Alternative Fuel Vehicle Infrastructure

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“The North Carolina Clean Energy Technology Center advances a sustainable energy economy by educating, demonstrating and providing support for clean energy technologies, practices, and policies.”
Why Alternative Fuel Vehicles?

Today a business success measured by the triple bottom line:

- Willingness to do business—customers and suppliers
- Ability to recruit and retain top talent
- Energy security & fuel diversity
- Domestic economy
- Savings—reinvest or other areas
- Reduced emissions-environment/health
- Mandate or regulation
Significant Contributor to GHG Emissions


- Transportation: 28%
- Industry: 22%
- Electricity: 28%
- Commercial & Residential: 11%
- Agriculture: 9%

https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions
GHG Emissions by Fuel Type

- Gasoline (E10)
- Diesel (B20)
- Biodiesel (B100)
- Ethanol (E85)
- Natural Gas
- Propane
- Electricity

- Well to Wheel GHGs (Kg/GGE)
- Tailpipe GHGs (Kg/GGE)
# Snapshot of US Public AFV Infrastructure

## US Public Alternative Fuel Stations

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Stations</th>
<th>Plugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>467</td>
<td></td>
</tr>
<tr>
<td>CNG</td>
<td>921</td>
<td></td>
</tr>
<tr>
<td>LNG</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>EV L1</td>
<td>1,086</td>
<td>2,200</td>
</tr>
<tr>
<td>EV L2</td>
<td>17,948</td>
<td>45,177</td>
</tr>
<tr>
<td>EV DCFC</td>
<td>2,517</td>
<td>9,013</td>
</tr>
<tr>
<td>TOTAL EV</td>
<td>21,551</td>
<td>56,390</td>
</tr>
<tr>
<td>Ethanol</td>
<td>3,301</td>
<td></td>
</tr>
<tr>
<td>Biodiesel (&gt;B20)</td>
<td>197</td>
<td></td>
</tr>
</tbody>
</table>

156,000 Public Gas Stations in US

Source: [https://afdc.energy.gov/stations/#/find/nearest](https://afdc.energy.gov/stations/#/find/nearest)
Snapshot of US AFV Infrastructure

Source: [https://afdc.energy.gov/stations/#/find/nearest](https://afdc.energy.gov/stations/#/find/nearest)
Recent Trend AFV Stations: Public and Private

Source: http://www.afdc.energy.gov/data/10332
Recent Trend AFV Stations: Public and Private Electric Plugs

Electric Plugs: ~70% Public

Source: [http://www.afdc.energy.gov/data/10332](http://www.afdc.energy.gov/data/10332)
Top States for EVSE

Top 10 States for Charging Infrastructure
(2017 Public & Private ~70% public)

Source: http://www.afdc.energy.gov/afdc/fuels/stations_counts.html
Multi-State ZEV Task Force

Source: https://www.zevstates.us/
PEV Sales 2011-2016

All Electric Vehicle Sales 2011-2016

Cumulative Sales: 295,330
Approximately 500,000 on US Roads

>60 PEV options 2018/2019

Source: [https://insideevs.com/compare-plug-ins/](https://insideevs.com/compare-plug-ins/)
<table>
<thead>
<tr>
<th>Charging Types Summary</th>
<th>Charging Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>4 to 5 miles per hour</td>
</tr>
<tr>
<td>Level 2</td>
<td>11 to 60 miles per hour</td>
</tr>
<tr>
<td>DC Fast</td>
<td></td>
</tr>
<tr>
<td>25kW</td>
<td>22.5 miles per 15 minutes</td>
</tr>
<tr>
<td>50kW</td>
<td>45 miles per 15 minutes</td>
</tr>
<tr>
<td>120kW</td>
<td>108 miles per 15 minutes</td>
</tr>
<tr>
<td>150kW</td>
<td>135 miles per 15 minutes</td>
</tr>
<tr>
<td>350kW</td>
<td>315 miles per 15 minutes</td>
</tr>
<tr>
<td>400kW</td>
<td>360 miles per 15 minutes</td>
</tr>
</tbody>
</table>

Sources: [https://www.fleetcarma.com/electric-vehicle-charging-guide/](https://www.fleetcarma.com/electric-vehicle-charging-guide/)
[https://evobsession.com/electric-car-charging-101-types-of-charging-apps-more/](https://evobsession.com/electric-car-charging-101-types-of-charging-apps-more/)
[https://plugincars.com/first-150-kw-fast-charging-station-opens-tesla%e2%80%99s-backyard-132652.html](https://plugincars.com/first-150-kw-fast-charging-station-opens-tesla%e2%80%99s-backyard-132652.html)
DOT FHWA Alternative Fuel Corridors

Objectives:
- National network of alternative fueling and charging infrastructure along national highway system corridors
- Promote build out of national network
- Develop national signage and branding to help catalyze applicant and public interest
- Encourage multi-State and regional cooperation and collaboration

To date results:
- 58 Nominations
- Portions/segments of 84 Interstates & 43 US highways/state roads
- 44 states & D.C.
- Over 100,000 miles of the National Highway System (all fuels combined).

