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China’s PEV Deployment
Portland, June 21, 2017
## U.S.- China PEV Development

### US PEV Sales

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>15/14</th>
<th>16/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEVs</td>
<td>67,851</td>
<td>71,158</td>
<td>84,246</td>
<td>4.9%</td>
<td>18.4%</td>
</tr>
<tr>
<td>PHEVs</td>
<td>55,357</td>
<td>43,143</td>
<td>72,935</td>
<td>-22.1%</td>
<td>69.1%</td>
</tr>
<tr>
<td>Total PEVs</td>
<td>123,208</td>
<td>114,301</td>
<td>157,181</td>
<td>-7.2%</td>
<td>37.5%</td>
</tr>
</tbody>
</table>

### China PEV Sales

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>15/14</th>
<th>16/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total BEVs</td>
<td>45,048</td>
<td>247,482</td>
<td>409,000</td>
<td>449.4%</td>
<td>65.3%</td>
</tr>
<tr>
<td>Total PHEVs</td>
<td>29,715</td>
<td>83,610</td>
<td>98,000</td>
<td>181.4%</td>
<td>17.2%</td>
</tr>
<tr>
<td>Total PEVs</td>
<td>74,763</td>
<td>331,092</td>
<td>507,000</td>
<td>342.9%</td>
<td>53.1%</td>
</tr>
</tbody>
</table>

### Additional Information

- **Source:** US numbers from Hybridcars.com; Chinese numbers from CAAM

### Conversion

- **Total Auto Sales:**
  - US: 16,435,226
  - China: 24,597,600
  - Total: 41,032,826

- **PEVs as % of Auto Sales:**
  - US: 0.75%
  - China: 0.30%
  - Total: 1.05%
Motivations of China’s EV Policy

• National Security-Energy Dependency
  – The Strait of Malacca dilemma
  – Heavy dependency on Imported Oil 66%-70%
  – Resources imbalance (lot’s of coal, not much oil, and little NG)

• Industrial Policy
  – Leapfrog *(JV accounts for 4/5 and 7/10 top sellers in China in 2016)*
  – Renewable Industry Expansion
  – Regional GDP (Shanghai, Beijing, Shenzhen, and Hefei)

• Environmental Policy
  – Smog (PM 2.5) in megacities
  – Meeting China’s international commitment to Climate changes
Players in China’s EV Sector

- **MoST**
  - Minister WAN Gang
  - 863 R&D Program
  - Ten city and One Thousand Program
- **MIIT**, the designated regulator of the auto industry
  - Certification and List
  - CAFC and ZEV Policy
- **NDRC**
  - Permit to production and expansion
  - Special List for NEV producers
  - Carbon Tax
- **MoF**
  - Subsidies
  - Taxes
- **EV100**
- **DRC**—Development and Research Center of the State Council, an advisory body to the Premier
- **CATARC**—testing and certification, provides staff and advice to NDRC, MIIT, MOF
- **NDRC-ERI**
- **CAAM** (China Association of Automotive Manufacturers) works closely with MIIT
- **SAE-China**
- **State Grid and Southern State Grid**
- **Tsinghua University**
  - Professor Ouyang Minggao’s Group
Why did the Chinese PEV Market take off in 2014-2016?

- Monetary Incentives
- Non-monetary Incentives
- Innovative business models and others
- Issues to be addressed
Why did the Chinese PEV Market take off in 2014-2016?

1. Monetary Incentives

- Huge subsidies: USD 8.4 Billion in 2015 in obligation by the Central Gov. vs USD 865 million or less by Washington (close to 10 times)
  - Local governments’ subsidies could match or double that amount as shown in Shanghai and Beijing.
  - 84 percent of the USD 8 billion are for commercial vehicles in 2015
- Exemption of the 10% sales tax
- Subsidies to install home chargers
Why did the Chinese PEV Market take off in 2014-2016?

