MAY 23, 2018

Beneficial Electrification: Opportunities and Considerations for Air Quality

2018 NACAA Spring Membership Meeting

Chattanooga, Tennessee

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Electrification:

The use of electricity in end uses that would otherwise be powered by fossil fuels (natural gas or petroleum).

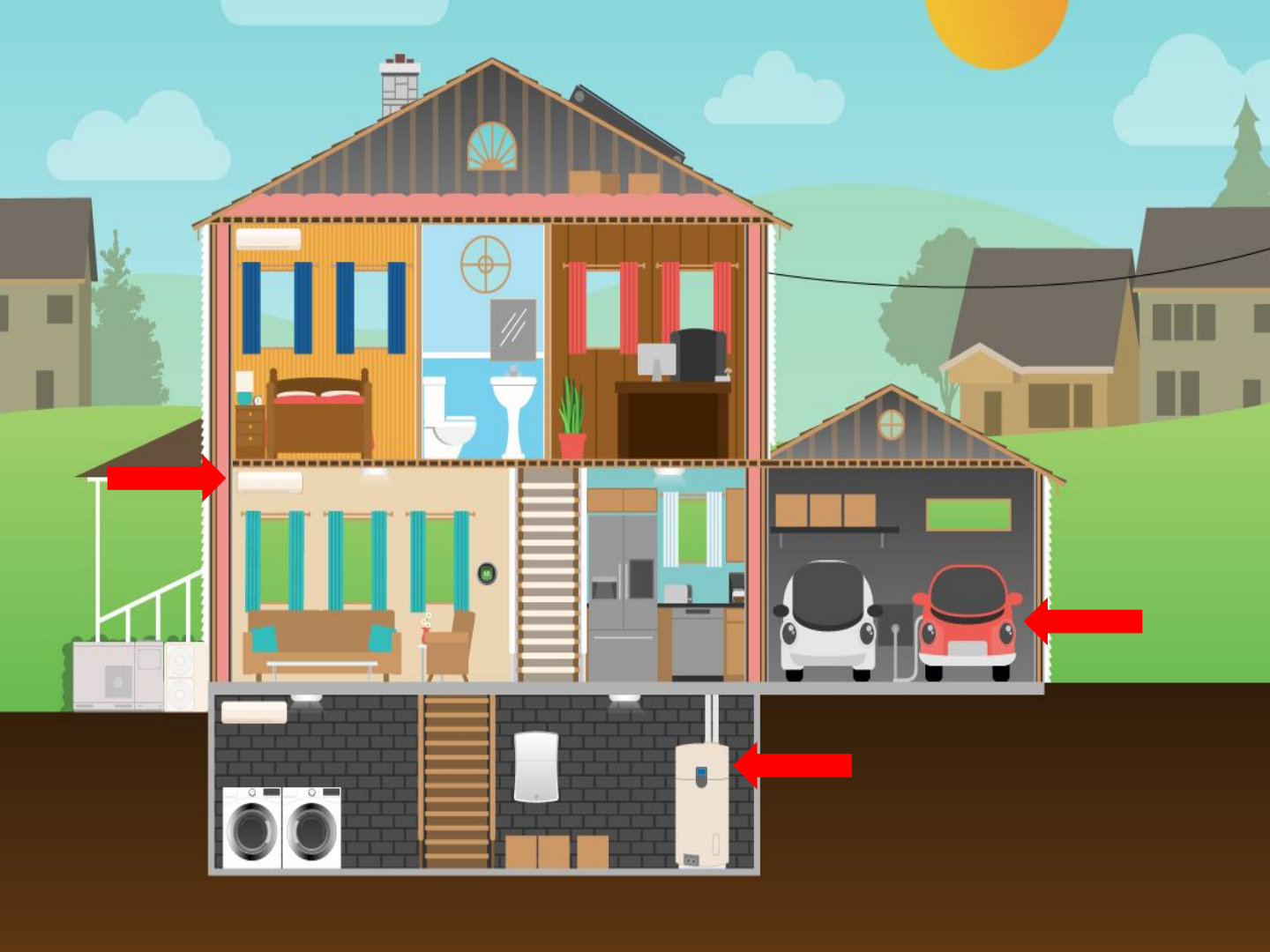
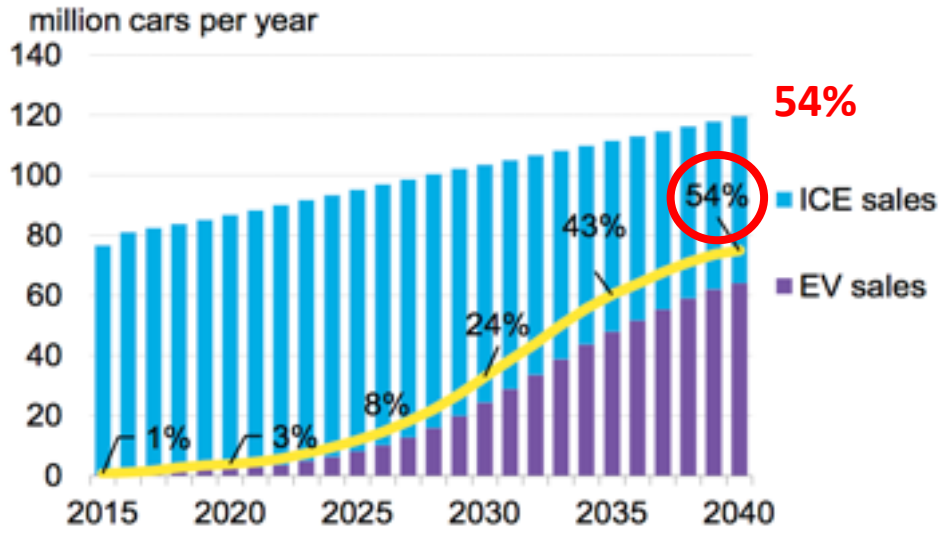


