

Discussion of New Dual Nameplate kVA for Distribution Transformers

2020 IEEE PES T&D Panel Session #PS31

NEW ANTICIPATED LOADS IN THE UNITED STATES

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Overview

Key trends in electric loading due to:

- **Transportation Electrification**
- **Building Electrification**
- **Codes, Standards, Policies, and Laws**

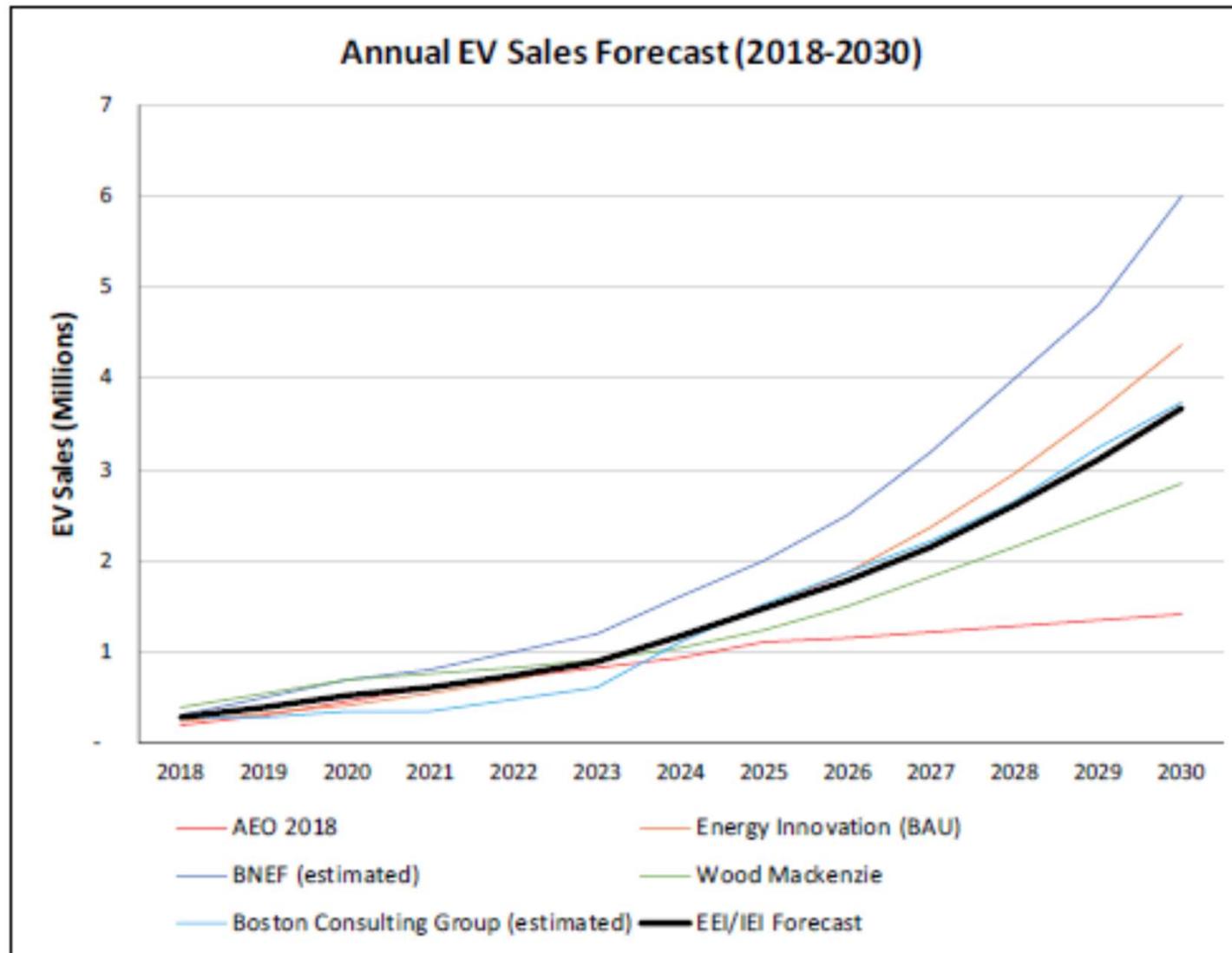
TRANSPORTATION ELECTRIFICATION

Light Duty Vehicles

As of August 2020, there are ~1.6 Million all-electric or plug-in hybrid electric vehicles operating in the US.

