ENERGY STORAGE and ELECTRIC VEHICLES (EV)

Bill Muston

Oncor Electric Delivery Company LLC

Joint Session: IEEE Dallas Communication and Vehicle Technology Chapter (CVT) and Dallas Electric Club (DEC).

March 16, 2021

Disclaimer

Scope & Disclaimer

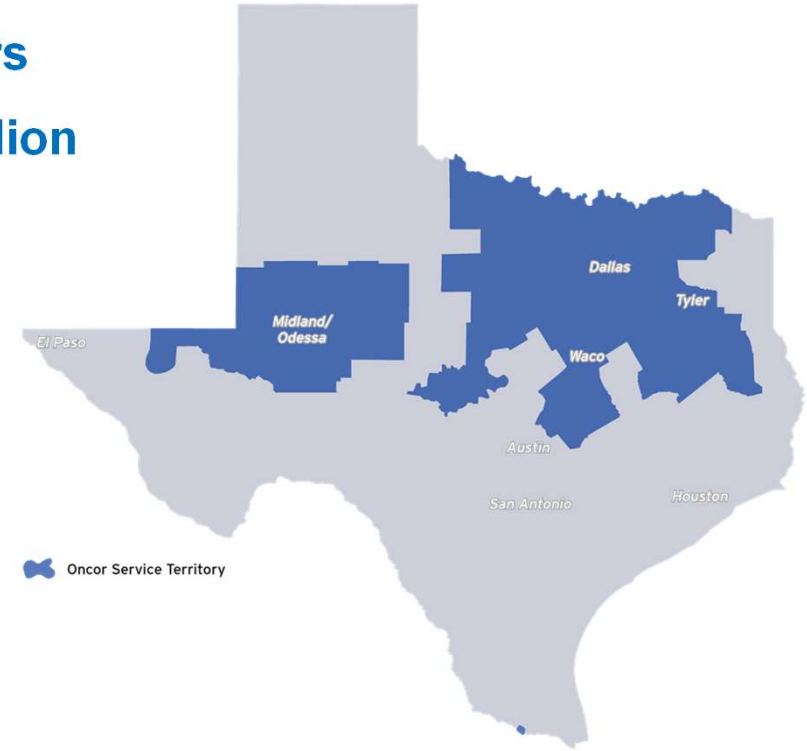
This presentation is intended to be broad in scope. It will include a range of energy storage system (ESS) applications in the power grid.

The applications and examples cited in this presentation are general in nature and are not specific to market structures, nor are they specific to Oncor or even related to the business of Oncor under market structure and rules set by the PUCT.

ONCOR

- **Distribution**
- **Transmission**
  - Move energy to distributors
  - Open access
- **Distribution**
- **Interconnections**
- **Metering**
  - Wholesale
  - Retail

- **3.7+ M Customers**
- **Serving ~10+ Million people**



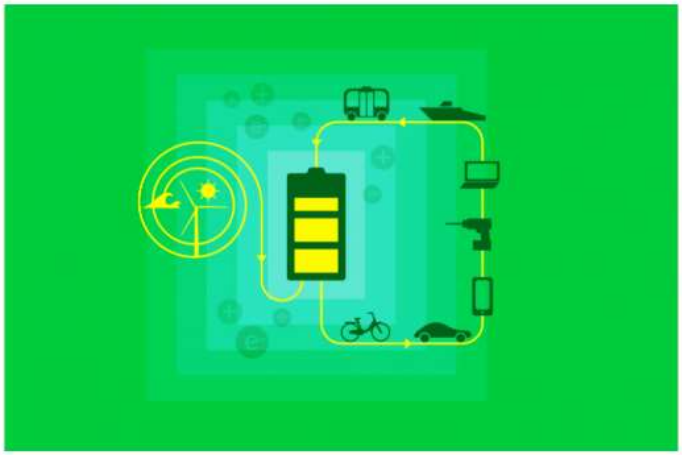
Regulated, investor-owned, utilities in ERCOT
– do not generate or sell electricity –
– but deliver it –

The Nobel Prize in Chemistry 2019

They created a rechargeable world

The Nobel Prize in Chemistry 2019 rewards the development of the lithium-ion battery. This lightweight, rechargeable and powerful battery is now used in everything from mobile phones to laptops and electric vehicles. It can also store significant amounts of energy from solar and wind power, making possible a fossil fuel-free society.

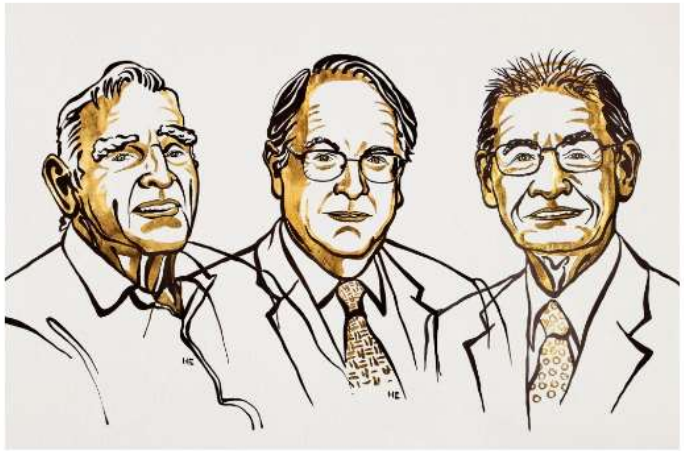
Read the press release
Read more in the scientific background
Find out more in the popular information



© Johan Jarnestad/The Royal Swedish Academy of Sciences

The 2019 Chemistry Laureates

The 2019 Nobel Prize in Chemistry are awarded to John Goodenough, M. Stanley Whittingham and Akira Yoshino "for the development of lithium-ion batteries". Through their work, they have created the right conditions for a wireless and fossil fuel-free society, and so brought the greatest benefit to humankind.

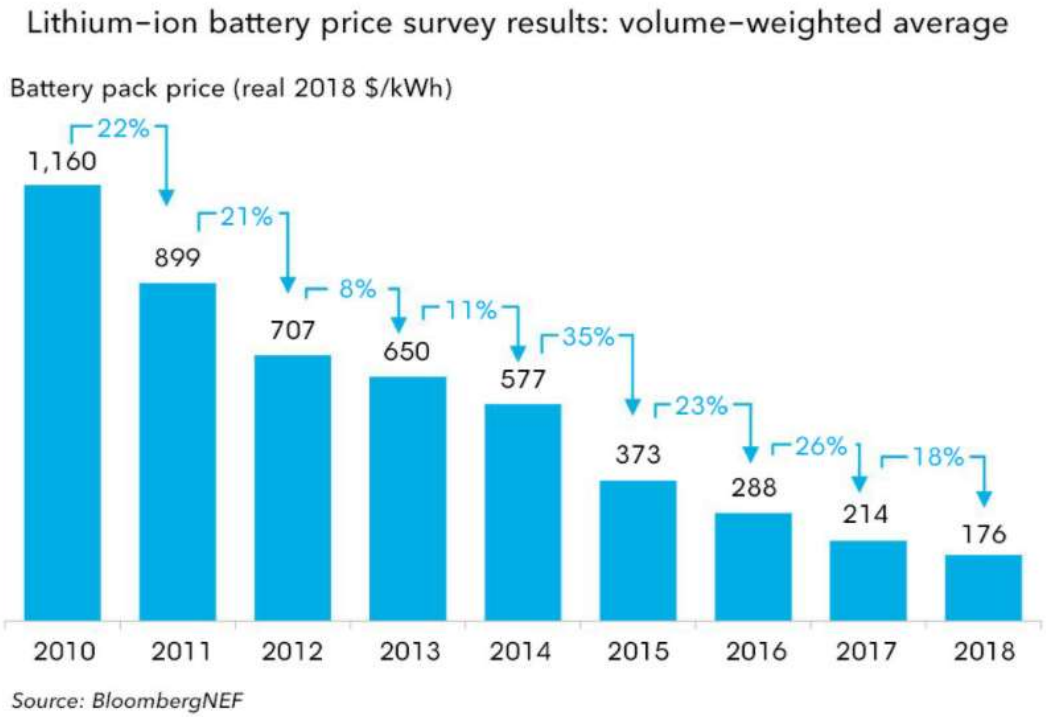


Ill. Niklas Elmehed. © Nobel Media.

THE NOBEL PRIZE

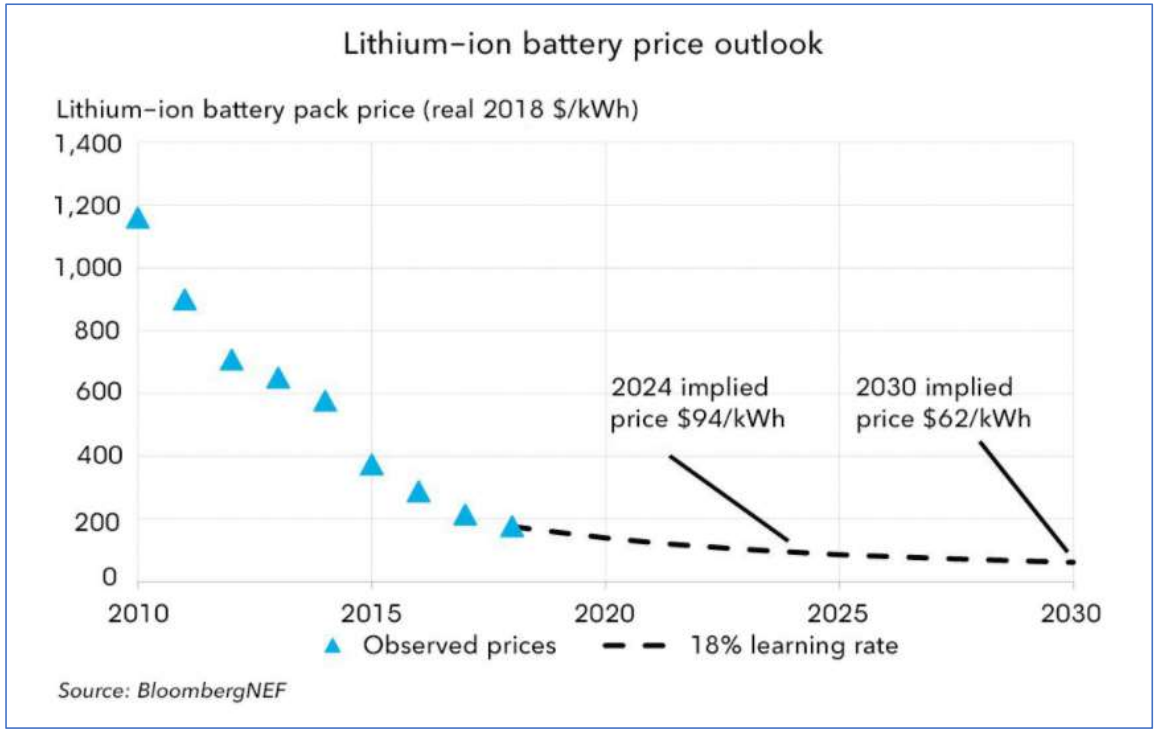
https://www.nobelprize.org/prizes/chemistry/