Figure 1: Annual global light duty vehicle sales



Source: Bloomberg New Energy Finance

But, not all electrification is created equal.

So, when is electrification *beneficial*?

Beneficial **Electrification (BE) Can Provide a Window of Opportunity**

1. Saves Customers Money Long-Term; More Services

2. Reduces Environmental Impacts

3. Enables Better Grid Management

Photo credit: Flickr 401(k) 2012

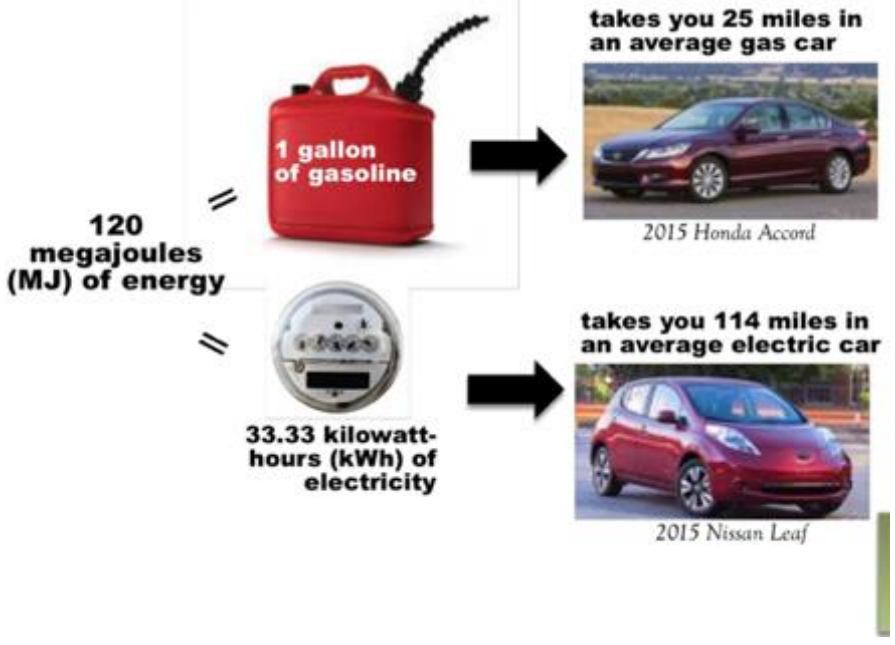
1. Saves Customers Money Long-Term

2. Reduces Environmental Impacts

3. Enables Better Grid Management

Beneficial Electrification – Transportation

Efficiency of Electric Vehicles



Source: JJ MCoy, ”Building “good load” to reduce carbon emissions”, 2016. http://nwenergy.org/wp-content/uploads/2016/01/Transpo-Electrification-TE-Workpaper-1-25-2016-FINAL.pdf.zip

So, what does that mean for consumers, the environment, and the grid?