- March 2020: GM announces \$20 Billion investment in EVs through 2025; plans to sell 20 models of EVs by 2023.
- July 2020: GM partners with EVgo to build more than 2,700 new fast chargers (100 – 350 kW) across the US over the next five years.
- EEI / IEI Projections (October 2018 report):
 - 18.7 Million EVs on U.S. roads in 2030 (about 7% of LDV's).
 - Annual sales of EVs exceed 3.5 million vehicles in 2030, or about 20% of annual US light duty sales in 2030.

Figure 4. EEI/IEI Annual EV Sales Forecast Compared to Selected Forecasts



Light Duty Vehicles (continued)

Energy / Demand impacts:

If 12,000 Miles per year (average vehicle miles traveled):

- 4 miles / kWh = 3,000 kWh / year
- 3 miles / kWh = 4,000 kWh / year
- 2 miles / kWh = 6,000 kWh / year

Charging Levels

- Level 1: 1.4 kW typical (maximum = 1.9 kW, per SAE-J1772)
- Level 2: 3.3 kW was typical (1st generation < 2016). Now, 4.8 – 7.2 kW (maximum = 19.2 kW, per SAE-J1772 specifications).

Commercial (Medium / Heavy Duty) Duty Vehicles

“FedEx Acquires 1,000 Chanje Electric Vehicles” (Nov 2018)

“UPS orders 10,000 electric delivery vans from startup Arrival” (January 2020)

“Amazon has ordered 100,000 custom electric delivery vehicles from electric vehicle maker Rivian.” (February 2020).

“Wal-Mart to electrify and zero out emissions from all of its vehicles, including long-haul trucks, by 2040” (September 2020)

Commercial (Medium / Heavy Duty) Duty Vehicles (continued)

Newer applications:

- E-scooters (Lime, Lyft, Bird, Skip, Jump, Spin, Bolt, Razor, etc.)
- E-baby strollers (Bosch, Cybex, etc.)
- Autonomous Electric “Last-Mile” Delivery Vehicles (Nuro, etc)
- Autonomous Electric Ride Shares (AutoX, Pony.ai, Waymo, Zoox, Cruise, May Mobility, etc.)

Commercial (Medium / Heavy Duty) Duty Vehicles (continued)

<u>Vehicle Type</u>	<u>Annual Miles Traveled per Vehicle</u>
Class 8 Truck	63,428
Transit Bus	34,012
Refuse Truck	25,000
Paratransit Shuttle	22,679
Delivery Truck	12,958
School Bus	12,000
Light Truck/Van	11,991

(source: <https://afdc.energy.gov/data/10309>)

Commercial (Medium / Heavy Duty) Duty Vehicles (continued)

Energy / Demand impacts:

If 12,000 to 63,000 Miles per year (average vehicle miles traveled):

- 1 miles / kWh = 12,000 – 63,000 kWh per year
- 1.5 miles / kWh = 8,000 – 42,000 kWh per year
- 2 miles / kWh = 6,000 – 31,500 kWh per year

Charging Levels

- Level 2: 7.2 – 19.2 kW range
- DC Fast Charging: 50 / 100 / 150 / 250 / 350 / 450 / 500 kW
- “Daimler Aims For **3 MW** Charging For Electric Trucks” (source: Inside EV’s, April 29, 2019) (*emphasis added*)

BUILDING ELECTRIFICATION

Distribution Transformer Loading



Buildings

Electrification due to:

- Higher efficiency + higher efficiency gains with technologies (e.g., geothermal heat pumps, LED lights, heat pump water heaters)
- Stable pricing compared to other fuels
- Apps, Artificial Intelligence, 5G communications allow more on-site and remote controls
- External Factors

Buildings – AHRI Shipment Data (<http://ahrinet.org/statistics>)

Heat Pump Shipments

- 2009 – 1.64 Million
- 2014 – 2.35 Million
- 2019 – 3.11 Million

Commercial Electric Storage Water Heaters

- 2009 – 55,625
- 2014 – 73,458
- 2019 – 150,667

CODES, STANDARDS, POLICIES AND LAWS

Codes, Standards, Policies and Laws

US Climate Alliance – 24 States (55% of the US population) have joined, pledging to:

- Accelerate new and existing policies to reduce carbon pollution and promote clean energy deployment at the state (and federal) level.
- Implement policies that advance the Paris Agreement, to reduce GHG emissions by at least 26-28% below 2005 levels by 2025.
- Track and report progress to the global community in appropriate settings.

Codes, Standards, Policies and Laws (continued)

Codes / Standards / Policies / Laws that are already in place in certain states:

- Economy-wide carbon reduction goals (e.g., 50% reduction from 2005 levels by 2030)
- “Carbon neutral” or “net zero” carbon by 2040-2050
- Higher Renewable Portfolio Standards for Electricity (e.g., 50-70% by 2030, “zero-carbon” or 100% RPS by 2040-2050)
- “EV Ready” or “EV Capable” infrastructure required for new buildings
- Policies / Goals on restricting fossil fuel infrastructure (pipelines)
- Restrictions on using gas / all fossil fuels in new (or existing) buildings

Codes, Standards, Policies and Laws (continued)

Fossil Fuel (gas or all types) Restrictions:

- Total prohibition in new residential and/or commercial buildings.
- Carbon reduction mandates in existing buildings (e.g., 50% by 2030).
- Only certain gas appliances allowed but must be installed with nearby electric infrastructure so customer can switch to electric.
- Only certain gas appliances allowed, but only after receiving approval from the local building official on a case-by-case basis.
- Gas equipment only allowed if the building is at least 10-15% more efficient than an all-electric building.
- Phaseout of gas / fossil fuel use in existing buildings by 20xx.

Example: New York Headlines (Jan-Aug 2020)

- “Governor Cuomo announces additional \$2 Billion in utility energy efficiency and building electrification initiatives to combat climate change” (*emphasis added*)
- “Scrapped pipe project for New York a dire sign for other Northeast gas proposals”
- “How New York City plans to end natural gas, oil use in buildings”
- “After clash with Cuomo, National Grid warns of widening NY gas shortage”

SUMMARY

Summary

- **Transportation Electrification**
 - Increasing number of electric light duty vehicles
 - Increasing number of commercial electric vehicles
 - More applications of autonomous electric vehicles

- **Building Electrification**
 - Higher efficiency of newer electric end-uses
 - Corporate “green” goals and policies
 - Impact of LEED, Energy Star, and other “green” codes

- **Codes / Standards / Policies / Laws**
 - More stringent energy codes and appliance standards
 - State & Local carbon reduction mandates / Higher RPS’s
 - EV infrastructure requirements for new buildings
 - Fossil fuel restrictions = More electric consumption

Summary (continued)

- **Impacts on future electric loads**
 - **Depends on market segment (residential, commercial, industrial or transportation).**
 - **Short-term versus Long-term impacts of trends and policies**

- **Forecast****
 - **Electric loads will increase, especially for transportation.**
 - **The range of increase will vary widely, anywhere from 5 to 50%, depending on multiple factors.**

 - **** “forecasting is like driving a car blindfolded and getting instruction from a person looking out the rear window.”**
 - **“We have 2 classes of forecasters: Those who don't know . . . and those who don't know they don't know.” - John Kenneth Galbraith**