Bloomberg Battery Price Survey



Source: Bloomberg https://about.bnef.com/blog/behind-scenes-take-lithium-ion-battery-prices/

Bloomberg Battery Price Outlook



Source: Bloomberg https://about.bnef.com/blog/behind-scenes-take-lithium-ion-battery-prices/

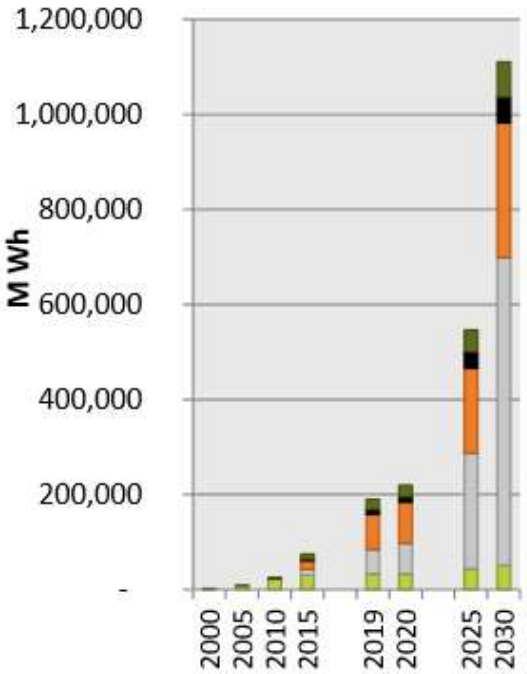
Li-Ion Market Is Dominated by EV Market

… Values as MWh, comprehend COVID-19 impact

From 160 GWh in 2018 to >1,2 TWh

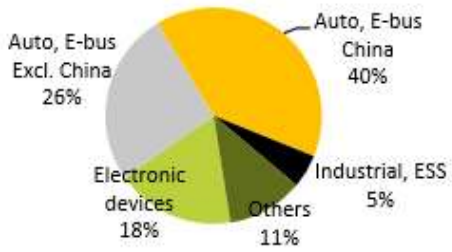
CAGR 2015/2030
+20 % per year in Volume

Li-ion Battery sales, MWh, Worldwide, 2000-2030

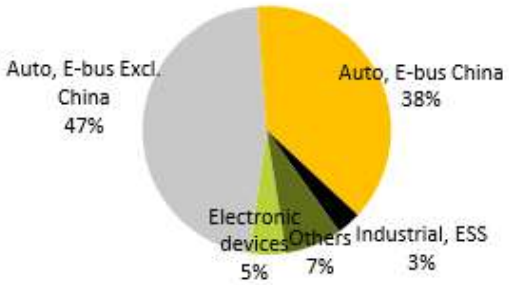


	CAGR 15/30 (Optimistic)
Others	14%
Industrial, ESS	21%
Auto, E-bus China	20%
Auto, e-bus Excl. China	30%
Electronic devices	4%

2019: >190 GWh



2030: >1100 GWh



Others: medical devices, power tools, gardening tools, e-bikes…

Source: AVICENNE Energy 2020 - COVID 19 impact partially implemented as the crisis is not over - Impact could be worst

Tesla ESS at Oncor Microgrid, Jan 2019

WHAT IS ENERGY STORAGE?

A means to transform Grid electricity into another form of energy and return that energy when needed

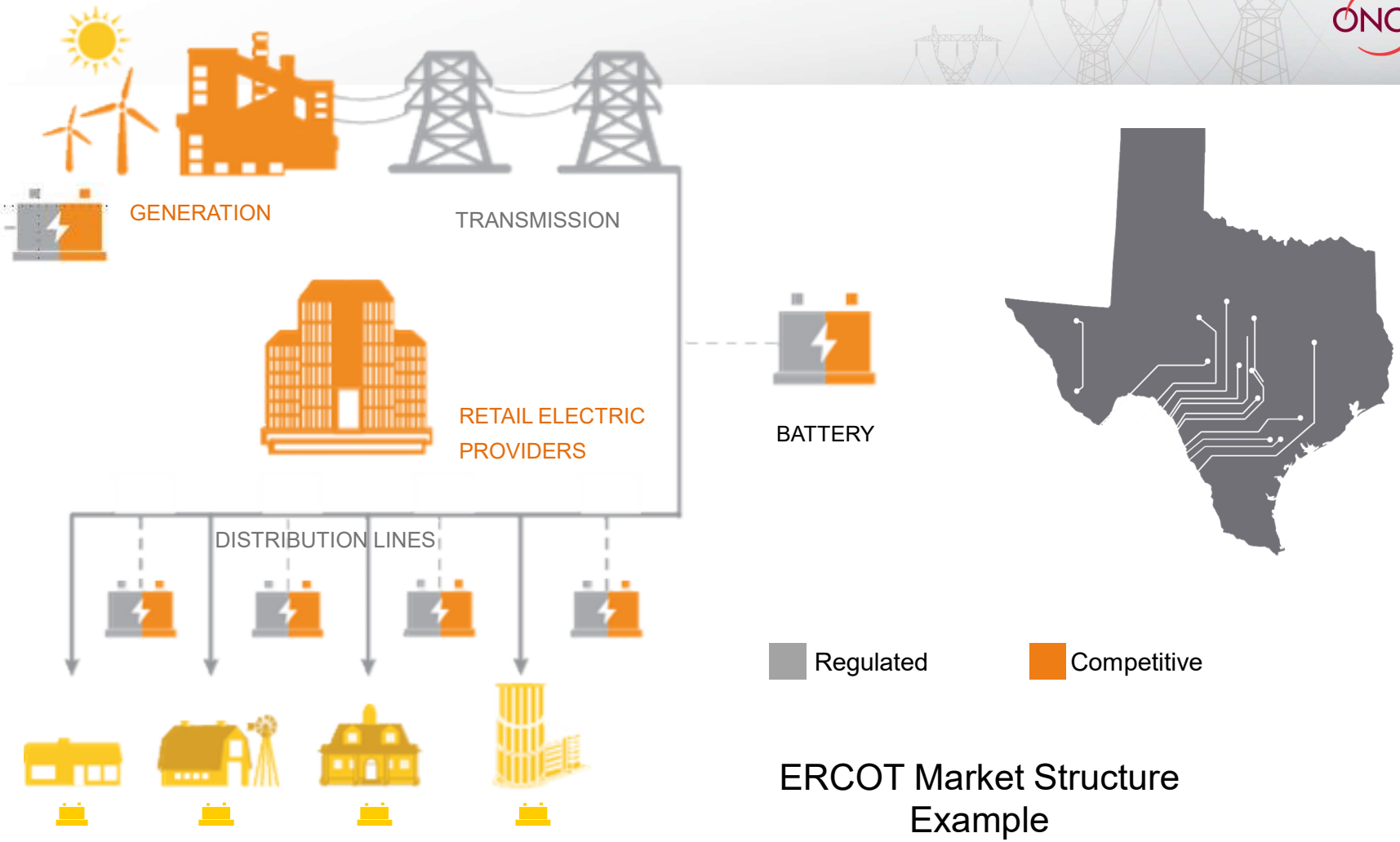
Many forms of energy storage exist

- Pumped Hydro – hydro potential energy
- Battery – Electrochemical
- Battery – Flow battery
- Flywheel – Inertial Energy in Spinning Mass
- Compressed Air – Mechanical Compression
- Liquid Air – Mechanical Compression and Thermal Cooling
- Capacitors – Electrical Charge

Lithium-ion batteries are the new market leader

- **Declining costs**
- **Modular deployment in small, rapid capital increments**
- **Highly flexible and controllable**

Lithium-Ion energy storage is transformative to the grid



ERCOT Market Structure Example

ROLES FOR ENERGY STORAGE

BULK GRID

Wind & solar smoothing & dispatch

Time-shift available energy supply to meet later grid needs

Hedge for upside price opportunity

Reliability services
- Supply regulation
- Frequency regulation
- Responsive reserves for grid contingency
- Fast response

Peaking capacity in ISO's w capacity markets (not ERCOT)

TRANSMISSION

Reliability Role

Meet a short-run N-1 operational need

Economy Role

Market role in ERCOT?

SUBSTATION & DISTRIBUTION

Support a feeder segment during short upstream outages

Defer or substitute for traditional upgrades needed to support growing loads

Integrate distributed energy resources (DERs) to the local grid to maintain grid stability & voltage

Extended-time local area operations with storage as part of a microgrid during outages

CUSTOMER

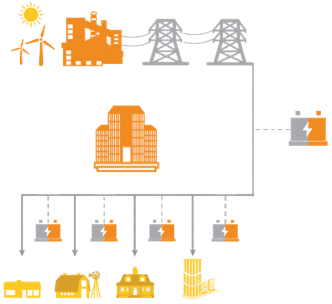
Manage peak demand to limit demand charges

Smooth & firm solar

Time-shift energy from the grid or from customer-sited solar, such as to manage energy use under a time-of-use retail rate

Support site operations during a grid outage

Provide service to utility needs when market structure supports that role & the utility need exists



DESIGN FLEXIBILITY & CHOICES – BATTERY STORAGE

Power: Charge-discharge

Energy: How much

Rapid charge-discharge ➔ High C-rate

Power conversion system (two-way ac/dc/ac converter)

Container & systems

Grid transformer & SCADA

Site meteorological

Site layout

Efficiency –

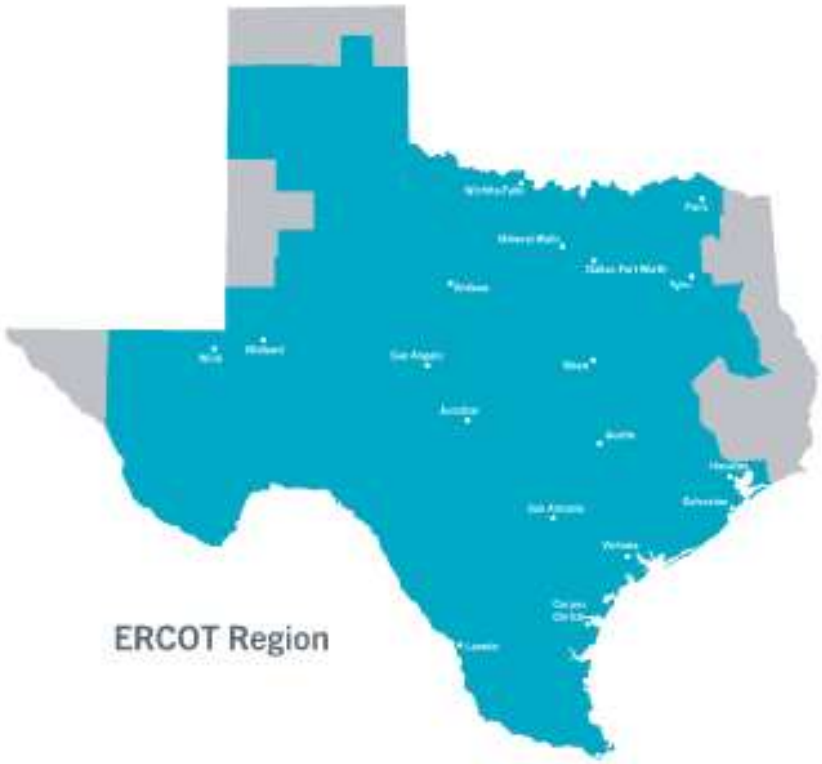
$$kWh_{AC}\ out\ /\ kWh_{AC}\ in$$

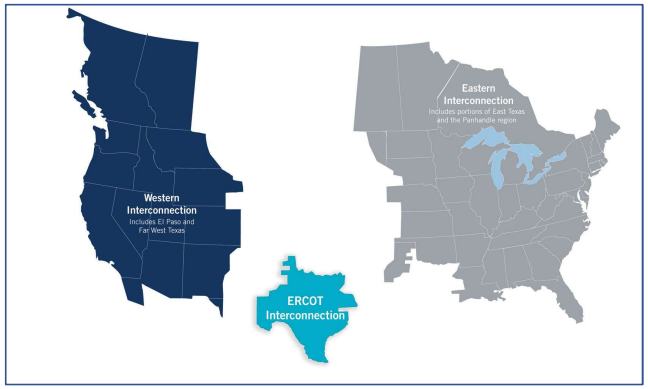
Life – cycles & shelf life

www.kaplanco.com

WHO IS ERCOT

ercot
Your Power. Our Promise.