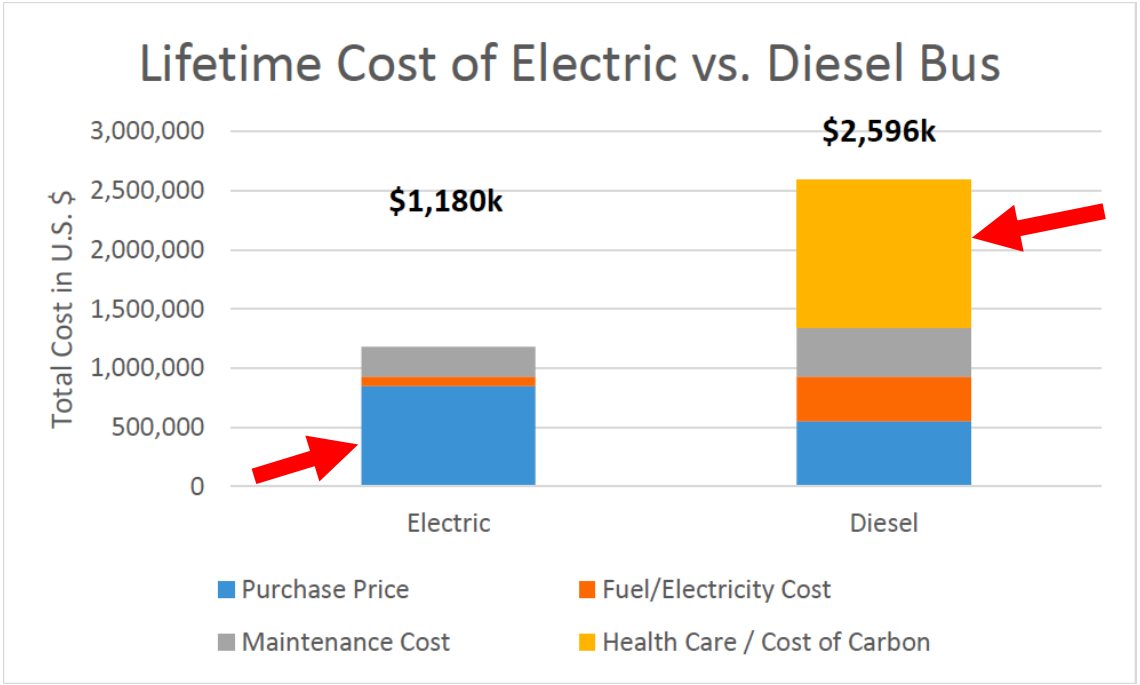
Assessing BE: Customer Costs

Gasoline Vehicle: 350 gallons / year @ $2.40 / gallon
= **$840 / year**

EV: 3,000 kWh / year x 13¢ / kWh
= **$390 / year**
Fuel savings: ***$450 / year***

Vehicle assumptions: Both vehicles drive 10,000 miles per year.
Gasoline vehicle efficiency = 28.6 mpg (2015 adjusted fuel economy for cars).
EV efficiency = 30kWh/1000 miles (roughly equivalent to a Nissan Leaf).

Assessing BE: Environmental Benefit

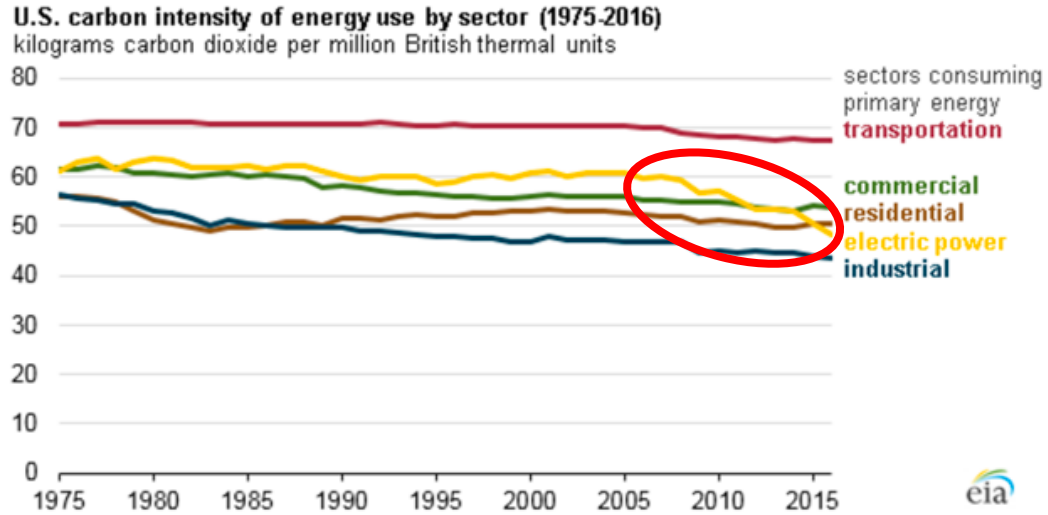


Source: Aber, Judah, "Electric Bus Analysis for New York City Transit," Columbia University, May 2016.

