Are the buyers ready for electric cars?

Frances Sprei
Associate Professor in Sustainable Mobility
Department of Space, Earth and Environment
Chalmers

September 13th 2018 - Initiative seminar: Electromobility - Back to the future
Are the electric cars ready for the buyers?

Frances Sprei
Associate Professor in Sustainable Mobility
Department of Space, Earth and Environment
Chalmers
Share of vehicles that can cover all their driving on a given range

Source: Jacobsson et al, 2016
Share of vehicles that can cover all their driving on a given range – with adaptation once per month

Source: Jacobsson et al, 2016
Share of vehicles that can cover all their driving on a given range – with adaptation once per week

Source: Jacobsson et al, 2016
What range do BEV have?

Source: Nykvist et al, under review
BEVs in Two-Car Households

Share of cars that fulfill all driving

Fulfill all driving at range 120 km:
First cars < 10%
All Cars ≈ 15%
Second cars ≈ 30%

Jakobsson et al., 2016 "Are multi-car households better suited for battery electric vehicles – Driving Patterns and economics in Sweden and Germany". *Transportation Research Part C: Emerging Technologies*
How are battery electric vehicles used in 2-car households?

On average (20 households):

- Long daily driving distances are reduced.
- Short daily driving distances are reduced.
- Distances congregate at 40-90 km.
Large differences between households – interviews help explain why
BEV attributes - charging

Source: Nykvist et al, under review
BEV attributes – size and acceleration

Source: Nykvist et al., under review
When will cost for a 200 mile range come down to average prices?

Source: Nykvist et al, under review
So are BEV ready for buyers?

Short answer: pretty close

Long answer:
- With 300 km range ~ 65 % of cars can cover all their driving
- 85 % with some kind of adaptation once a month
- Two-car households are especially suitable for adoption of BEV
- Regarding other attributes BEV are comparable with average vehicles
- 300 km range could reach average price of US market slightly after 2020
CHALMERS

Extra slides
Comparing 4 different data sets (no adaptation and once a month)

Share of users that manage their driving within a range

Source: Plötz et al, 2017
How does range and charging power affect charging need? Germany

<table>
<thead>
<tr>
<th>Power</th>
<th>50 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range [km]</td>
<td>100</td>
</tr>
<tr>
<td>Time (min)</td>
<td>14.09</td>
</tr>
<tr>
<td>fast charging stations/1,000BEV (VRI)</td>
<td>6.8</td>
</tr>
</tbody>
</table>

Based on German driving data, queueing model, max 5 min waiting

Source: Gnann et al, 2018
How does range and charging power affect charging need? Germany

<table>
<thead>
<tr>
<th>Power</th>
<th>50 kW</th>
<th>100 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range [km]</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Time (min)</td>
<td>14.09</td>
<td>22.8</td>
</tr>
<tr>
<td>fast charging</td>
<td>6.8</td>
<td>5.3</td>
</tr>
<tr>
<td>stations/1,000BEV (VRI)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on German driving data, queuing model, max 5 min waiting

Source: Gnann et al, 2018
### How does range and charging power affect charging need? Germany

<table>
<thead>
<tr>
<th>Power</th>
<th>50 kW</th>
<th>100 kW</th>
<th>150 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range [km]</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Time (min)</td>
<td>14.09</td>
<td>7.0</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>22.8</td>
<td>11.4</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>27.0</td>
<td>13.5</td>
<td>9.0</td>
</tr>
<tr>
<td>fast</td>
<td>6.8</td>
<td>2.4</td>
<td>1.4</td>
</tr>
<tr>
<td>charging</td>
<td>5.3</td>
<td>1.8</td>
<td>1.0</td>
</tr>
<tr>
<td>stations/1,000BEV (VRI)</td>
<td>3.7</td>
<td>1.2</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Based on German driving data, queing model, max 5 min waiting

Source: Gnann et al, 2018
Attributes of BEV – divided by price percentile

- Highest third
- Middle third
- Lowest third
Battery pack costs
Long ranged PHEV can achieve similar electric VKT as shorter range BEV

Source: Plötz et al (2017)
Share of eVMT in 2+ car households in California

 depicts the share of electric vehicle miles traveled (eVMT) in households with 2+ cars, based on 74 households with at least 2 cars and a PEV. The graph shows similar shares between longer range PHEVs (e.g., Volt) and Leaf.

Data source: UC Davis

Based on 74 households with 2+ cars with a PEV

Similar shares between longer range PHEV (Volt) and Leaf