The Electric Reliability Council of Texas (ERCOT) is a nonprofit organization that ensures reliable electric service for 90 percent of the state of Texas. The grid operator is regulated by the Public Utility Commission of Texas and the Texas Legislature.

ERCOT has four primary responsibilities:

- Maintain system reliability.
- Facilitate a competitive wholesale market.
- Facilitate a competitive retail market.
- Ensure open access to transmission.

http://www.ercot.com/content/wcm/lists/219736/ERCOT_Fact_Sheet_2.1.21.pdf

ERCOT STATISTICS

74,820 MW
Record peak demand
(Aug. 12, 2019)

73,821 MW
Weekend peak demand record
(Aug. 15, 2020)

1 MW of electricity can power about 200 Texas homes during periods of peak demand.

2021 Generating Capacity

Reflects operational installed capacity based on the December 2020 CDR report

**Other includes hydro, biomass-fired units and DC tie capacity*

2020 Energy Use

**Other includes solar, hydro, petroleum coke, biomass, landfill gas, distillate fuel oil, net DC-tie and Block Load Transfer imports/exports and an adjustment for wholesale storage load*

381 billion kilowatt-hours of energy were used in 2020, a nearly 5 percent decrease compared to 2019.

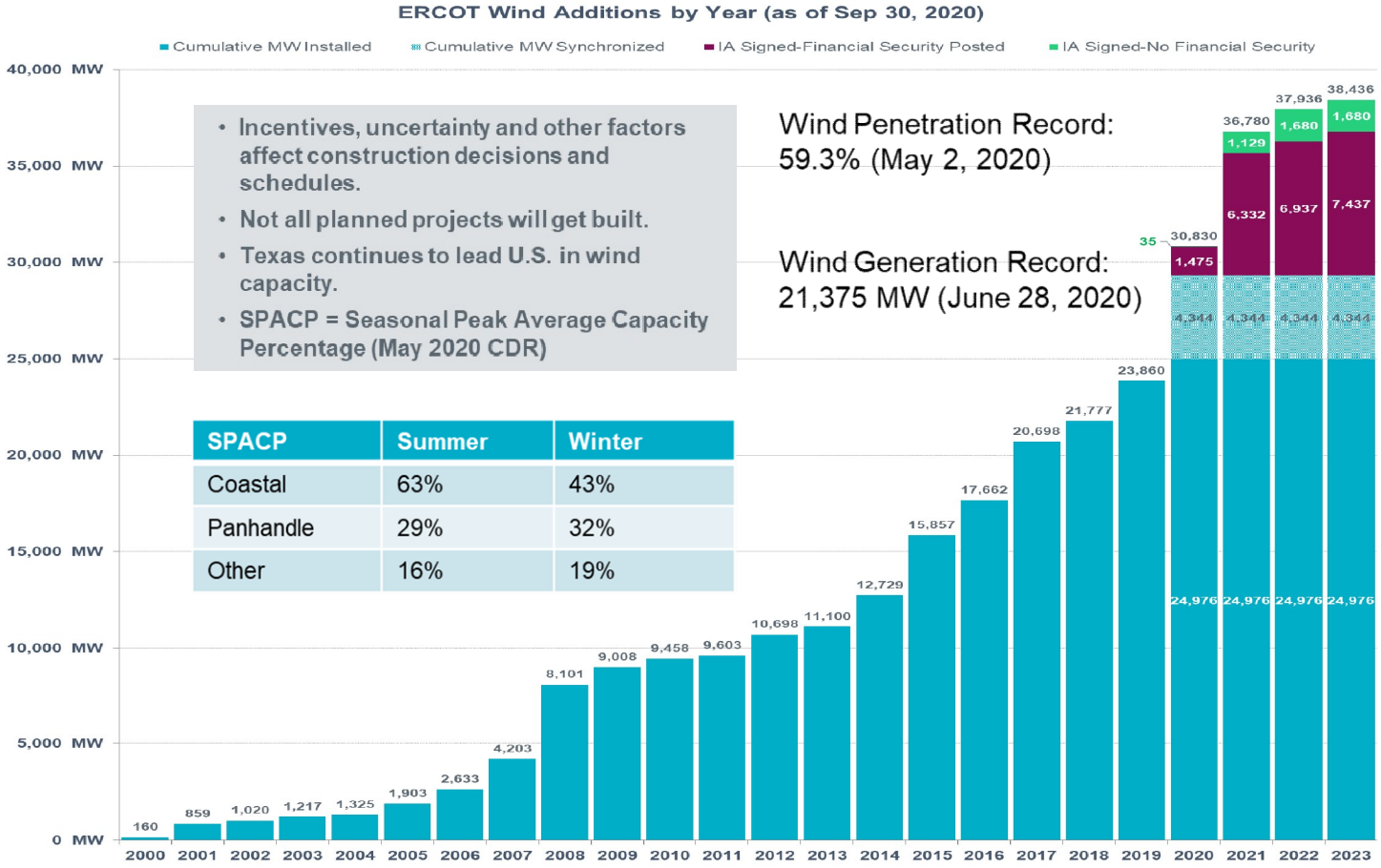
http://www.ercot.com/content/wcm/lists/219736/ERCOT_Fact_Sheet_2.1.21.pdf

ERCOT Energy Storage Overview

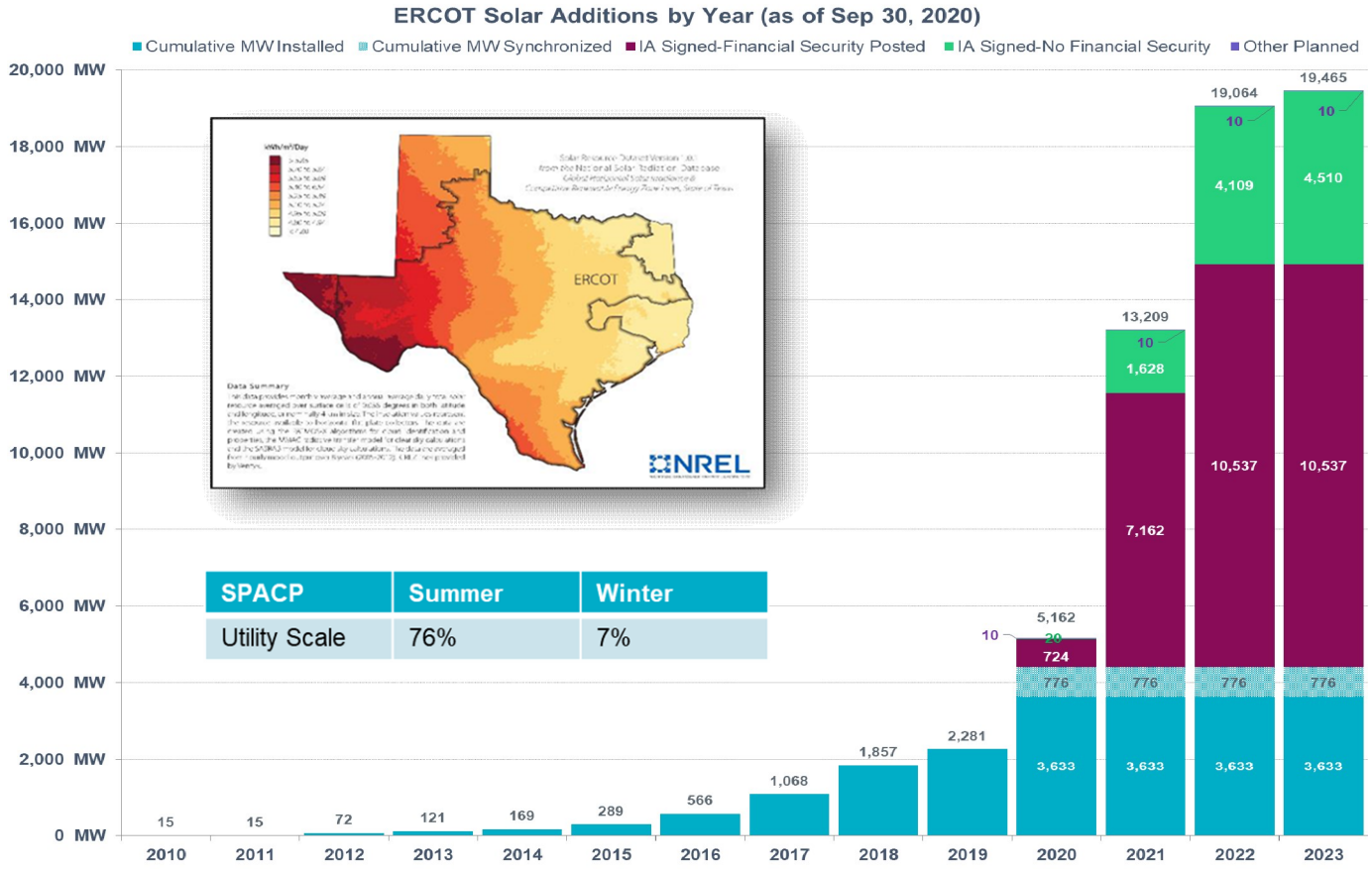
Kenneth Ragsdale
Principal, Market Design
ERCOT

October 14, 2020

ERCOT Wind Additions by Year (as of September 30, 2020)

