MAINE’S ELECTRIC VEHICLES AND INFRASTRUCTURE NEEDS

26 April 2019
Jonathan Rubin
US Transportation Energy Declines unto 2037 – Increased Efficiency

Source: AE0, 2019
US New Vehicle Sales of PEVs (1,000s): History & Projected

Source: EIA, AEO 2019, ref T48
Daily vehicle miles of travel per driver

<table>
<thead>
<tr>
<th>Year</th>
<th>Miles</th>
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<tbody>
<tr>
<td>1990</td>
<td>28.5</td>
</tr>
<tr>
<td>1995</td>
<td>32.1</td>
</tr>
<tr>
<td>2001</td>
<td>32.7</td>
</tr>
<tr>
<td>2009</td>
<td>29.0</td>
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<tr>
<td>2017</td>
<td>25.9</td>
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Driven Miles by Trip Purpose

- Work: 30.2%
- Work-related business: 6.4%
- Shopping: 14.7%
- Family/personal: 14.3%
- School/church: 5.4%
- Social: 14.6%
- Medical: 8.8%
- Recreational: 2.4%
- Other: 3.2%
- Average Journey-to-Work: 12 miles

Source: 2017 National Household Travel Survey nhts.ornl.gov
Maine PEV Population

- December 2018, 2,894 PEVs
  - 33% are dedicated battery electric (BEVs)
  - 67% are plug-in electric hybrids (PHEVs)
- Data from BMV Registration
  - Manufacturer, Model, Year, Town, Miles Driven
  - Gives us battery size
- Calculated electric range of vehicles by season
- Calculated annual electricity demand by town
# Maine’s PEVs: Electricity Demand

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Min</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td><strong>Vehicles</strong> (2894)</td>
<td></td>
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<tr>
<td>Miles driven/day</td>
<td>26</td>
<td>20</td>
<td>&lt;1</td>
<td>135</td>
</tr>
<tr>
<td>Range (miles)</td>
<td>69</td>
<td>78</td>
<td>10</td>
<td>295</td>
</tr>
<tr>
<td>Battery Capacity (KWH)</td>
<td>21</td>
<td>22</td>
<td>4.4</td>
<td>100</td>
</tr>
</tbody>
</table>

**Electricity Demand:** \[ D_{BEV_i} = \frac{M_i}{R_i} \times C_i \]
Top 10 PEV towns in Maine

1. Portland
2. Brunswick
3. Falmouth
4. South Portland
5. Bangor
6. Cape Elizabeth
7. Scarborough
8. Cumberland
9. Freeport
10. Saco
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Charging Options

- More than 80% of EV Owners charge at home

- **Level 1 – 120 V**
  - Can deliver 2 to 5 miles of range per hour of charging
  - Does not require installation of additional charging equipment

- **Level 2 – 240 V**
  - 10 to 20 miles of range per hour of charging
  - Need to install additional charging equipment

- **Level 3 – DC Fast Charger – 480 V**
  - 60 to 80 miles of range in 20 minutes
  - Used in public charging stations (corridors)
  - **Maine: 863 vehicles can use DC fast charger**

https://www.energy.gov/eere/electricvehicles/vehicle-charging
154 Charging Locations in Maine
Summer Daily Charge Frequency

Once/day

Daily average (0.6/day)
Winter Daily Charge Frequency

-41% driving range on winter days (20F) with heat on
Charging demand of PEVs in Maine (2018) ~ roughly the annual electricity demand of 750 homes
Maine’s 75% Net Electricity Gen. is Renewable: Low GHGs from PEVs

State Averages for Maine

Electricity Sources

- Hydro: 31.44%
- Biomass: 22.07%
- Wind: 21.06%
- Natural Gas: 19.66%
- Other Fossil: 3.24%
- Oil: 1.76%
- Coal: 0.66%
- Solar: 0.11%

Annual Emissions per Vehicle

- All Electric
- Plug-in Hybrid
- Hybrid
- Gasoline

Pounds of CO2 Equivalent

Maine PEVs – each BEV saves 90% v. gasoline, each PHEV saves 65% (low GHG electricity, high fuel economy)

NREL: EV Infrastructure Tool

Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite
This tool provides a simple way to estimate how much electric vehicle charging you might need at a city- and state-level.

Your Results
In the Portland area, to support 356 plug-in electric vehicles you would need:

9 Workplace Level 2 Charging Plugs
7 Public Level 2 Charging Plugs
   There are currently 44 plugs with an average of 1.6 plugs per charging station per the Department of Energy’s Alternative Fuels Data Center Station Locator.
1 Public DC Fast Charging Plugs
   There are currently 15 plugs with an average of 2.5 plugs per charging station per the Department of Energy’s Alternative Fuels Data Center Station Locator.

Number of vehicles to support 356

Vehicle Mix
| Plug-in Hybrids 20-mile electric range | 15% |
| Plug-in Hybrids 50-mile electric range | 35% |
| All-Electric Vehicles 100-mile electric range | 15% |
| All-Electric Vehicles 250-mile electric range | 35% |
| Total | 100% |

Tool: Charging at non-residential stations will be used to maximize eVMT
https://afdc.energy.gov/evi-pro-lite
Insights from National Research

- Consumer preference for PHEV versus BEVs not settled, but important
  - Residential charging at multi-unit dwellings is a key factor for the non-residential PEV charging infrastructure
  - A minimum level of fast charging coverage across the city is still required (range anxiety)

- Consumers don’t need public charging for most daily trips but they want it anyway

- Communities are expected to have significantly larger charging infrastructure requirements (coverage) than Interstate corridors

Levinson, Rebecca and Todd H. West, “Impact of Public Electric Vehicle Charging Infrastructure,” Sandia National Laboratory, TRB 97th Annual Meeting, 2017
Muratori, Matteo, “Plug-In Electric Vehicles: Infrastructure Analysis at NREL,” TRB 97th Annual Meeting, 2017
Despite a doubling of the number of charging stations in California from 2014 to 2017 there was no meaningful increase in the number of consumers who claim to have seen a charger.

Source: Automakers and Policymakers May Be on a Path to Electric Vehicles; Consumers Aren’t By Ken Kurani and Scott Hardman
California Research: Awareness of EVs is Low

- Awareness of EVs in California has not increased between 2014–2017
- Outreach investment likely needs to be significantly higher than current levels to significant compared to general vehicle advertising
- Dealers have very low levels of knowledge in selling EVs

Source: Brown, A and S. Fuller, UC Davis Policy Institute for Energy, Environment & Economy, Webinar, April 8th 2019
How can we support PEV adoption in Maine?

- Range is still an issue – perceived or real
  - Rebates on home charger installation
  - Workplace/shopping chargers
- Targeted (income/location based) rebates on vehicles
- Consider building codes that require chargers at multi-unit residences
- Lack of awareness
  - Information tools and events for the public
    - Test driving improves perceptions
  - Cost calculators, vehicle comparisons, EV days
- Work with local dealerships to increase sales