Comprehensive Overview of Human Interface for an Extended Range Electric Vehicle

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Human Interface for an Extended Range Electric Vehicle

- Three high level operations that require unique human interface design:
  - Charging
  - Driving in Electric
  - Driving in Extended Range Mode

- Information is presented on the cluster, center stack, charging status indicators, and by mobile application or internet.
Charging

• Very important interface because the customer will interact with the charging system regularly in order to drive the vehicle in electric operation.

• Visual
  ✴ Charging Status Indicator on Dashboard (SAE J1772)
  ✴ Peek In Screen on Cluster
  ✴ Charging Screens on Center Stack

• Audible – Indications to inform the customer that the vehicle is successfully charging or is set to begin charging at a later time.
# Charging Status Indicator

<table>
<thead>
<tr>
<th>Charging Status Indicator</th>
<th>Sound</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Yellow</td>
<td>No sound</td>
<td>Cord is okay, vehicle is not charging</td>
</tr>
<tr>
<td>Solid Green</td>
<td>One horn chirp</td>
<td>Charging has begun</td>
</tr>
<tr>
<td>Long Flashing Green</td>
<td>Two horn chirps</td>
<td>Charging is delayed and scheduled to begin later</td>
</tr>
<tr>
<td>Short Flashing Green</td>
<td>No sound</td>
<td>Charging is complete</td>
</tr>
<tr>
<td>Solid or Long Flashing Green</td>
<td>Four horn chirps</td>
<td>Insufficient time to fully charge by set departure time</td>
</tr>
<tr>
<td>No light</td>
<td>No sound</td>
<td>Charge cord connection should be checked</td>
</tr>
<tr>
<td>No light</td>
<td>Repeated horn chirps</td>
<td>Electricity interrupted before charging was complete</td>
</tr>
</tbody>
</table>
Charging Screens

- The Charging Screens appear on the Center Stack and allow the customer to view and change their charging settings as well as displaying the charging start and end times.

The “Peek In Screen” allows the customer to preview the charging information by opening the driver door.
Electric Range Display

- The electric range is a prediction of the distance the vehicle could travel based on current and previous factors. These factors fall into three categories that can significantly impact actual electric range and the estimated electric range display:
  
  - **Terrain**
    
    The electric range changes due to driving terrain (also known as road load) depending on the elevation changes in the roads as well as head winds, snow, road surface conditions and the amount of passengers or cargo.
  
  - **Temperature**
    
    Electric range may vary due to energy usage for air conditioning, cabin heating, fan, heated seat usage, and thermal battery temperature maintenance of the high voltage battery. The performance of the high voltage battery at different temperatures will also impact the range.
  
  - **Technique**
    
    Driving technique varies from hyper-miler (economical technique) to more typical driving to more of an aggressive (performance technique) driving style. Slow accelerations and smooth braking that optimizes regenerative energy aid in achieving a higher electric range.
Driving in Electric

- Battery Gauge is displayed prominently with a predicted Electric Range.
- Customer could choose Simple or Enhanced Configuration.

Figure 1. Simple configuration shown with battery gauge in the foreground and fuel gauge on the right.

Figure 2. Enhanced configuration shown with battery gauge in the foreground and driver efficiency gauge on the right.
Driving in Extended Range Operation

- Fuel Gauge is displayed with associated fuel range.
- Additional selectable operating modes are available with the press of the Drive Mode button.
- Selectable Modes are Sport, Mountain, and Normal.
Energy Power Flow Screens

- The customer can access additional information through the green leaf button.
- Screens may be viewed during Electric or Extended Range Mode to show the customer how the vehicle is operating and when they are recovering power.

Displayed on Center Stack
Energy Information Displays

- The Energy Usage Screen summarizes the electric and fuel mileage and fuel used since the last full charge compared to the lifetime fuel economy.
- Energy Efficiency provides a score of the driving style and climate setting for the trip.
Maintenance Modes

• Engine and Fuel Maintenance Modes are part of the extended range system.
• Messaging was developed to give the customer the option of delaying the maintenance for 24 hours and to inform the customer.
Summary / Conclusion

• Human Interface designed to help the customer feel comfortable with new and unfamiliar.

• Additional information available for those who are interested in more about the vehicle’s operation.

• The interface was designed so the customer could easily operate the vehicle as intended, but also have the information to achieve the maximum fuel economy benefit.