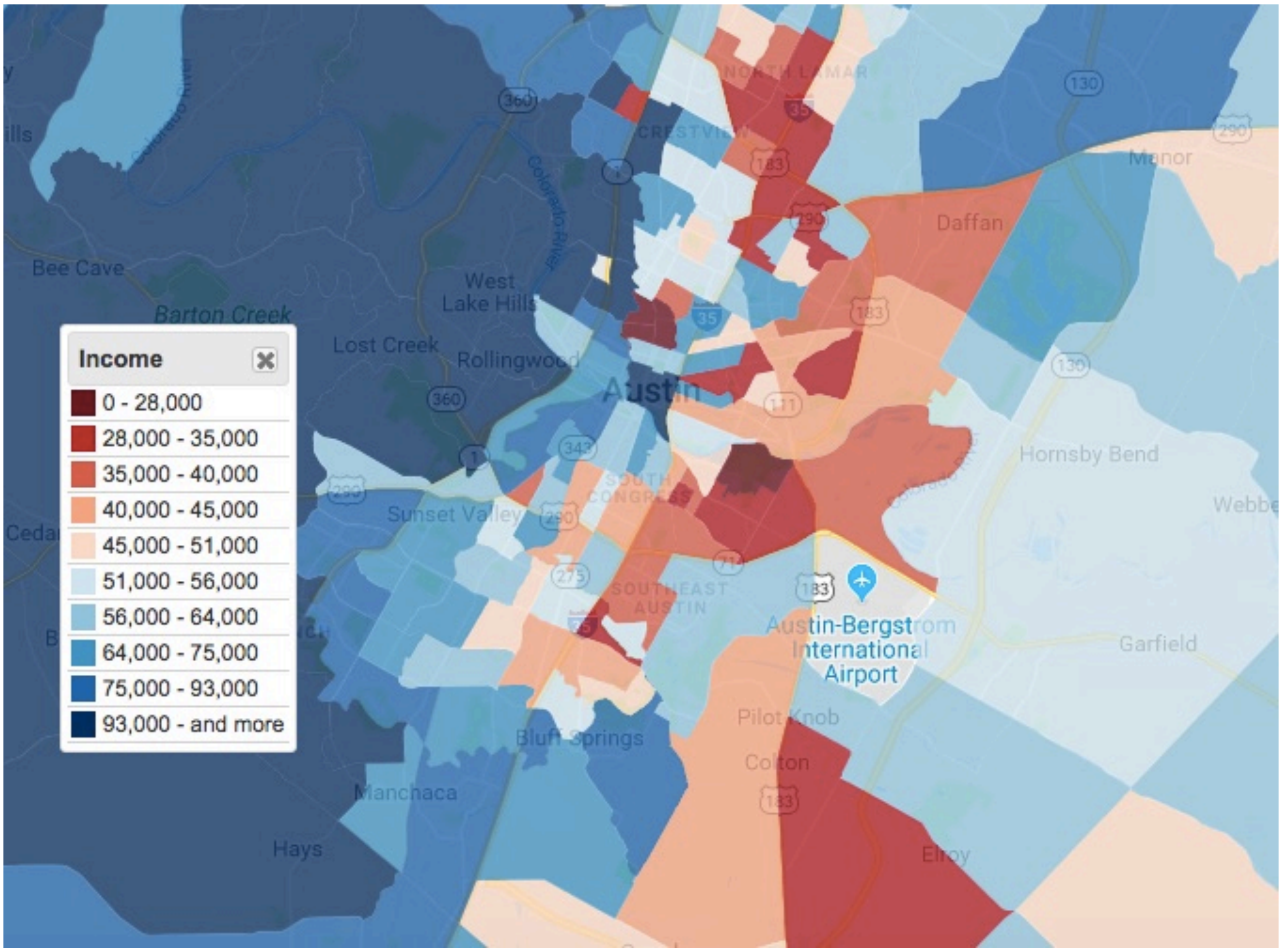
Conclusion:

The TCEQ's decisions on the standards and locations used to deploy charging stations across the state can have profound impact on the evolution of the electrified transportation system in Texas. If the right standards for equipment and location are put in place it can dramatically reduce pollution resulting from the transportation section by increasing consumer confidence. The decisions made in about standards in this round of grants can help assure that TCEQ's investment will pay off for many years to come. In addition, it can lay the paving stones to shift low-income families from high cost gasoline powered vehicles to lower cost EVs while reducing pollution in their communities.