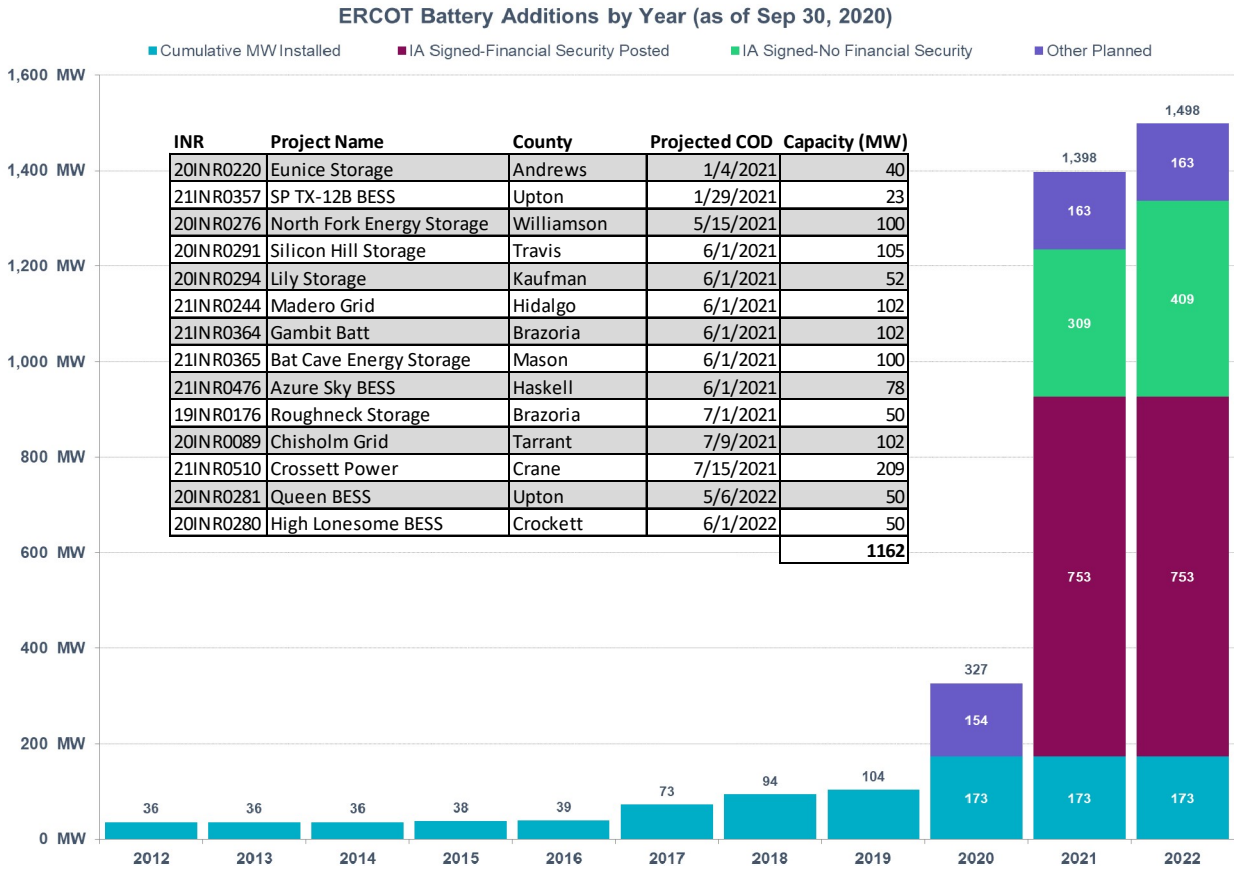


Utility Scale Solar Additions by Year (as of September 30, 2020)



Other Planned capacity reflects registered projects under 10 MW in size that are not included in the Resource Integration and Ongoing Operations Interconnection Services (RIOO-IS) System.

Battery Additions by Year (as of September 30, 2020)



INR	Project Name	County	Projected COD	Capacity (MW)
20INR0220	Eunice Storage	Andrews	1/4/2021	40
21INR0357	SP TX-12B BESS	Upton	1/29/2021	23
20INR0276	North Fork Energy Storage	Williamson	5/15/2021	100
20INR0291	Silicon Hill Storage	Travis	6/1/2021	105
20INR0294	Lily Storage	Kaufman	6/1/2021	52
21INR0244	Madero Grid	Hidalgo	6/1/2021	102
21INR0364	Gambit Batt	Brazoria	6/1/2021	102
21INR0365	Bat Cave Energy Storage	Mason	6/1/2021	100
21INR0476	Azure Sky BESS	Haskell	6/1/2021	78
19INR0176	Roughneck Storage	Brazoria	7/1/2021	50
20INR0089	Chisholm Grid	Tarrant	7/9/2021	102
21INR0510	Crossett Power	Crane	7/15/2021	209
20INR0281	Queen BESS	Upton	5/6/2022	50
20INR0280	High Lonesome BESS	Crockett	6/1/2022	50
				1162

Other Planned capacity reflects registered projects under 10 MW in size that are not included in the Resource Integration and Ongoing Operations Interconnection Services (RIOO-IS) System.

Summary of Generation Interconnection Requests (as of 10-1-20)

Fuel Type/ Technology Type	SS and FIS Completed IA (MW)	Grand Total (MW) In Progress
Natural Gas	1,668	6,494
Coal	0	420
Wind	8,027	**23,679**
Solar	11,128	**77,074**
Compressed Air Storage	0	324
Battery	419	**18,109**
Other	0	350
Total	21,242	126,450

~ 30 % Co-located

Does not include project requests on the distribution system
SS = Security Screening Study
FIS = Full Interconnection Study
IA = Interconnection Agreement

Report run Dec 1, 2019: 7,214 MW
Report run Dec 1, 2018: 2,048 MW
Report run Dec 1, 2017: 0 MW

Questions?

Kenneth Ragsdale
ERCOT

ERCOT Market Example . . . *From Aug 25, 2020 Energy Storage News*

'Largest standalone battery project' in Texas' ERCOT market begins construction

Within a very short space of time Texas' ERCOT market has gone from welcoming projects such as the 10MW Prospect project from developer GlidePath to much bigger projects such as Able Grid's Chisholm and those under development by Broad Reach Power. Image: GlidePath.

Source: Energy Storage News, Aug 25, 2020 https://www.energy-storage.news/news/largest-standalone-battery-project-in-texas-ercot-market-set-to-begin-const

Construction on a 100MW battery energy storage project in Texas has begun through partners Able Grid Energy Solutions, MAP Energy, Astral Electricity and Mortenson.

Developer Able Grid announced that full notice to proceed has been issued on the Chisholm Grid battery energy storage system, which will have an initial rated capacity of 100MW and is scheduled to begin operations in mid-2021.

. . . the plant, located in the city of Fort Worth, will play into the Electricity Reliability Council of Texas (ERCOT) market.

. . . another developer, Broad Reach Power, is delivering more than a dozen projects of 10MW / 10MWh this year

ERCOT 20INR089
Chisholm Grid Tarrant County 7/9/2021 COD 102 MW

ERCOT Market Example . . . *From Mar 10, 2021 Dallas Morning News*

Business

ENERGY

Tesla plugs into Texas

Musk's company secretly builds battery storage system

"Tesla's energy storage business on a percentage basis is growing faster than their car business, and it's only going to accelerate."

Another market example from the ERCOT interconnection queue, recently identified as Tesla

ERCOT 20INR0364				
Gambit	Batt	Brazoria County	6/1/2021 COD	102 MW

Dallas Morning News
Wednesday, March 10, 2021

GRID ENERGY STORAGE USES

BULK GRID

Wind & solar smoothing & dispatch

Time-shift available energy supply to meet later grid needs

Hedge for upside price opportunity

Reliability services
- Supply regulation
- Frequency regulation
- Responsive reserves for grid contingency
- Fast response

Peaking capacity in ISO's w capacity markets (not ERCOT)

TRANSMISSION

Reliability Role

Meet a short-run N-1 operational need

Economy Role

Market role in ERCOT?

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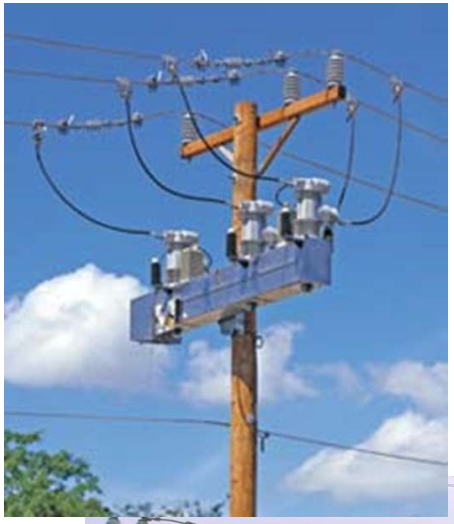
DELIVERY OF POWER – SUBSTATIONS & DISTRIBUTION



DISTRIBUTION FEEDER – BASIS FOR DISCUSSION

CIRCUIT BREAKER AT SUBSTATION

Circuit Breaker for Each Feeder

Protective Relays

DISTRIBUTION FEEDER

Radial, not networked

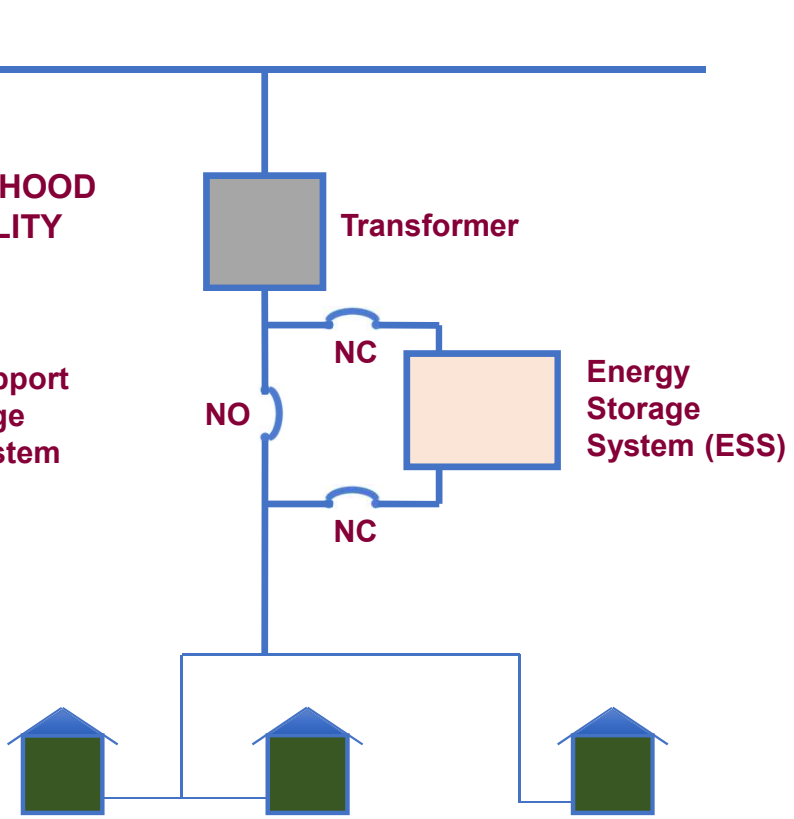
Simplified diagram does not show reclosers, capacitor banks, voltage regulators and laterals

12.5 kV or 25 kV primary voltage at Oncor

ESS PLACED AT LOAD-SERVING TRANSFORMER

ONCOR NEIGHBORHOOD STORAGE RELIABILITY INITIATIVE (NSRI)

25 kW x 25 kWh
Discharge only to support homes in a grid outage
Recharge only off system peak