Assessing Environmental Benefit: Trends Are Important

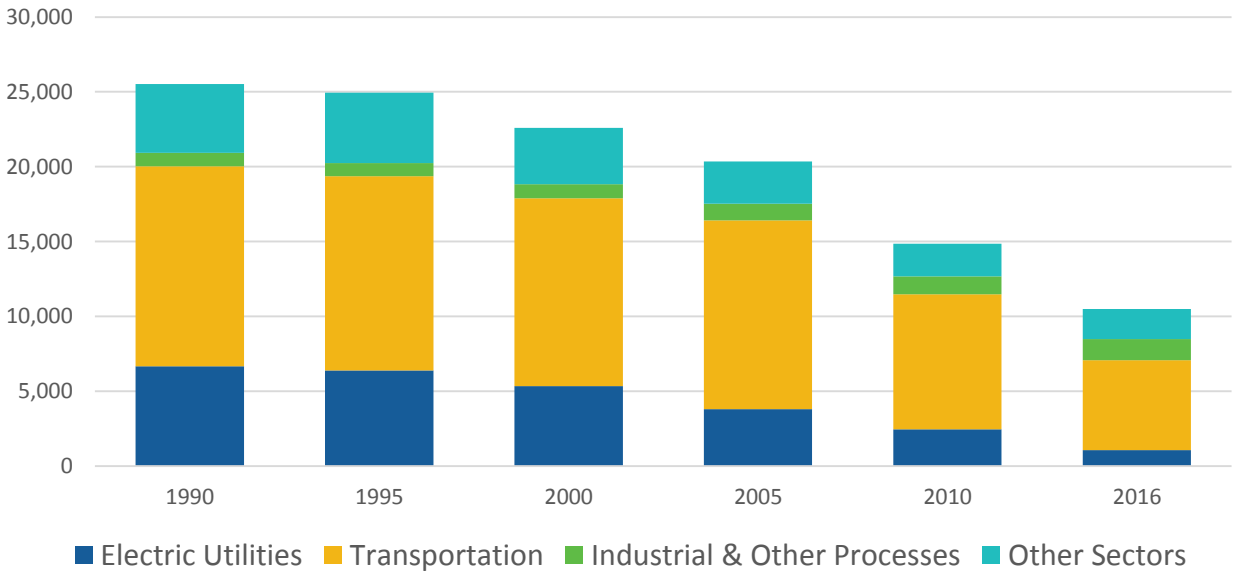
MAY 1, 2017

Carbon intensity of energy use is lowest in U.S. industrial and electric power sectors



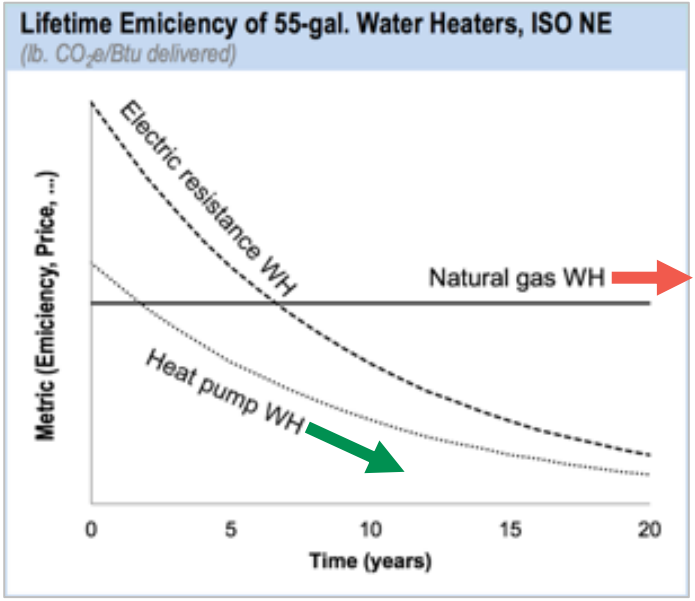
Source: https://www.eia.gov/todayinenergy/detail.php?id=31012