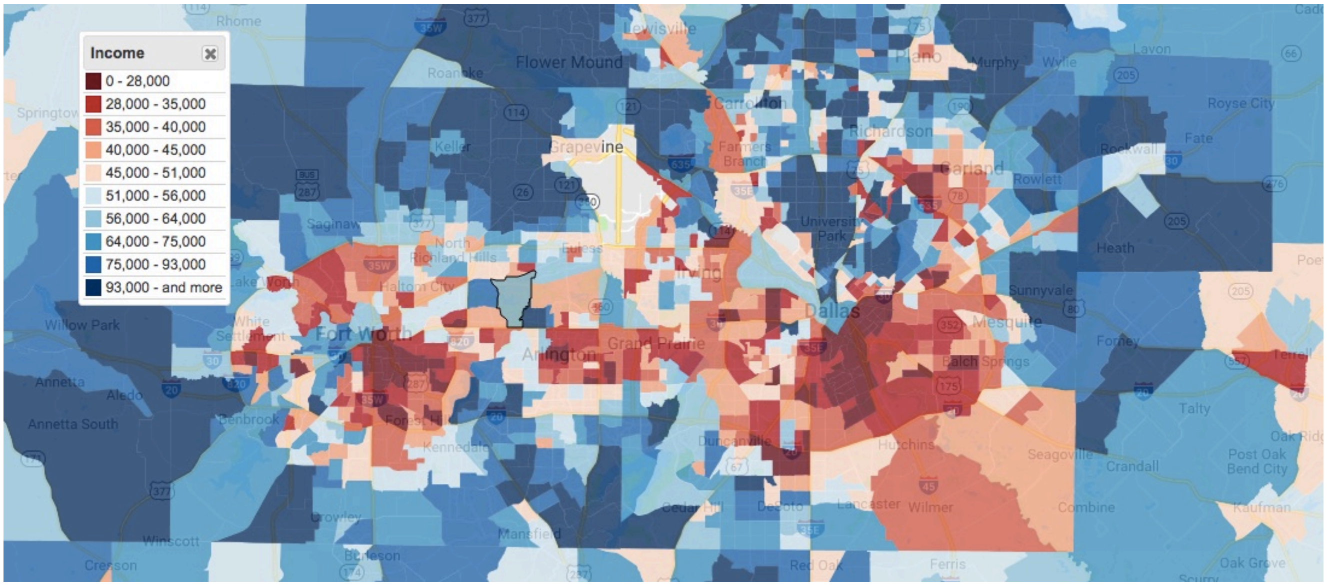
Texas Low Income Maps.

The following maps were produced by Justice Map (http://www.justicemap.org) – an organization of national subject area experts and information technology specialists that produces high income resolution maps of race and income in the United States. This free interactive mapping tool provides unprecedented insight into the racial and socioeconomic composition and enables users to represent race and income data in visually compelling digital maps that can be annotated and exported.