NEIGHBORHOOD STORAGE RELIABILITY INITIATIVE

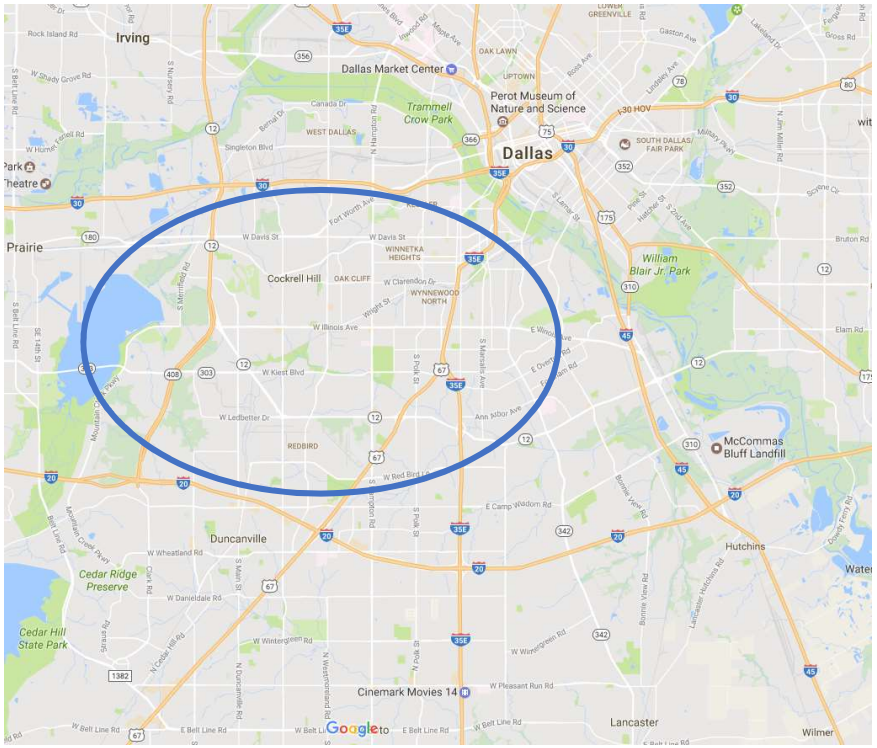
Evaluate effectiveness of deploying small-scale battery storage to bridge outages and improve local power quality

Six 25 kW x 25 kWh lithium ion batteries

These batteries are capable of bridging outages up to a few hours of duration

Install on secondary of transformer, test and monitor

120/240 Single Phase



Deployed & operational by the end of 2014
SAIDI improvement confirmed & documented
Removed from service in 2019

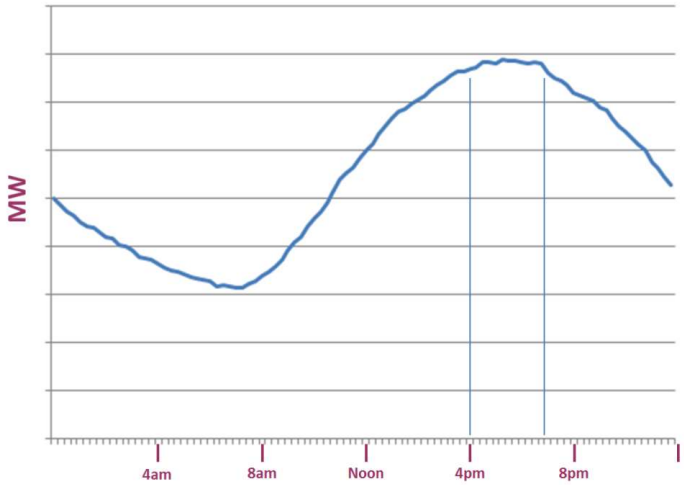
SAIDI = System Average Interruption Duration Index

SERVE GROWING LOAD – LOCAL PEAK LOAD

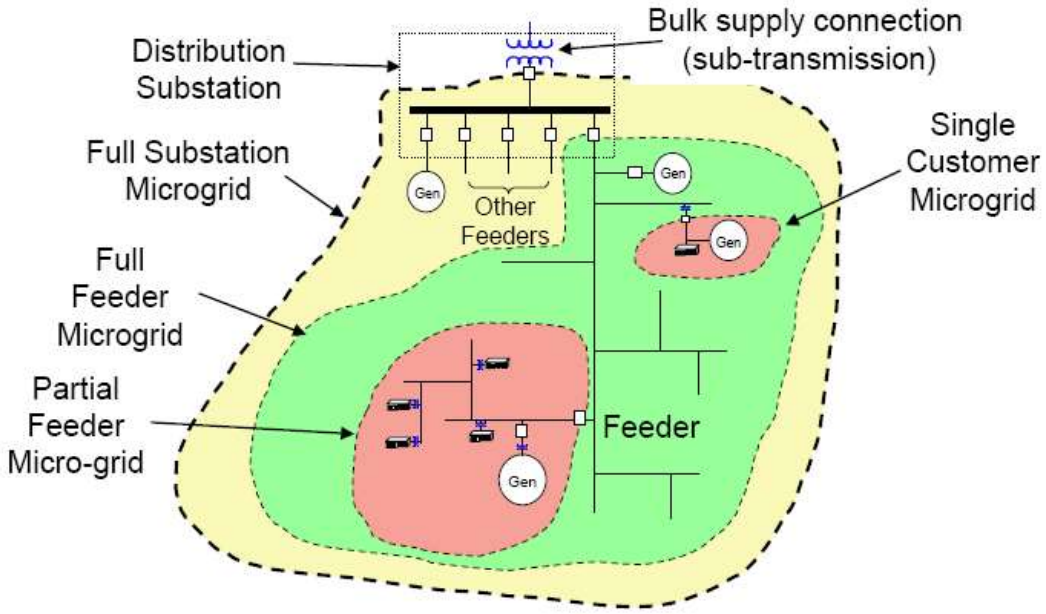
RELIEVE OVER-DUTIED SUBSTATION EQUIPMENT

For a fully loaded substation transformer, could an ESS serve incremental peak load growth to avoid overloading the transformer?

Defer a substation expansion with new transformer for a year or two or three?

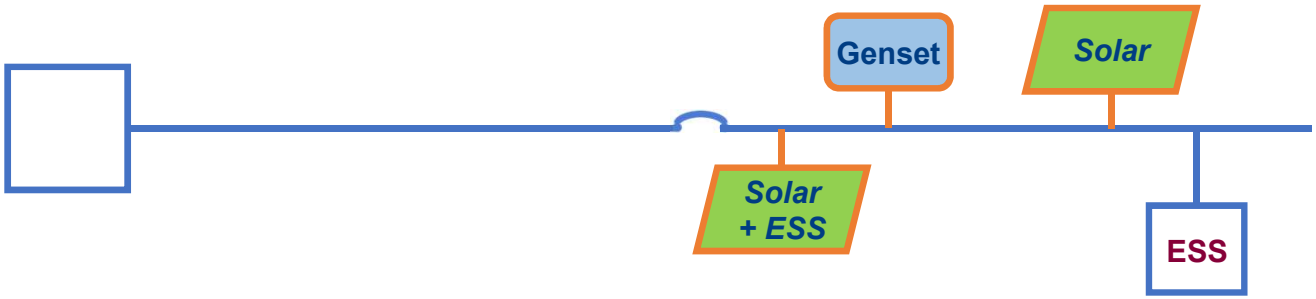


What is a Microgrid?



"A group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and that connects and disconnects from such grid to enable it to operate in both grid-connected or 'island' mode"

LOCAL MICROGRID – FUTURE CONSTRUCT



ESS on Feeder with DER

- Feeder segment with storage
- Grid-connected and islanded operations
- Grid-connected: Limit abrupt changes of power level on feeder/support voltage stability
- Islanded: ESS as grid-forming element / Controller dispatches supply and ESS to balance with load during island

Reliability → Resilience

- Utilize ESS to support feeder segment in an outage
- Distributed energy resources (DER) extend the electrical island operation
- Local controller to maintain frequency & voltage, resynchronize to the grid
- Controller dispatches supply and ESS to balance with load
- Reliability → Resilience if designed for robust events

STORAGE TO ANCHOR A MICROGRID

Demonstrate capability of storage to anchor a distributed microgrid DURING LOSS OF UPSTREAM GRID POWER

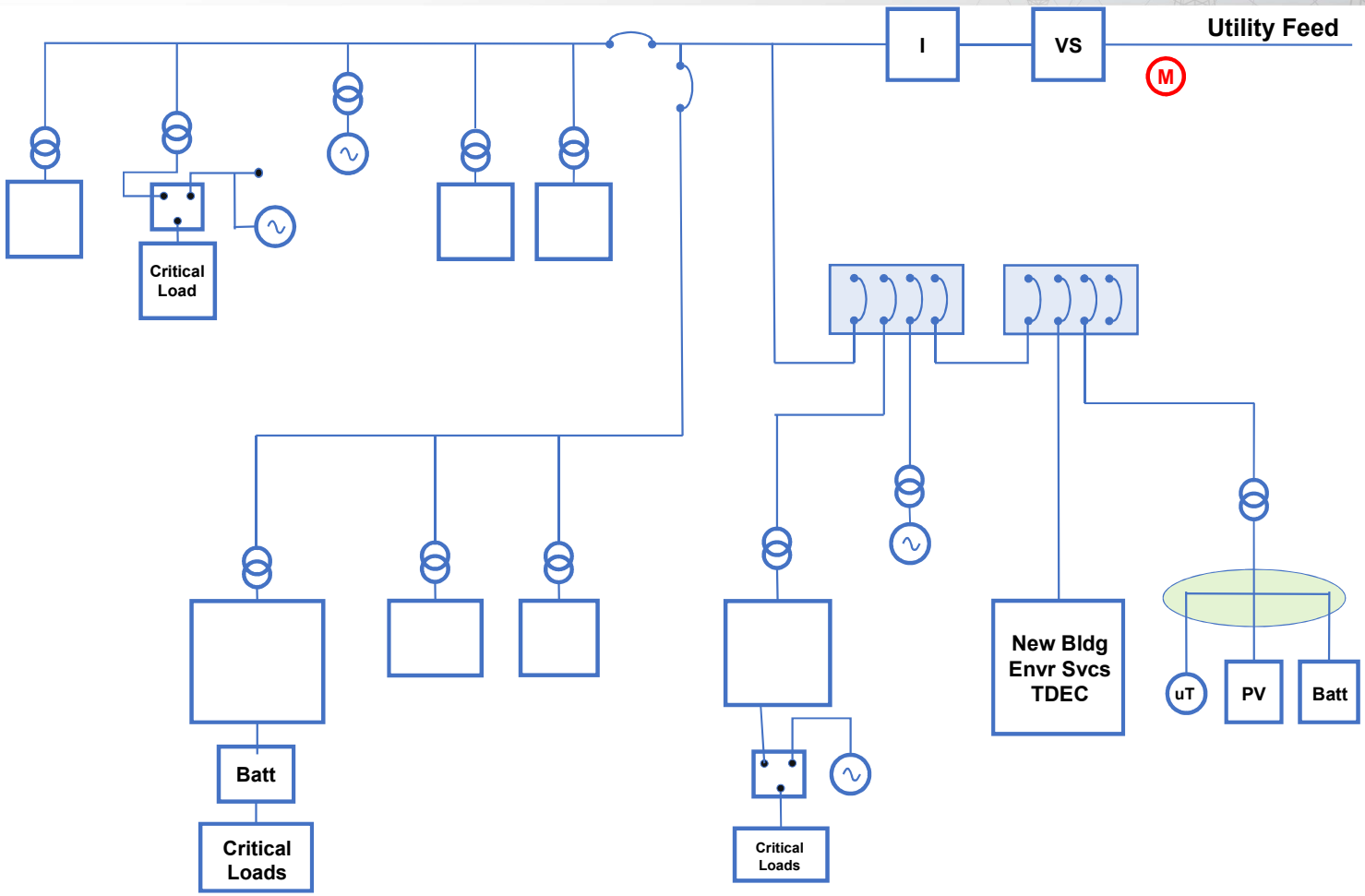
Type: Behind-the-meter campus-styled microgrid

Type: Utility feeder segment anchored by storage

- Customer loads
- Solar by customers & 3rd-parties
- Dispatchable natural gas generation by 3rd-parties & customers
- Energy storage with inverter with grid-forming capabilities

A key evolutionary integration capability for electric utilities as distributed resources increase?