Nitrogen Oxides – National Trends



Source: U.S. EPA National Emissions Inventory, 2016

As the Grid Gets Cleaner, So Do Electric Devices



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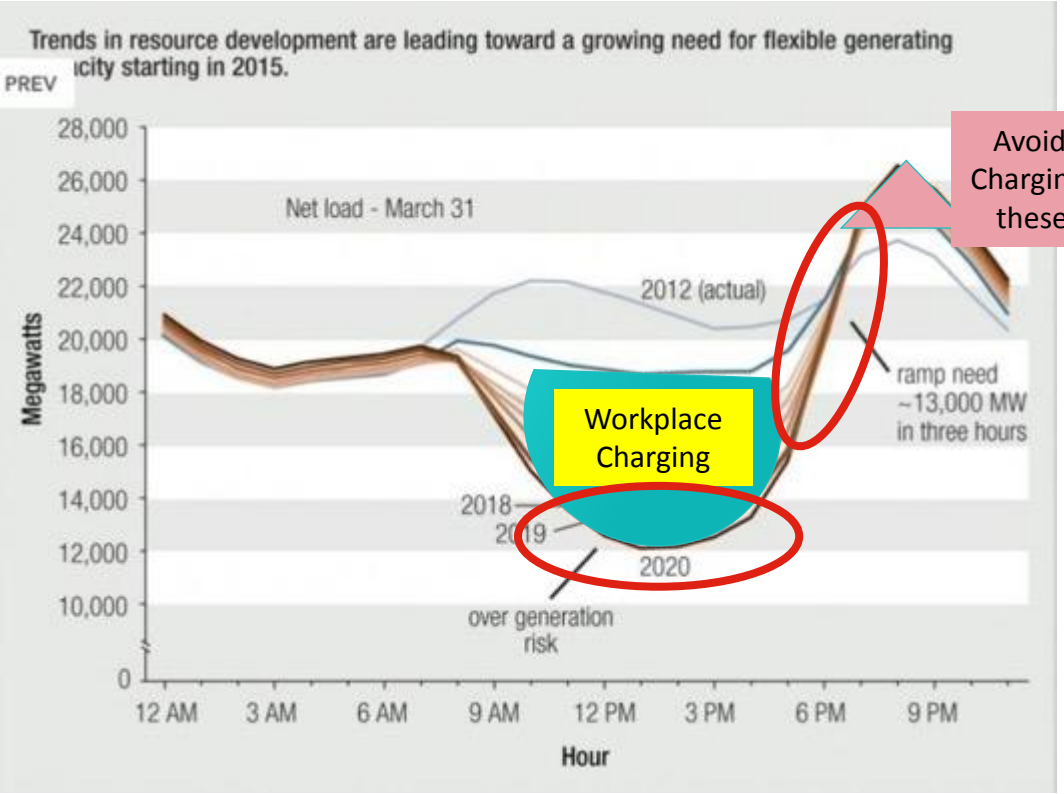
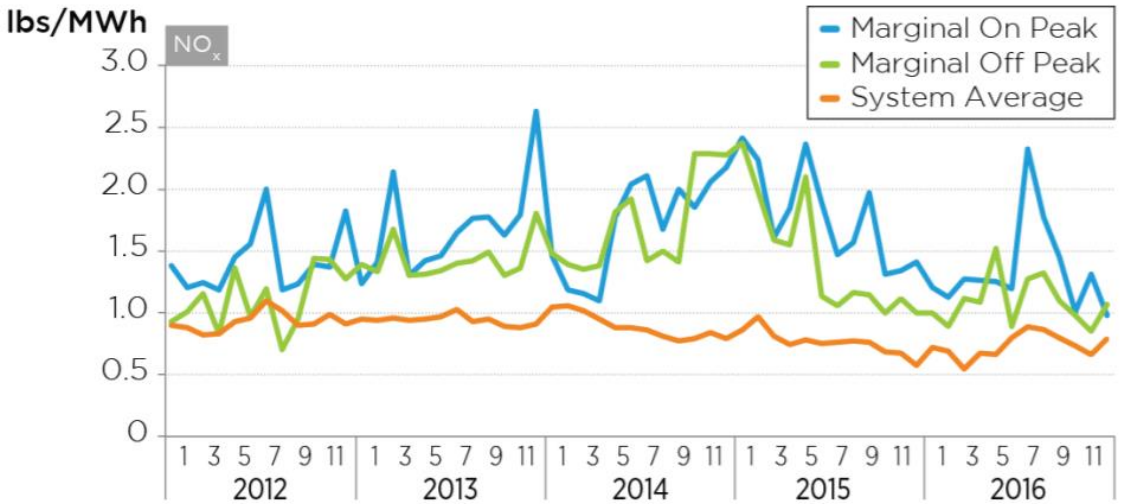
Assessing BE: Better Grid Management



