Ford Vehicle to Grid & Vehicle to Building Outlook

Desired Outcome for Discussion:
- Outline EV market evolution
- Understand how Ford’s BEV lineup supports V2L
- Case for exporting DC to support Vehicle to Building
Electric Utility Perspective

Utilities continue to renovate the grid with investments in renewable energy technology.

- 40% of all new electricity generating capacity added in the U.S. in Q1 2020 was Solar (3.6 GWdc of PV)

- By 2025, 33% of new residential solar systems and 25% of new non-residential solar systems will be paired with energy storage

<table>
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<tr>
<th>Effects of Environmental Factors</th>
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<td><strong>Mismatched Energy Production &amp; Demand</strong></td>
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<td>Renewable sources produce energy when the sun shines or wind blows.</td>
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| **Grid Disruption** |
| Weather events temporarily disable/prevent grid to customer distribution. |

| **Key Consideration** |
| Continued renewable generation growth will drive a need for careful load management, and for energy storage |
EV Consumers Perspective

**Current State**

EVs (e.g. MachE) have large batteries:
+70 kWhr

**Daily Commute**

EV drivers will use only a small portion of their total battery capacity 10%-15% for the average commute

**Could Large-Capacity BEVs help support power needs via V2H, V2G?**
Ford BEV Historical Lineup

Focus Electric (2009-2017)
- Range: 70-120 miles
- Battery Size: 23-33.5 kWh

Mach-E (2021-)
- Range: 230-300 miles
- Battery Size: 68-88 kWh

F-150 (2022-)
- Range: ? miles
- Battery Size: ? kWh
- Pro Power: ? kWAC

E-Transit (2022-)
- Range: ~126 miles
- Battery Size: 67 kWh
- Pro Power: 2.4kW AC

Daily driver/commuting

Commercial / Fleet customers

Power Export for Job Sites

- F-150 Hybrid: Pro Power Feature
  - 2.4KW Standard on PowerBoost™ / Outlets in bed: Dual 120V 20A
  - 7.2KW Optional on PowerBoost / Outlets in bed: Four 120V 20A, one 240V NEMA L14-30R

- Gradual increases in both range and available battery capacity
- Vehicle to Load historically unavailable
Considerations for Exporting Power (V2B)

**Vehicle to Load (AC Export)**
- Requires onboard mobile inverter for bidirectional flow
- Communication to grid could be handled by vehicle
- Requires further certification work for automakers
- Larger portion of costs attributed onboard the vehicle (Package, Thermal Mgmt)
- Ford does not recommend using AC for home backup
- Small local benefits to consumers

**Vehicle to Building (DC Export)**
- Uses stationary inverter on electric vehicle supply equipment (EVSE)
- Grid Monitoring and Communication managed off-board
- Already established devices in the market
- Larger portion of costs attributed offboard the vehicle
- Larger benefits to consumers and utilities
- Ford recommends DC for energy backups
Challenges with Vehicle to Building/Exporting Power

• Technology onboard vehicles needs development and uniform standards adoption

• Inverters are generally expensive (thousands of dollars)

• Warranty concerns surrounding added battery cycling
  • Differences between V2L vs. V2B
  • Battery Durability Requirements

• Certification and Regulatory authority over automobile electrical systems.
  • Need to develop complete certification structure for automakers

• Cost – Onboard Inverter cost is more expensive than Off board inverter.
  • Overall cost system cost dependent upon architecture.
  • Typical cost drivers : Inverter sizing > 10KW, Critical Load Sub panel, Transfer SW.
How can the CEC help?

- Consider allowing automaker self-certification
  - Allows for more streamlined approvals
  - Limits unnecessary cost increases on vehicles

- Incentives for vehicle to grid adoption
  - CARB could consider a credit mechanism for GHG abatement
  - Incentives for automakers, customers, etc.
  - Warranty based on a mix of Amp-hrs / vehicle miles

- Help deliver a strong, consistent signal to the market for widespread deployment
  - Update Rule 21 to streamline interconnection.

Regulatory certainty will accelerate development and adoption of V2H technologies
Q &A