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Institute of Transportation Studies  
UC Davis  
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PEV WORLD MARKET
A plausible California scenario based on laws, incentives & history of previous technology rollouts

1st generation: policy, vehicles, "innovators" & infrastructure 200,000 PEVs

2nd generation: 200 mile batteries, automated vehicles, "followers" 4-500,000 PEVs

3rd generation: batteries, vehicles, "core market" 6-800,000 PEVs

4th generation: 3 - 4 million???

Curve based on rollout of HEVs in Japan & California 1997-2015 & rules

2010: 1-2% 3-5% of market
2015: 3-5% of market
2020: Early core market: 6-15%
2025: Main market 15-25%
2030: California 2025 ZEV goal = 15% / 1.2-5 million BEVS, FCV & PHEVs

Lithium pack prices per kWh:
- 700
- 300
- 200
- 150
Many PEV sales forecasts getting optimistic about PEV sales

Tom estimates red line would be 10% of world market in 2020 (100 million LDVs)

Tom guesses 600 million might be 40% of world market in 2040 (150 million LDVs?)

Source: Bloomberg New Energy Finance
Recent stated policy goals shaping market and commercialization of PEVs

- California like ZEV programs potentially expanding to China, EU
- 2040 national goals to eliminate conventionally fueled vehicle sales:
  - UK “clean air,”
  - France “carbon” (all policy steps not yet developed)
  - India, Norway (2030)
- Cities: ban on diesel in cities:
Multiple studies point to “pack” prices under $200 per kWh early next decade. A 60 kWh pack (Bolt or Tesla 3) would be around $10,000.

- Tesla says cells $190 kWh in 2016 & $100 in 2020.
- GM said it paid $145 per kWh “cell” for 2017 Bolt.

Source: Bloomberg, McKinsey, DOE.
The total number of PEVs in the world at end of 2017 will likely exceed 3 million (out of 1 billion vehicles) & 1 million in sales out of 88 million (about 100,000 per month)
There was 37% PEV market growth worldwide in 2016.
Just 14 urban markets account for a third of global electric vehicle sales

- The sales leaders have 10,000 to 40,000 new electric vehicle sales per year
- The sales share leaders have electric vehicle shares of 10-27% of new vehicle sales

6 cities near or above 10% of sales in 2016

Hold up in subsidies in 1st quarter 2017 & 2016 slowed sales in China. US saw strong growth in 1st quarter compared with last year.

**Plug-in Sales and % Growth**

- **China**: 60 (2017-Q1), 43 (2016-Q1) (+41%)
- **Japan**: 11 (2016-Q1) (+21%)
- **Europe**: 66 (2017-Q1), 52 (2016-Q1) (+28%)
- **USA**: 28 (2016-Q1) (+49%)
- **Other**: 4 (2016-Q1) (+195%)
China now has over 1 million PEVs and accounts for almost 50% of world sales.

China Plug-in Volumes - Passenger Cars

- PEV Population (Pass. Cars '000s)
- Annual Sales ('000s)

2% of total sales

EVVOLUMES.COM
### 2016 PEV Sales Top 10 Cities in China: BEVs only in Beijing & registration restrictions are important

<table>
<thead>
<tr>
<th>City</th>
<th>2016 PEV Sales</th>
<th>BEV Manufacturer</th>
<th>PHEV Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing</td>
<td>63000</td>
<td>BAIC</td>
<td></td>
</tr>
<tr>
<td>Shanghai</td>
<td>41483</td>
<td>SAIC</td>
<td></td>
</tr>
<tr>
<td>Qingdao</td>
<td>27198</td>
<td>BYD</td>
<td>BYD</td>
</tr>
<tr>
<td>Shenzhen</td>
<td>25131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tianjin</td>
<td>21611</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taiyuan</td>
<td>17854</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guangzhou</td>
<td>16506</td>
<td></td>
<td>GAC</td>
</tr>
<tr>
<td>Hangzhou</td>
<td>15033</td>
<td>Geely, Zotye</td>
<td></td>
</tr>
<tr>
<td>Hefei</td>
<td>7805</td>
<td>JAC</td>
<td></td>
</tr>
<tr>
<td>Wuhu</td>
<td>7413</td>
<td>Chery</td>
<td></td>
</tr>
</tbody>
</table>

*City with plate restriction*

Data Source: WAYS, 2017 [www.way-s.cn](http://www.way-s.cn)
Cumulative USA & California PEVs June 2017

USA
Total PEV = 647,956
June sales = 16,591
YTD sales = 86,934

California
Total PEV = 308,174

CUMULATIVE SALES

- USA
  - Total PEV = 647,956
  - June sales = 16,591
  - YTD sales = 86,934
- California
  - Total PEV = 308,174

* Assumes CA sales are approximately 50% of National sales (7/5/2017)
Refer to www.hybridcars.com
USA Sales could hit 200,000 by end of year; Tesla 3 and next Nissan Leaf should be significant additions (source Inside Evs)

1 % of US market
California almost 5% in this quarter, 8 states are at 1-2%, the rest of US at about .5%
California PEV sales around 5%:
1st quarter 2017 - source CNCDA
German car market responding to incentives and new models
(June & July around 4000)

1% of new car sales
Market is increasingly diversified, with new competition each quarter.