ONCOR OPERATIONAL SITE WITH MICROGRID



MICROGRID

Key Microgrid Attributes

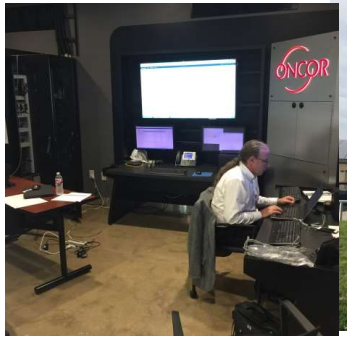
- Grouping of interconnected loads and distributed energy resources
- Can operate in island mode or grid-connected if desired
- Controls and grid-forming inverter to accommodate both modes of operation

Immersion Room

EV Charger & Solar Canopy

Microturbine

Energy Storage



Control Center

Legacy Equipment

Tesla ESS at Oncor Microgrid, Jan 2019

SUMMARY

Energy storage technology and vendors and business models are evolving rapidly worldwide

Declines in energy storage cost and improvements in performance will continue

Utilities and regulators in western and northeastern states, and in Hawaii & Ontario, are driving early deployments and regulatory models

Texas Legislature and PUCT have acted quickly and continuously to integrate energy storage to wholesale markets

Yet the Leg & PUCT have been slow to consider and define appropriate roles for TDSPs to own or use energy storage for traditional T&D purposes

The growth of EVs will further drive opportunities in grids for energy storage, with vehicles being capable of injecting their energy into homes or the grid, and serving in the same roles as energy storage.

Transportation Electrification

Views for Oncor Strategy and Emerging Issues

March 2021

ONCOR®

KEY TERMS

- Charging options: Level 2 (240Vac); DC Fast Charger (higher kW chargers – generally 25kW to 1MW+)
- EVs –Any vehicle that utilizes an electric motor as source for propulsion
- PEVs–Any vehicle that connects to the primary grid or generation source to recharge energy storage system
- BEVs –Battery Electric Vehicle– Vehicle that only uses an electric motor for propulsion with energy storage as a power source. Recharging can be done by plugging into the primary grid and/or generation source
- PHEVs – Plug Hybrid Electric Vehicles – Vehicle that uses both an electric motor with energy storage and an internal combustion engine for propulsion. Recharging can be done by plugging into the primary grid and/or generation source
- Hybrid Electric Vehicles – generally use an internal combustion engine to charge a battery to power an electric motor drive system (most Prius vehicles – they cannot take a grid charge)
- EVSE – Electric Vehicle Supply Equipment, official name for EV chargers
- Fleet Vehicles – Delivery vans and freight box trucks and tractors (classes 4-8)
- Green Fleet Tools: Oncor proprietary tools to estimate distribution system impacts of fleet electrification
- Light Duty Vehicles – passenger cars, SUVs, pickups and vans
- NCTCOG – North Central Texas Council of Governments (DFW Clean Cities, EV North Texas)
- Public Charging Infrastructure – electric vehicle chargers that are publicly available for any EV owner
- Underserved Areas – locations where few if any public chargers are available and current economics limit investment attractiveness.

EV's Affordable & Available

Hyundai Kona $35,000
Range: 258 miles

Chevy Bolt $37,000
Range: 259 miles

Tesla 3 $41,190
Range 250-322 miles

Globally 400 New OEM Models by 2023

And the Flood of New Models is Just Starting

15

Existing and newly launched BEV[1] and PHEV[2] models by vehicle segment, number of model launches

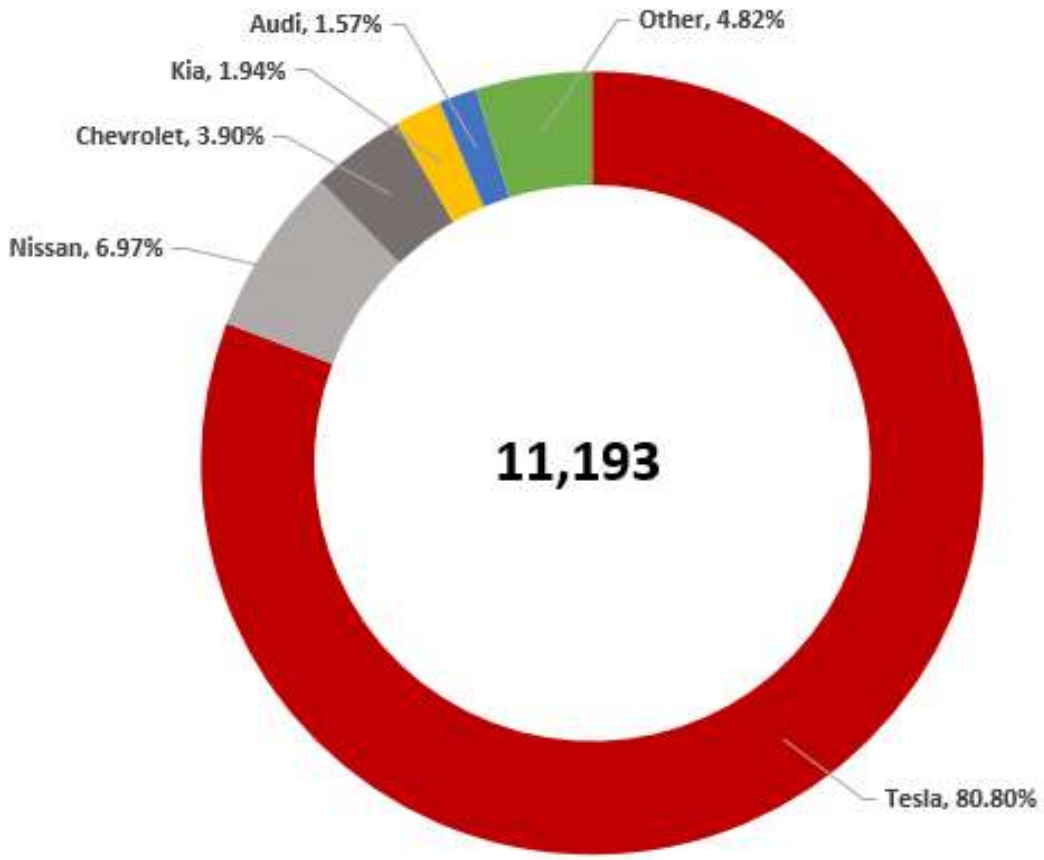
	2018[3]	2019	2020	2021	2022	2023	Total
A City car or minicompact	12	3	4	10	1	1	31
B Supermini or subcompact	8	16	11	5	9	11	60
C Compact or small family	31	28	42	22	25	29	177
D Large family or midsize	21	10	27	19	30	27	134
E Executive or full size	24	9	17	16	21	22	109
Total	96	66	101	72	86	90	511

[1]Battery electric vehicle. [2]Plug-in hybrid electric vehicle. [3]Cars actually produced in 2018. All subsequent year numbers are estimates by segment.
Source: IHS Markit; McKinsey analysis

McKinsey & Company

Note: For the US market IHS Markit forecasts 43 OEMs will release an ever changing number of the 400 models in the US..

BEVs in Oncor Service Area



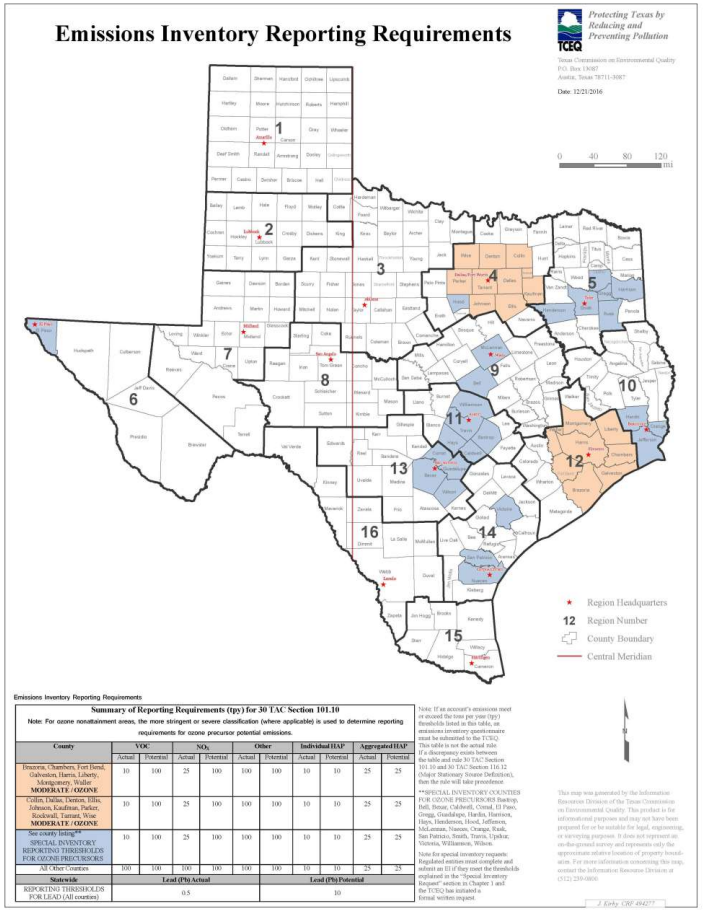
2020 Q2 Make Distribution

Source: Oncor calculations from NCTCOG data obtained from TxDMV

Environmental Impact of EV Adoption in Texas

- Texas has two Clean Air Act non-attainment areas including the DFW area.
- For North Texas, the primary non-attainment is an 8 hour ozone per the 2015 standard (.70 ppm).
- NOx is the primary pollutant that must be reduced to achieve a reduction in ozone.
- If the required NOx reduction were to come solely from EVs replacing ICE vehicles, it would require approximately 1.25 million of the 8.83 million registered vehicles (14%) in the Oncor service area to convert to an EV. (Oncor Estimate)

Oncor estimate



Evolving Charging Approaches

In-home Charging
- Level 1 (wall outlet – 120 vac
- Level 2 (dryer or oven outlet - 240 vac)

Workplace Charging
- Generally level 2

Public Charging
- Generally level 2 with increasing deployment of DC Fast Chargers (480 vac) for intercity and shopping centers
- Underserved areas
  - Apartment complexes, local shopping centers, communities with a lower than average household income
- Commercial areas
  - Drug stores, department stores, hotels/motels, community centers
- Intercity routes
  - Rest stops and access areas

