USA Hybrid and Electric Vehicles – Market and R&D Activity

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TRANSPORTATION IS FUNDAMENTAL TO OUR WAY OF LIFE

11 Billion Freight Tons
3 Trillion Vehicle Miles

- 50% of the weight and 37% of the value of goods are moved less than 100 miles between origin and destination.
- In 2018, USPS shipped 6.2 Billion packages — up from 4 Billion in 2014.
- Technologies and fuel choices are expanding.
- Transportation costs are high — second only to housing expenses.

In 2018, USPS shipped 6.2 Billion packages — up from 4 Billion in 2014.
Transportation Fuel Type (2018)
(Total consumption: 28.4 trillion Btu)

- **Petroleum (91.6%)**
- **Natural Gas (3.1%)**
- **Renewables* (5.0%)**
- **Electricity (0.3%)**

* "Renewables" include hydro-electric, geothermal, wind, solar, and bio-mass energy.

Source: Transportation Energy Data Book, edition 37 (January 2019), Table 2.03
Vehicle Miles Traveled (VMT) has increased about 150% over the past 40 years, but Petroleum Use and GHG Emissions have decreased about 40%.

Advanced Vehicle Technology and Regulations have played a major role in this trend.

**THE CHALLENGE**

- 240 million LDV on the road in the U.S.
- 16M LDVs annual sales
- 10-15 years for annual sales penetration
- 10-15 years to turn over fleet

**Sources:**

- Petroleum and GHG from EIA Monthly Review [http://www.eia.gov/totalenergy/data/monthly](http://www.eia.gov/totalenergy/data/monthly)
- VMT from AFDC [http://www.afdc.energy.gov/data/10315](http://www.afdc.energy.gov/data/10315)
HEV Sales (1999–2018)

- 60 models available
- 343,219 sold in 2018
- 5% decrease over 2017

Source: Argonne National Laboratory Data
HEV Market Share (2013 vs. 2018)

• Over 2013–2018, HEV sales shrank from 495,535 to 343,219 (31% loss).
• Toyota still held the top market share in 2018 (45%), but it was smaller than in 2013 (58%).
• In 2018, Toyota, Ford and Lexus accounted for about 73% of the HEV market (down from 82% in 2013).

HEV Market Share (by Automaker)

Source: Argonne National Laboratory Data
PEV Sales (2011–2018)

• 52 models available
• 361,315 sold in 2018
• 85% increase over the 2017 sales (195,581).

Source: Argonne National Laboratory Data
PEV Market Share (2018)

PEV Market Share (by Automaker)

- In 2018, 52 PEV models were available for sale in the U.S.
- Tesla held the top market share (53%)
- The 2018 PEV sales leaders represented 70% of sales
  - Tesla Model 3 (139,782)
  - Prius PHEV (27,595)
  - Tesla Model X (26,100)
  - Tesla Model S (25,745)
  - Honda Clarity Plug-in (18,602)
  - Chevrolet Volt (18,306)
  - Chevrolet Bolt (18,019)
- Sales were 85% more in 2018 than in 2017.

Source: Argonne National Laboratory Data
Industry

- **Tesla** became the top seller of luxury cars in the U.S.
  - From January to November 2018, Tesla Model 3 sold about 114,160 units.
- **GM** plans to double its allocated resources for EVs and autonomous vehicles in 2019-20.
- **Ford** plans to spend $11 billion on 40 PEVs over 2018-2022.
- **Mazda** vehicles mix, by 2030, will be HEVs 95%, PEVs 5%.
- **Daimler** will develop >10 PEVs by 2022, with associated charging infrastructure (“ecosystem”).
- **Volvo** will have five new full EVs in its lineup by 2021.
- **Electric scooters** debuted in cities across the U.S. (**Bird, Lime**).
  - Smartphone apps for rental.
- **MD/HD vehicle manufacturers** are entering the EV market.
  - **Daimler** deployed its first all-electric truck.
  - **Volvo Trucks** plans to begin demonstrations of all-electric VNR heavy-duty trucks.
Electric trucks coming from Daimler, Freightliner, Volvo, and others

Daimler unveils electric eCascadia semi truck to compete with Tesla Semi, launches electric truck group

Volvo introduces electric delivery/garbage truck with 186-mile range

big, and tonight he showed off his
tric Tesla Semi. Powered by a massive:
,000 pounds, it can ramble 500 miles
tself—on the highway, at least.
ill start in 2019.
Policy Activities

FEDERAL (U.S. Department of Energy)
- $19 million to 12 cost-shared projects focused on batteries and electrification technologies to enable extreme fast charging.
- $80 million for early-stage research of advanced vehicle technologies.
- New initiatives
  - Next-Generation “Low Cobalt/No Cobalt” Cathodes ($24 million over 3 years)
  - Battery Recycling Prize ($5.5 million)
  - Lithium-ion Battery Recycling R&D Center ($15 million over 3 years)

STATE
- California Executive Order B-48-18
  - all state entities to work with the private sector and government to put at least 5 million zero-emission vehicles (ZEVs) on California roads by 2030.
- Electrify America: $200-million investment in zero emission vehicle (ZEV) infrastructure as well as education and awareness in California
- Maryland Bill SB 1234
  - requires a percentage of its light-duty vehicles fleet purchases are to be ZEVs.
- EVolve NY: New York Power Authority
  - Committed up to $250 million (through 2025) for various EV initiatives.
# Charging Stations available

<table>
<thead>
<tr>
<th>Chargers</th>
<th>2017</th>
<th>2018</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Level 1 Chargers</td>
<td>1,300 (2,604)</td>
<td>1,031 (2,029)</td>
<td>-21% (-22%)</td>
</tr>
<tr>
<td>AC Level 2 Chargers</td>
<td>15,639 (38,264)</td>
<td>19,008 (48,818)</td>
<td>+22% (+28%)</td>
</tr>
<tr>
<td>Fast Chargers</td>
<td>2,232 (6,267)</td>
<td>2,620 (9,626)</td>
<td>+17% (+54%)</td>
</tr>
<tr>
<td>Superchargers (incl. in Fast Chargers)</td>
<td>394 (2,831)</td>
<td>594 (5,413)</td>
<td>+51% (+91%)</td>
</tr>
<tr>
<td>Totals</td>
<td>17,219 (47,135)</td>
<td>20,959 (60,535)</td>
<td>+22% (+28%)</td>
</tr>
</tbody>
</table>

U.S. Electric Charging Stations

Source: http://www.afdc.energy.gov/fuels/electricity_locations.html
State-level Distribution of Charging Stations

- California leads other states in the number of charging stations by an order of magnitude

Source: http://www.afdc.energy.gov/data
DOE Batteries & Electrification Program

Structure, Budget, and Information Resources

FY 2019 ($163.4M)

Electric Drive
- Power Electronics
- Electric Motors
- Traction Drive Systems

($110.1M)

Grid & Infrastructure
- Modeling & Simulation
- Grid Integration
- Cybersecurity

($31.1M)

Battery R&D
- Materials R&D
- Battery Development
- Advanced Processing

($22.2M)

Resources

- VTO Annual Merit Review Report

- R&D Annual Progress Reports
  https://www.energy.gov/eere/vehicles/annual-progress-reports

- R&D Roadmaps

- R&D Highlights (USCAR)
Battery Cost Reduction

$197
Cost per kWh for modeled battery down from $1000/kWh in 2008.

- Results based on prototype cells & modules meeting DOE/USABC performance targets.
- Detailed USABC battery cost model used to estimate the cost of PEV battery packs assuming that 100,000 batteries are manufactured annually.
Questions?

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