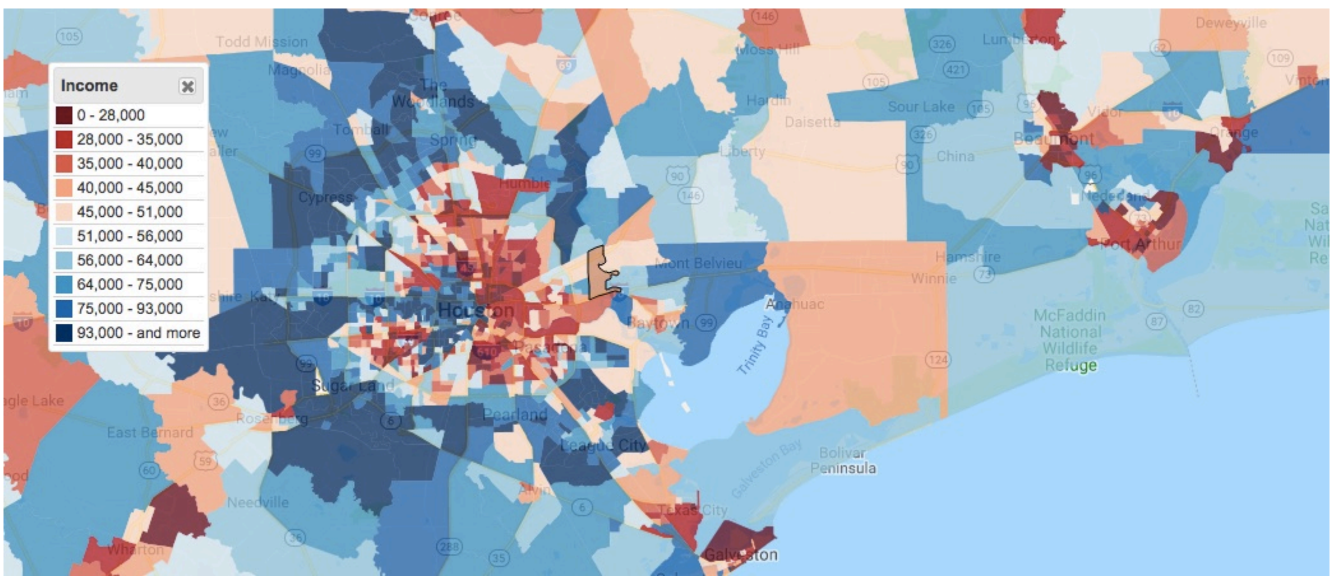
Austin



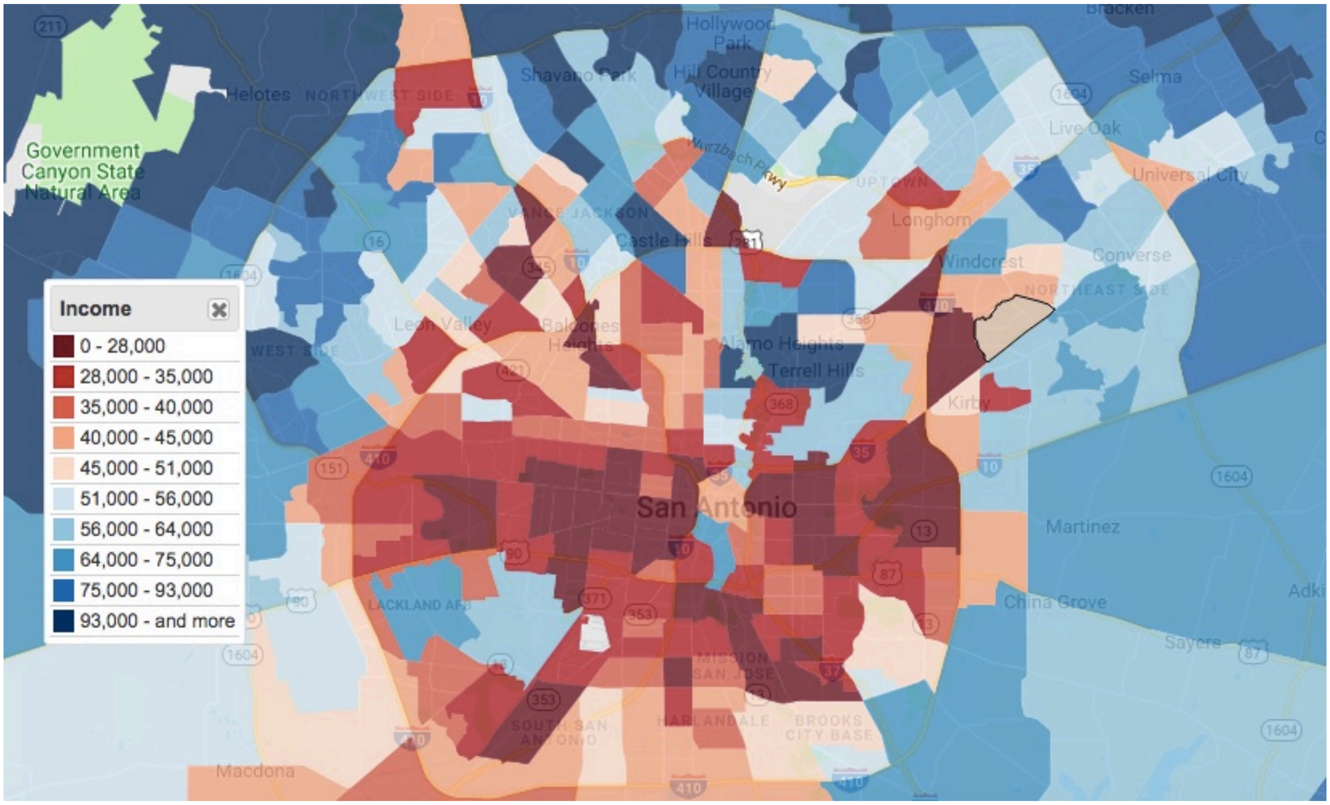
Dallas-Ft. Worth



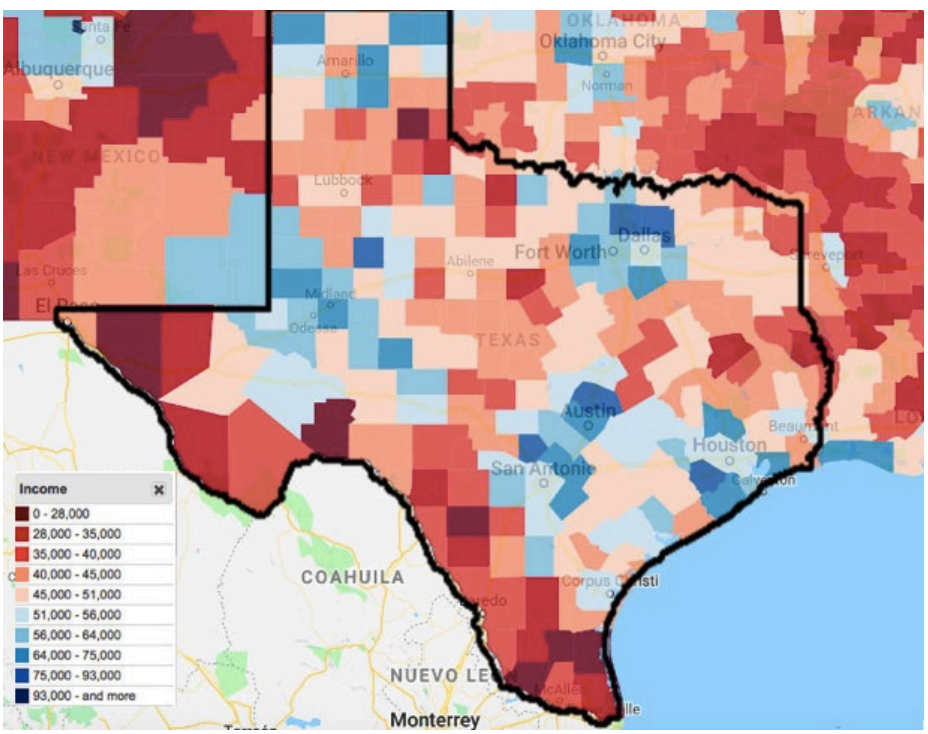
Houston



San Antonio



Texas



References:

Source	Link
From Gas to Grid: Building Charging Infrastructure to Power Electric Vehicle Demand RMI	https://www.nrel.gov/docs/fy17osti/69031.pdf
NREL	
Plug in America	https://pluginamerica.org/get-equipped/find-an-ev-charging-station/
Evergy.GOV	https://www.energy.gov/science-innovation/vehicles
Evergy.GOV	https://www.nrel.gov/docs/fy17osti/69031.pdf
Edison Electric	http://www.eei.org/future/Pages/story.aspx?sid=124_National
Drive Electric Week 2018 National Plug-in Electric Vehicle Infrastructure Analysis	https://www.nrel.gov/docs/fy17osti/69031.pdf https://greentransportation.info/ev-charging/range-confidence/chap8-tech/ev-dc-fast-charging-standards-chademo-ccs-sae-combo-tesla-supercharger-etc.html
EV DCFC standards – CHAdeMO, CCS, SAE Combo, Tesla Supercharger, etc.	http://www.electrictechnologycenter.com/pdf/Volume%202%20CCET%20-%20Texas%20Triangle%20Plan%20Oct%202012.pdf
Electrify America	https://www.electrifyamerica.com/
EVTRIP Planner	https://www.evtripplanner.com/efficiency.php
EVgo	https://www.evgo.com/
Tesla	https://www.tesla.com/supercharger
DOE	https://www.afdc.energy.gov/laws/