Other Principles to Consider: Marginal Emissions

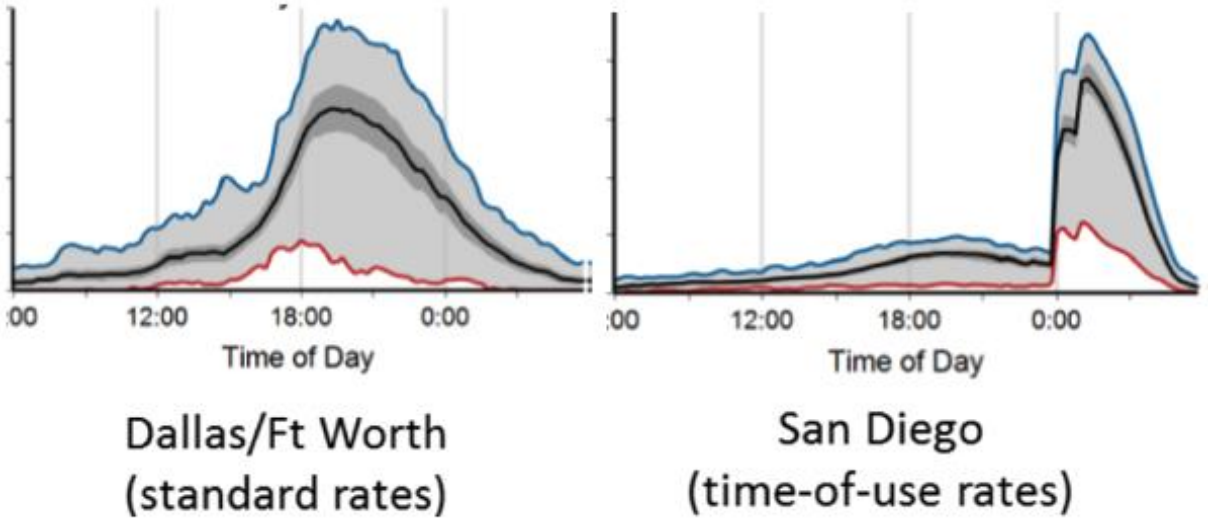
NOx emissions - PJM



Source: https://www.pjm.com/~/media/library/reports-notices/special-reports/20170317-2016-emissions-report.ashx

Other Principles to Consider: Rate Design

EV Charging Patterns – Rate Design Comparison



MJ Bradley, Accelerating the Electric Vehicle Market, 2017, P. 16, derived from Idaho National Energy Laboratory data.

Takeaways

1. BE means electricity use may increase, but overall energy-related emissions decrease
2. *When* electricity is used affects emissions and cost
3. BE may allow states to get ahead on achieving air quality standards
4. Key role for air regulators: ensure BE happens

Resources

- Beneficial Electrification – blog post series
- Opportunity Knocks for Beneficial Electrification – webinar
- Teaching the Duck to Fly
- Using Energy Efficiency to Advance Air Quality Compliance
- Retooling Regulation: Integrating Environmental and Energy Planning through a multi-pollutant E-Merge Approach

