Beneficial Electrification: Opportunities and Considerations for Air Quality

2018 NACAA Spring Membership Meeting
Chattanooga, Tennessee
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
1. Saves Customers Money Long-Term
2. Reduces Environmental Impacts
3. Enables Better Grid Management
Beneficial Electrification – Transportation
Efficiency of Electric Vehicles

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 = 30 kWh/1000 miles (roughly equivalent to a Nissan Leaf).
Assessing BE: Environmental Benefit

Assessing Environmental Benefit: Trends Are Important

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

Source: U.S. Energy Information Administration, Monthly Energy Review

Source: https://www.eia.gov/todayinenergy/detail.php?id=31012
Nitrogen Oxides – National Trends

As the Grid Gets Cleaner, So Do Electric Devices
Assessing BE: Better Grid Management

Avoid Home Charging during these hours

Workplace Charging
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

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)

### NOx Savings From Port Electrification

<table>
<thead>
<tr>
<th>Technology</th>
<th>Typical NOx emissions (lbs/year)</th>
<th>Potential load impact (MWh/year)</th>
<th>NOx emissions from electrification</th>
<th>% reduction in NOx (overall)</th>
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<td>Forklifts</td>
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</tbody>
</table>

Electricity system benefit from EVs charged with TOU rates

Lifetimes until replacement of key infrastructure

Smart Residential Rate Design

Source: SMUD
Assessing BE – Environmental Benefit

Gasoline vehicle:
350 gallons/ year x 19.6 lbsCO₂/ gallon
= 6860 pounds CO₂

EV:
3000 kWh charging on
100% coal = 6426 pounds CO₂
100% gas = 2386 pounds CO₂
And cleaner from there…