Off-grid Charging
- Chargers served by solar pv, batteries and or generators

Integrated Charging (with Solar PV)
- Residential and some commercial and intercity to reduce demand charges

Chargers by Vehicle Class

Source: EnelX April 20, 2019

- Currently the charging approaches are limited to AC for slow/overnight charging primarily of light duty vehicles and delivery vans.
- The DCFC connectors shown at left represent the public fast charging infrastructure and operate at 25 – 350 kW for those classes
- The same connectors are planned for higher class fleets but are still in development and range from 50kW to potentially 1.5MW+

Evolving Charging Markets – World View

- Tesla (15,000 DCFC)
- Electrify America (VW) (2,000 DCFC)
- Chargepoint (60,000)
- ChargeMaster (British Petroleum) UK only (7,000)
- Greenlots/New Motion (EU) (Shell) (30,000)
- EVgo (1,050 DCFC only)
- Daimler: RWE Effizienz/EnBW/New Motion (1200)
- Siemens (EU only – several hundred)
- EVBox (60,000 +700 DCFC)
- G2Mobility (10,000)

There are almost 150,000 charging stations across about 75,000 locations around the world excluding China. The countries with the highest number are:

1) United States ~ 21,000 charging stations
2) Germany ~ 12,000
3) Netherlands ~ 8,000
4) United Kingdom ~ 7,000
5) Italy ~ 4,000

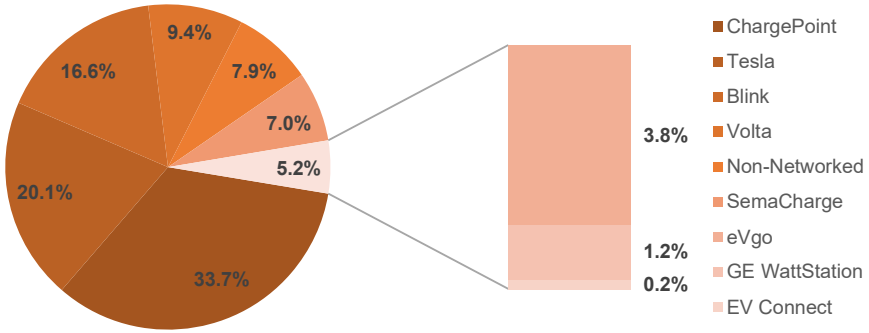
And even though home-installed chargers can be bought for $500 to $1,000, and approximately 86% of charging is currently done at home, as more renters and lower income individuals acquire EVs, there will still be an increasing demand for public chargers.

Source: Open Charge Map

Vendor Presence in Oncor

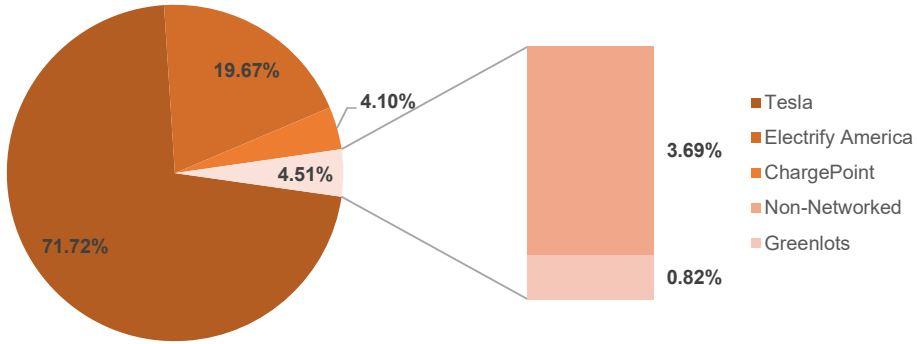
Level 2 AC Charging Stations: 120 V

- 860 stations



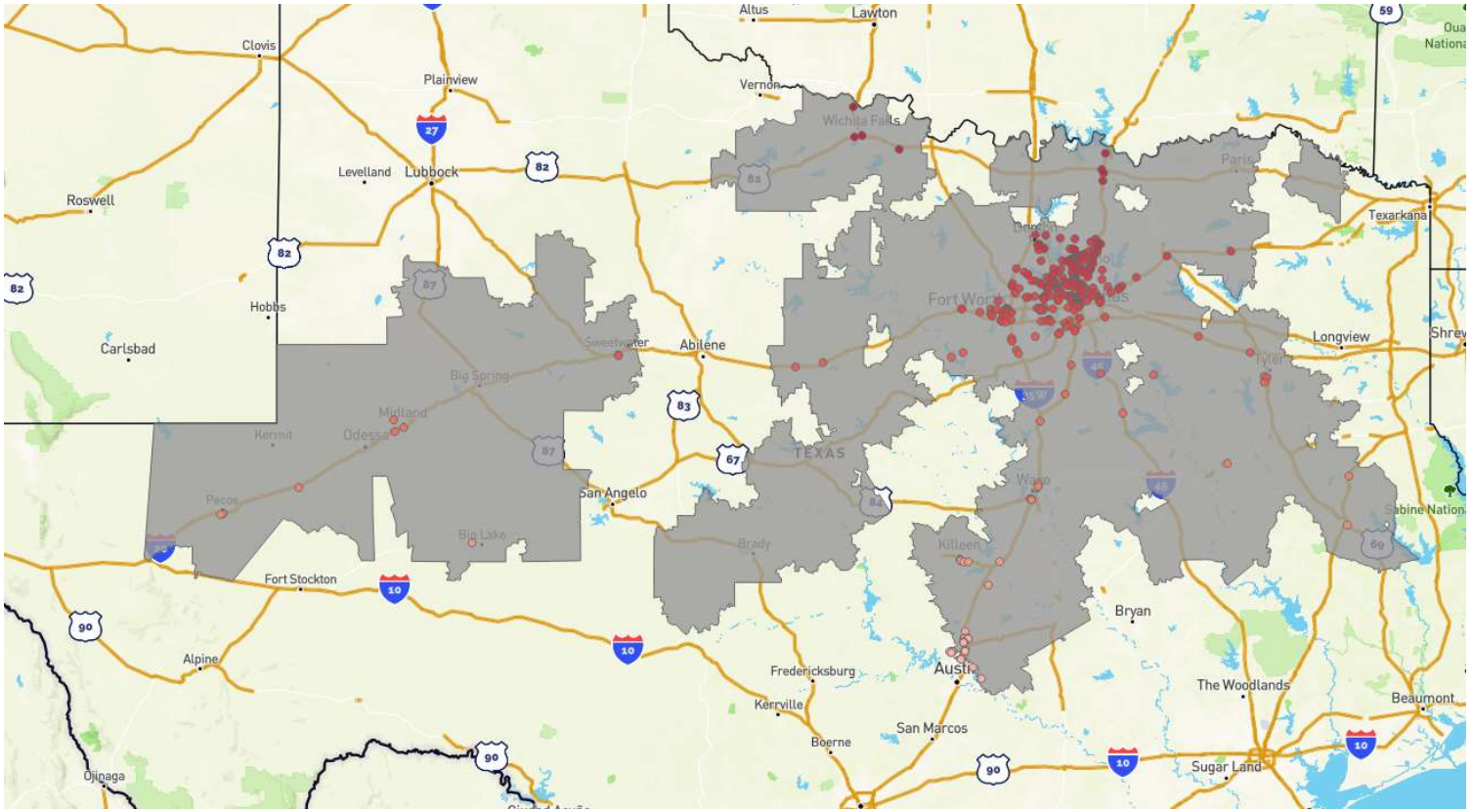
DC Fast Charging Stations: 240 V

- 244 stations



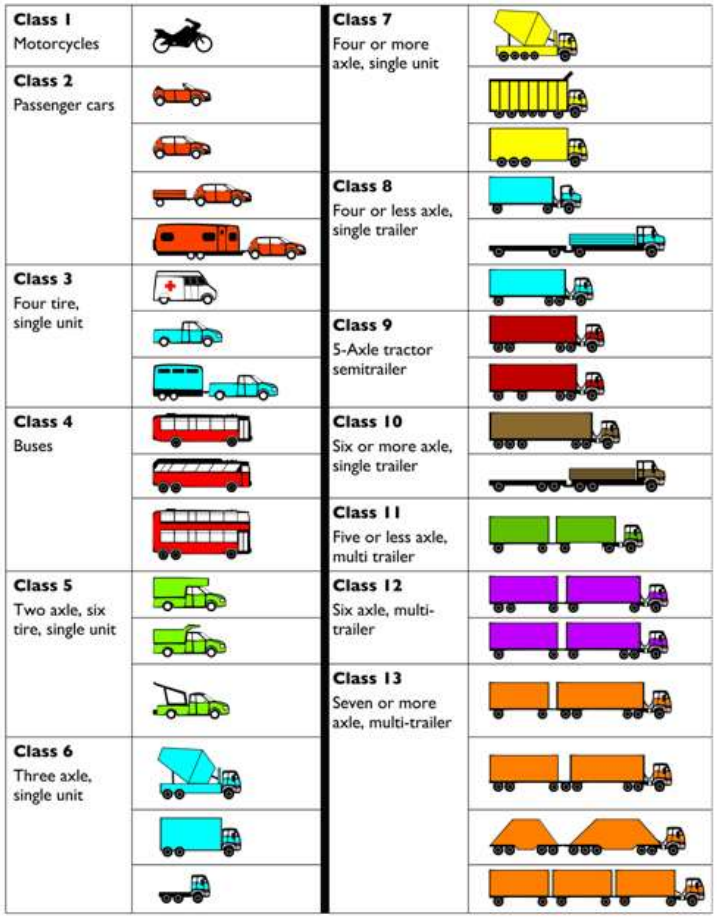
Note: Tesla charging infrastructure is unique to Tesla vehicle. A Tesla vehicle can use an adapter to use the typical J1772 connection. However, a non-Tesla vehicle cannot use charge at a Tesla station.

Public PEV Charging Stations in the Oncor Service Territory



- DCFC Stations located along highways for intercity travel.