<table>
<thead>
<tr>
<th>Make</th>
<th>EV '000s</th>
<th>PHEV '000s</th>
<th>Q1-17 Share</th>
<th>+/- vs CY2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesla</td>
<td>13,9%</td>
<td>13,0%</td>
<td>+4,0%</td>
<td></td>
</tr>
<tr>
<td>BMW Group</td>
<td>9,3%</td>
<td>9,2%</td>
<td>+1,7%</td>
<td></td>
</tr>
<tr>
<td>Nissan</td>
<td>8,8%</td>
<td>8,7%</td>
<td>+1,5%</td>
<td></td>
</tr>
<tr>
<td>BAIC</td>
<td>6,9%</td>
<td>6,8%</td>
<td>+0,9%</td>
<td></td>
</tr>
<tr>
<td>VW Group</td>
<td>6,3%</td>
<td>6,2%</td>
<td>-1,9%</td>
<td></td>
</tr>
<tr>
<td>TMC</td>
<td>5,5%</td>
<td>5,4%</td>
<td>+5,1%</td>
<td></td>
</tr>
<tr>
<td>GM</td>
<td>5,3%</td>
<td>5,2%</td>
<td>+1,1%</td>
<td></td>
</tr>
<tr>
<td>Renault</td>
<td>5,2%</td>
<td>5,1%</td>
<td>+1,7%</td>
<td></td>
</tr>
<tr>
<td>BYD</td>
<td>4,8%</td>
<td>4,7%</td>
<td>-8,4%</td>
<td></td>
</tr>
<tr>
<td>Daimler</td>
<td>3,5%</td>
<td>3,4%</td>
<td>+0,8%</td>
<td></td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>3,5%</td>
<td>3,4%</td>
<td>-0,3%</td>
<td></td>
</tr>
<tr>
<td>SAIC</td>
<td>3,4%</td>
<td>3,3%</td>
<td>+0,9%</td>
<td></td>
</tr>
<tr>
<td>Zhidou</td>
<td>3,0%</td>
<td>2,9%</td>
<td>+0,4%</td>
<td></td>
</tr>
<tr>
<td>Hyundai-Kia</td>
<td>2,9%</td>
<td>2,8%</td>
<td>+0,8%</td>
<td></td>
</tr>
<tr>
<td>Ford</td>
<td>2,6%</td>
<td>2,5%</td>
<td>-0,6%</td>
<td></td>
</tr>
<tr>
<td>Zotye</td>
<td>2,5%</td>
<td>2,4%</td>
<td>-2,2%</td>
<td></td>
</tr>
<tr>
<td>JMC</td>
<td>2,5%</td>
<td>2,4%</td>
<td>+0,5%</td>
<td></td>
</tr>
<tr>
<td>Volvo</td>
<td>2,1%</td>
<td>2,0%</td>
<td>-0,2%</td>
<td></td>
</tr>
<tr>
<td>Geely</td>
<td>1,0%</td>
<td>0,9%</td>
<td>-1,2%</td>
<td></td>
</tr>
<tr>
<td>Kandi</td>
<td>1,0%</td>
<td>0,9%</td>
<td>-0,5%</td>
<td></td>
</tr>
<tr>
<td>Dongfeng</td>
<td>1,0%</td>
<td>0,9%</td>
<td>+0,3%</td>
<td></td>
</tr>
<tr>
<td>JAC</td>
<td>0,8%</td>
<td>0,7%</td>
<td>-1,5%</td>
<td></td>
</tr>
<tr>
<td>PSA</td>
<td>0,8%</td>
<td>0,7%</td>
<td>+0,1%</td>
<td></td>
</tr>
<tr>
<td>FCA</td>
<td>0,8%</td>
<td>0,7%</td>
<td>+0,3%</td>
<td></td>
</tr>
<tr>
<td>Changan</td>
<td>0,7%</td>
<td>0,6%</td>
<td>+0,1%</td>
<td></td>
</tr>
<tr>
<td>Other (40)</td>
<td>1,8%</td>
<td>1,7%</td>
<td>-3,1%</td>
<td></td>
</tr>
</tbody>
</table>
EU Policy shapes PHEV vs BEV; supply of PHEVs has gone up
(source evVolumes)

- Austria is "not" rewarding PHEVs,
- Norway is recently rewarding PHEVs
- Netherlands has shifted policy emphasis to BEVs

% market growth in 2016

PHEVs | BEVs
---|---
Austria | 
Belgium | 
France | 
Germany | 
Netherlands | 
Norway | 
Sweden | 
United Kingdom |
Number of models in PEV market closely linked to sales growth—thru Q-1 2017

**USA**

- USA Sales
- USA No. of Models

**Norway**

- Norway Sales
- Norway No. of Models

**Germany**

- Germany Sales
- Germany No. of Models

**Netherlands**

- Netherlands Sales
- Netherlands No. of Models
While the current offerings emphasizes small sedans, the shift is to SUV/Crossover & should expand sales.

The number and variety of electric vehicle models continues to grow. By the end of 2017, about 40 different models are expected to be available. By 2021, at least 60 models are projected.
“Can you name a BEV that is being sold in the US?”

Awareness, knowledge, consideration of PEVs
Surveys of 2014-2017 California Car Buyers (n=1600)
Source: K. Kurani UC Davis
Thank you

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4 Research Staff, programmers