About RAP

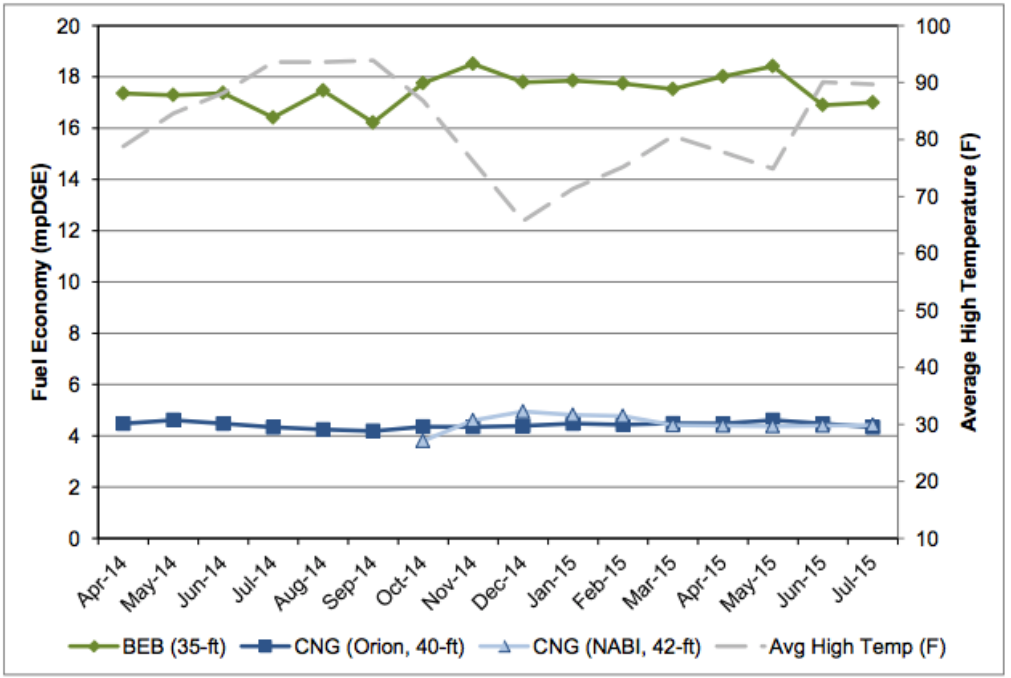
The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org

Extra slides

Efficiency of Electric Buses

Monthly average fuel economy for battery-electric and CNG buses (mpDGE)



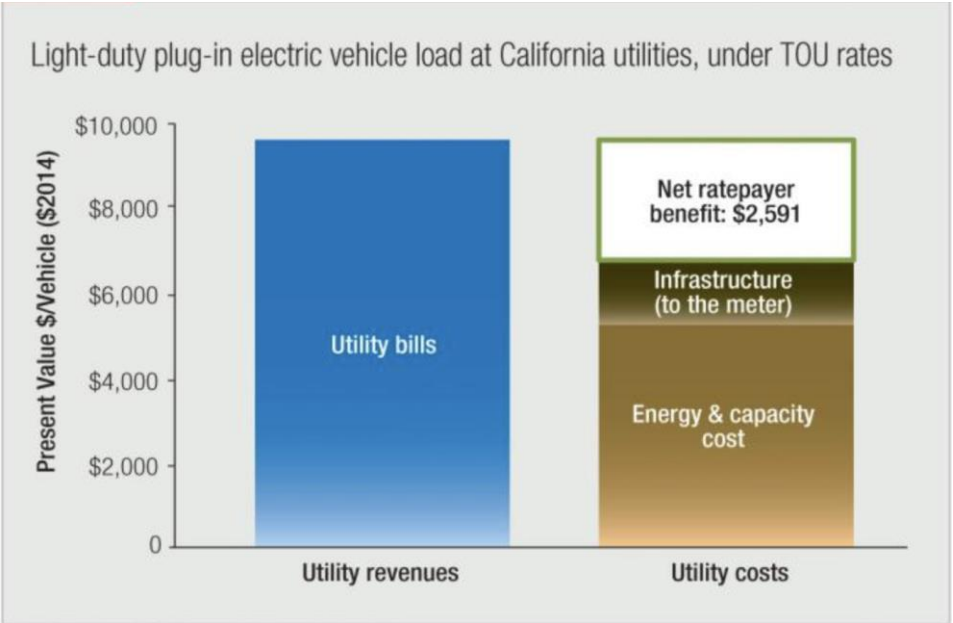
Source: NREL, 2016 https://www.nrel.gov/docs/fy16osti/65274.pdf

NOx Savings From Port Electrification

Technology	Typical NOx emissions (lbs/year)	Potential load impact (MWh/year)	NOx emissions from electrification	% reduction in NOx (overall)
RTG Cranes	5400	368	368	93
Yard Tractors	1600	78	78	95
Shore Power (per call)	900-1600	16-68	16-68	98
Switcher locomotives	16500	775	775	95
Forklifts	800	25	25	97