Source: [https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/](https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/)
FHWA Alternative Fuel Corridors: EVSE
FHWA Alternative Fuel Corridors: EVSE
### Summary of State EV Actions

<table>
<thead>
<tr>
<th>Type of Action</th>
<th># of Actions</th>
<th>% by Type</th>
<th># of States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Incentives</td>
<td>56</td>
<td>27%</td>
<td>11 + DC</td>
</tr>
<tr>
<td>Studies and Investigations</td>
<td>34</td>
<td>16%</td>
<td>23 + DC</td>
</tr>
<tr>
<td>Deployment</td>
<td>32</td>
<td>15%</td>
<td>16 + DC</td>
</tr>
<tr>
<td>Regulation</td>
<td>31</td>
<td>15%</td>
<td>12</td>
</tr>
<tr>
<td>Market Development</td>
<td>30</td>
<td>14%</td>
<td>7 + DC</td>
</tr>
<tr>
<td>Rate Design</td>
<td>28</td>
<td>13%</td>
<td>18 + DC</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>211</strong></td>
<td><strong>100%</strong></td>
<td><strong>32 States + DC</strong></td>
</tr>
</tbody>
</table>

Note: The “# of States/ Districts” total is not the sum of the rows because some states have multiple actions. Percentages are rounded and may not add up to 100%.

Common actions:
- Level 2 charging station deployment
- Electric vehicle rate tariffs
- Fast charging station deployment
- Rebate programs

Source: 50 States of EV Quarterly Report: Q3 2018, NC Clean Energy Technology Center
Summary of State EV Actions

Source: 50 States of EV Quarterly Report: Q3 2018, NC Clean Energy Technology Center
Number of Actions by Category

Source: 50 States of EV Quarterly Report: Q3 2018, NC Clean Energy Technology Center
National Plug-In Infrastructure Analysis

• DOE EERE Vehicle Technology Office September 2017
• How much EVSE is needed in the United States to support both plug-in hybrid electric vehicles (PHEVs) & battery electric vehicles (BEVs)—plug-in vehicles (PEVs)
• Looked at 2-pieces--Community non-residential and national network
• Four areas of deployment focus:
  – Cities >50,000 (71% of population)
  – Towns 2,500 to 50,000 (10% of US population)
  – Rural areas (19% of US population)
  – Interstate highway corridors (28,530 miles)

Source: https://www.nrel.gov/docs/fy17osti/69031.pdf
National Plug-In Infrastructure Analysis: Study Area
National Plug-In Infrastructure Analysis: Community Non-Residential Estimates

- Level 2 plug count 63,000 to 1,100,000—central case 600,000
- DCFC 8,400 to 65,000—central case 25,000
National Plug-In Infrastructure Analysis: DCFC National Network

- Station count 137 to 713—central case 408
- Plug count 824 to 3,709—central case 2,472
National Plug-In Infrastructure Analysis: DCFC National Network Coverage Area
National Plug-In Infrastructure Analysis: DCFC Combined Coverage Area
How to Fund/Accomplish

• Private companies: ChargePoint, ABB, Clipper Creek, Electrify America, . . .
• VW Settlement Mitigation Funds 15% of $3B
• CMAQ funding
• State funding and tax credits (currently 31 states)
• Public private partnerships—Northeast EV Network, the West Coast Electric Highway, Washington State EV Action Plan, . . .
• Cooperatives—Sourcewell, National Cooperative Buying Alliance, Fleets for the Future
General Comments

• PEVs are real and a viable transportation option
• EVSE network is critical for wide scale adoption
• “Perceived range anxiety” is an obstacle
• Rate and time of growth is uncertain
• Going to take a combination of awareness and motivation generation through education, policy, incentives and collaboration
• Moving target with rapid technology changes
• Largest obstacle to overcome is human nature to resist change
• Level 1 charging has its place
Some Interesting Statistics to Consider

• 73% of Tesla buyers supercharger network influenced purchase (Tesla)
• 95% to 98% of charging occurs at home or at work (DOE)
• 85%-95% of charging occurs at home (DOE)
• Person is 20 times more likely to purchase a plug-in vehicle, if they have access to charging at work (DOE)
• 70% of daily driving is <40 miles and 95% is <100 miles (DOE)
• US drivers use personal vehicle for trips >100 miles 6 days/year (DOE)
• 80% of consumer vehicles are owned by multi-vehicle households (DOE)
• 91% of PEV registrations where 71% of population lives—cities (DOE)
About the 50 States Report Series

Quarterly publications detailing state and utility activity related to: (1) distributed solar policy & rate design, (2) grid modernization and energy storage, and (3) electric vehicles

https://nccleantech.ncsu.edu/our-work/policy/the-50-states-reports/

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