EV Offerings by Vehicle Class

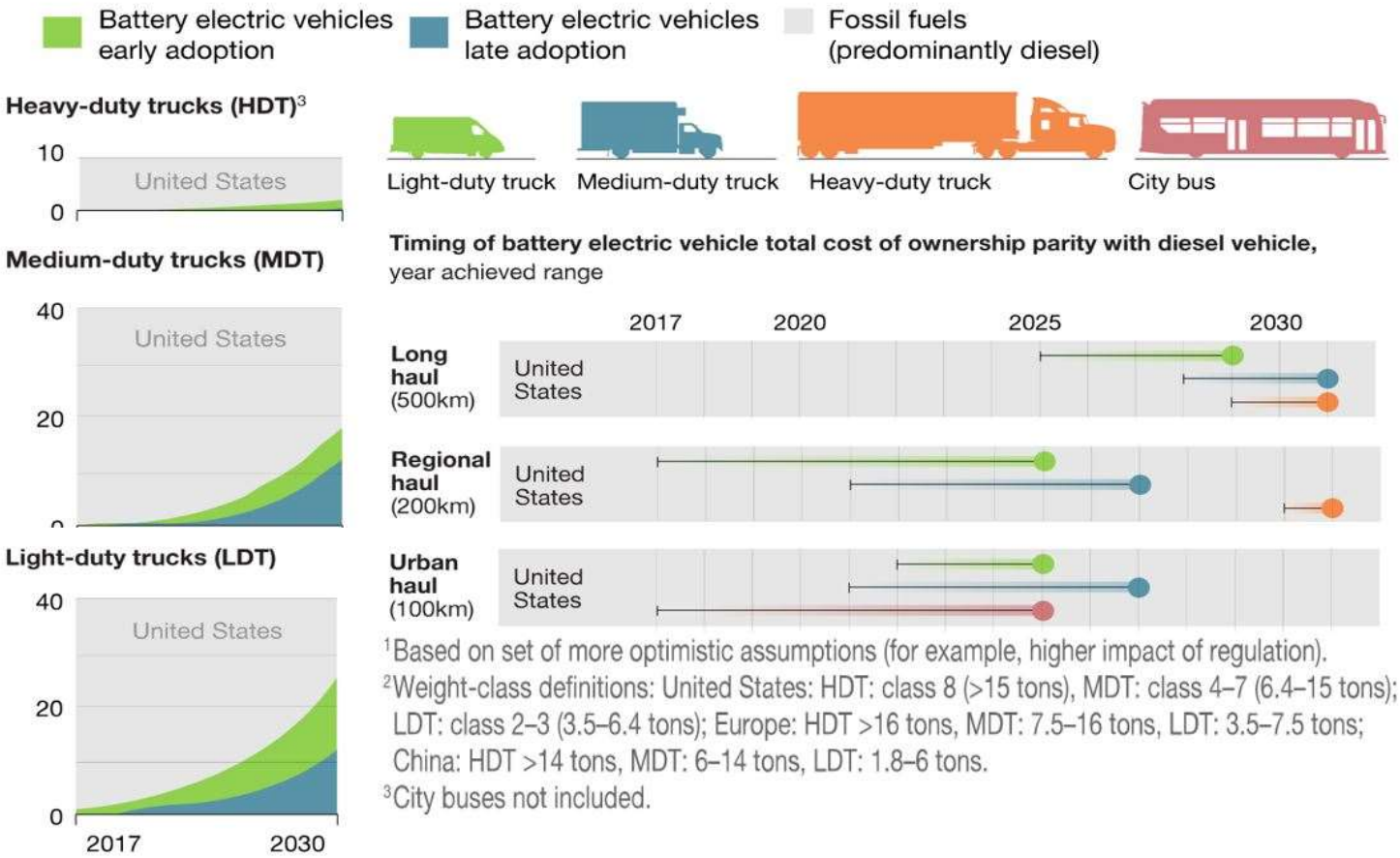


Federal Highway Admin Vehicle Classifications:

- Class 1 Motorcycles: 88 manufacturers listed on EVTrader
- Class 2 Passenger cars 400 models by 2023 (McKinsey)
- Class 3 Four Tire Single Unit: 8 US manufacturers 2020-2022
- Class 4 Buses: Globally 50 manufacturers (Wikipedia)
- Class 5 Two axle six tires single unit: 5 US manufacturers 2020+
- Class 6 Three axle single unit: 5 US manufacturers 2020-2022
- Class 7 Four or more axle single unit: none disclosed
- Class 8 Four or less axle single trailer: 7 US manufacturers 2021+

Note: If not otherwise attributed source is multiple publications assembled by Oncor

EV Fleet Adoption Timelines

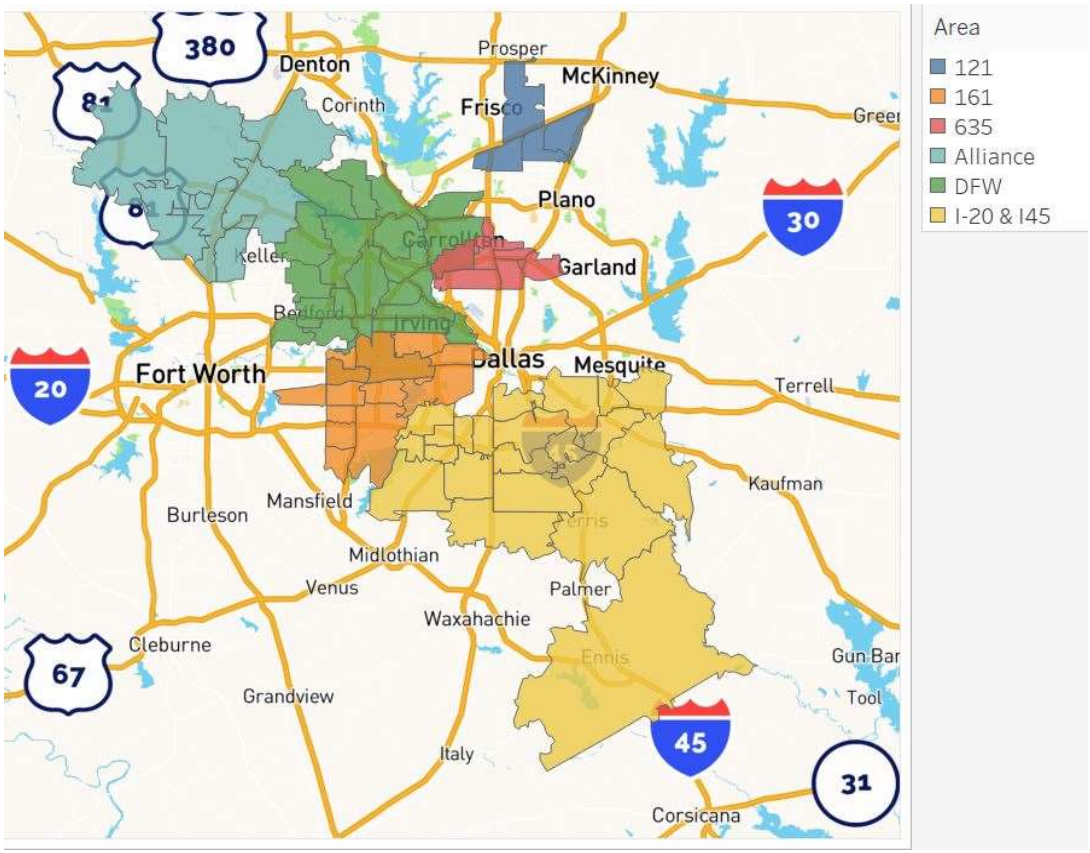


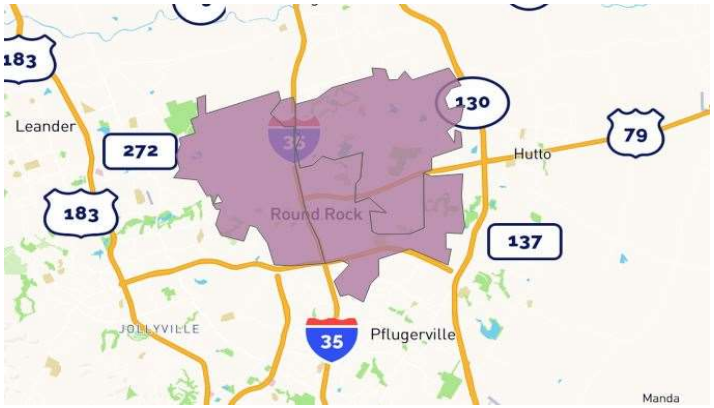
[1]Based on set of more optimistic assumptions (for example, higher impact of regulation).
[2]Weight-class definitions: United States: HDT: class 8 (>15 tons), MDT: class 4–7 (6.4–15 tons); LDT: class 2–3 (3.5–6.4 tons); Europe: HDT >16 tons, MDT: 7.5–16 tons, LDT: 3.5–7.5 tons; China: HDT >14 tons, MDT: 6–14 tons, LDT: 1.8–6 tons.
[3]City buses not included.

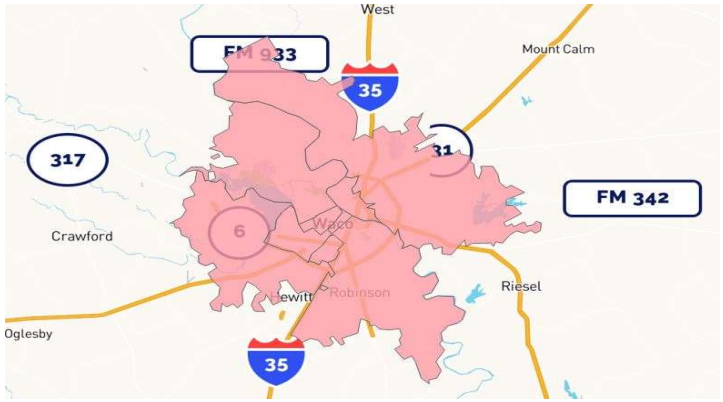
Freight Traffic

Approximately 13% of all freight traffic passes through Texas. Primary corridors are I-35 and I-45 north – south and I-20 and I-30 east - west, which pass through Dallas and Fort Worth

Fleet Hot Spots in Oncor Service Area







Co-location of Logistics and Distribution Centers

These pockets are very dense and could impact substations if multiple customers electrify only a few vehicles each simultaneously.

EV Charging Market Participants

- Personal Vehicles: OEMs to include Tesla, VW, GM, Daimler, BMW, Hyundai/Kia, Nissan, Ford
- Fleet Vehicles: OEMs to include Daimler Trucks, Peterbilt, Volvo, Tesla, Rivian, Arrival (UK)
- Fleet Lessors: Penske, Ryder, IdeaLease and others
- Fleet operators: AT&T, UPS, FedEx, PepsiCo, Comcast, Verizon, Amazon, etc.
- Buses: (Transit) Proterra, NewFlyer, BYD, (School bus) Thomas Built, Bluebird, Lion
- Auto Dealers: existing vehicle owners and prospective buyers
- Charging Ports: Tesla, ChargePoint, Electrify America, Greenlots, EVgo
- Charging Equipment: ABB, Siemens, Eaton
- Charging hosts: Walgreens, Walmart, local governments, parking garages, employers, Multifamily housing
- Utilities: SoCalEd, PG&E, Southern Company, Duke (Leaders)
- Utility commissions: Approval of utility owned and deployed public charging
- Federal and State governments: Incentives to purchase EVs

Oncor & Personal EVs

Oncor provides information about personal electric vehicles at oncor.com/ev

This information is imported to Oncor from trusted 3rd-party, market-neutral sources

oncor.com/EV

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Appendix

The February 2021 ERCOT Winter Event

IEEE SmartGrid – Panel on The Texas Electric Power Crisis

https://smartgrid.ieee.org/resources/webinars/panel-on-the-texas-electric-power-crisis

Exploring Tradeoffs in the Texas Energy System. McCombs Energy Initiative, Salem Center for Policy, The University of Texas at Austin

https://www.youtube.com/watch?v=GP_UpRMsfYY

More About Lithium-Ion Batteries

Perspective on lithium-ion battery evolution and future

The Interchange Podcast, March 11, 2021, Are Batteries at a Turning Point?

https://www.greentechmedia.com/podcast/the-interchange