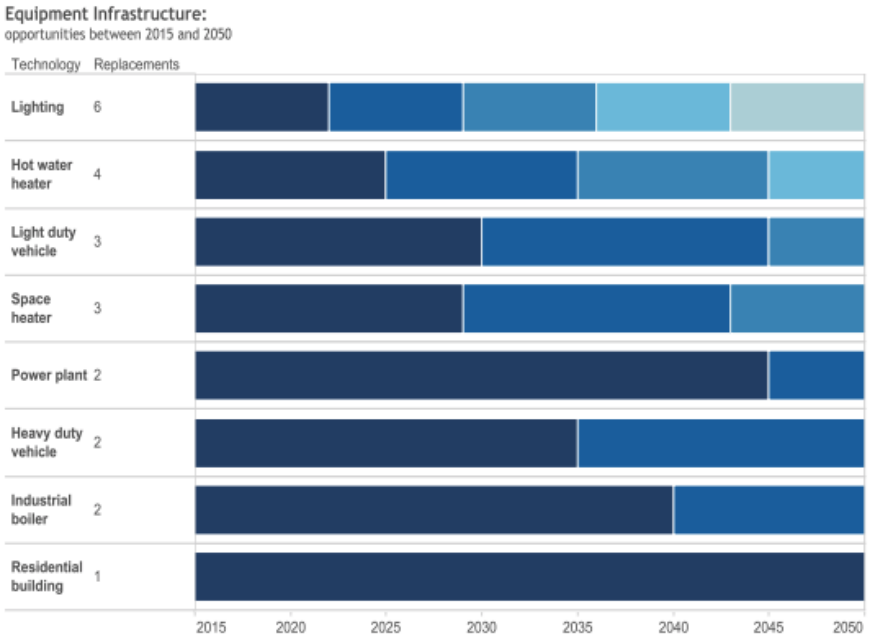
Source: National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports. See: https://www.epa.gov/ports-initiative/national-port-strategy-assessment.

Electricity system benefit from EVs charged with TOU rates



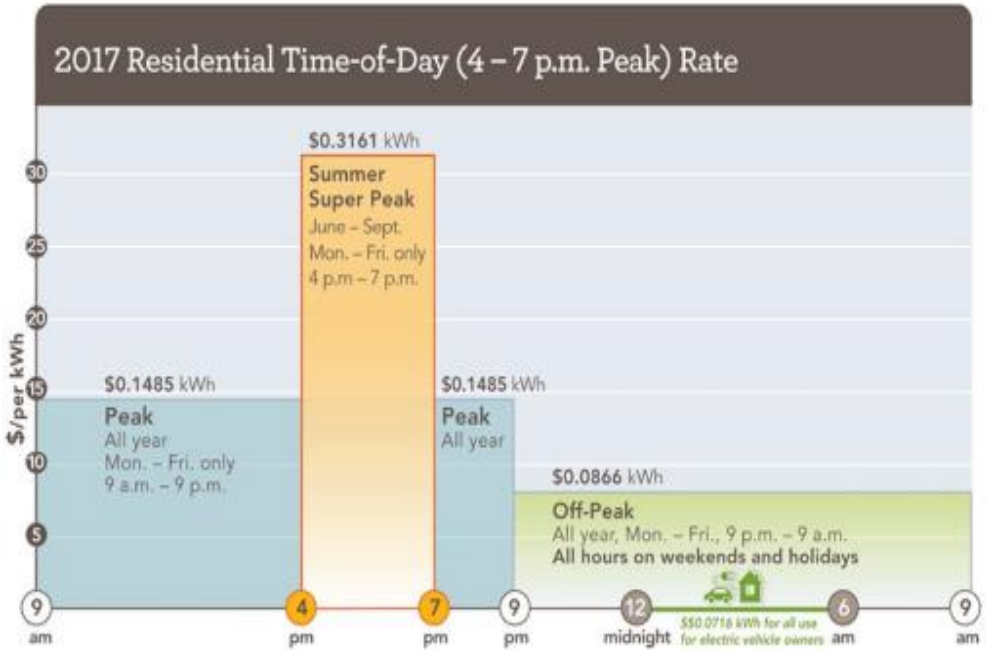
Nancy Ryan and Lucy McKenzie, *Utilities' Role in Transport Electrification: Capturing Benefits for All Ratepayers*, April 2016 https://www.fortnightly.com/fortnightly/2016/04/utilities-role-transport-electrification-capturing-benefits-all-ratepayers

Lifetimes until replacement of key infrastructure



Williams, J.H., B. Haley, R. Jones (2015). Policy implications of deep decarbonization in the United States. A report of the Deep Decarbonization Pathways Project of the Sustainable Development Solutions Network and the Institute for Sustainable Development and International Relations. Nov 17, 2015

Smart Residential Rate Design



Source: SMUD

Assessing BE – Environmental Benefit

Gasoline vehicle: 350 gallons/ year x 19.6 lbsCO_2/ gallon = **6860 pounds CO_2**

EV: 3000 kWh charging on

100% coal = **6426 pounds CO_2**

100% gas = **2386 pounds CO_2**

And cleaner from there…