2. Non-monetary Incentive--license plate privilege in Beijing and Shanghai

• Leading cities: Beijing, Shanghai, Shenzhen, Hangzhou, etc
• These are all cities with license restriction policies; Beijing and Hangzhou, Also driving restriction policies

• Beijing: lottery ; BEV
• Shanghai: auction ; BEV and PHEV
• Shenzhen: lottery and auction ; BEV and PHEV
• Hangzhou: lottery and auction ; BEV and PHEV
Direct and Implied Subsidies in Shanghai

But what is the value of a license plate in Beijing (0.15%)?

Direct and Implied Subsidies in Shanghai (Pudong).

<table>
<thead>
<tr>
<th></th>
<th>PHEV</th>
<th>BEV 150–250&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>31,500</td>
<td>45,000</td>
</tr>
<tr>
<td>Shanghai</td>
<td>30,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Pudong (Financial District)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Sub-total</td>
<td>81,500</td>
<td>105,000</td>
</tr>
<tr>
<td>2015 License Plate Price</td>
<td>80,686</td>
<td>80,686</td>
</tr>
<tr>
<td>Total Subsidies, RMB</td>
<td>162,186</td>
<td>185,686</td>
</tr>
<tr>
<td>2015 Exchange Rate</td>
<td>6.489</td>
<td>6.489</td>
</tr>
<tr>
<td><strong>Total Subsidies, US$</strong></td>
<td><strong>$24,994</strong></td>
<td><strong>$28,615</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup> We listed the typical BEV range of 150–200 km; for those above 250 km, they received more subsidies: 54,000 RMB per vehicle.

<sup>b</sup> We selected Pudong District, which provided additional support.
3. Innovative Business Models and Others
Kandi (Panda) Car Share and Hourly Leasing “Micro Transit” Center
Almost like a vending machine, where cars are being charged waiting for hourly renters
4. Issues to be addressed

- Sometimes conflicting goals (HEVs vs PEVs)
  - Leapfrogging international OEMs
  - Energy security
  - Clean air in mega-cities
- Regional protectionism (Beijing, Shenzhen-Yuan 50 million entrance fee, and other cities’ policies)
  - Demand local key components, local production, quid pro quo, 10 year/150km guarantee.
- Lack of inputs from consumers:
  - PHEVs or BEVs?
  - How big is the battery needed for Beijing/Shenzhen/Shanghai: 31km and 50% travel less than 10 km every day?
- Transition from the Visible Hand to the Invisible Hand (CA ZEV Policy)
  - Overinvestment and over-subsidies?
  - Wrong timing and wrong technologies?
- Dependency on and Cheatings of Subsidies and Quality Concerns (see next slide)
• One Passenger EV manufacture was penalized by MOF—Lifan_2395

• Five Commercial EV manufactures were penalized by MOF—Jimuxi_1131; Jinlong Lianhe_1683; Shaolin_252; Wuzhoulong_154; Qirui Wanda_327

• 5,942 EVs (1.8%); 1,124 million Yuan ($167.7 m) (3.4%); in early 2017, the government added another 7 companies with 4,468 EVs; all together, about 3.2% PEVs are in question.

• Up to 76,374 EVs (22.4%); 9,712 million Yuan ($1,388 m) (27.8%), based on unofficial but widely circulated report.
China is Adopting California ZEV Mandate
UC Davis—CATARC China-U.S. ZEV Policy Lab
with support from NDRC and CARB
September 6, 2014; Tianjin, China
The ZEV Policy Lab is a unique platform for stakeholder participation & informed discussions with gov’t officials (NDRC, MOF, MIIT, CATARC)

August 20, 2015 Asilomar Workshop – intense discussion and information exchange
June 2017: Governor Brown Promotes ZEV Cooperation with China
California ZEV Mandate: Percentage Credit Requirement

- **Minimum ZEV Floor** - Portion of ZEV requirement that must be met with ZEV credits
- **TZEV Credits** - Portion of requirement that may be met with credits from TZEVs

<table>
<thead>
<tr>
<th>Model Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.0%</td>
<td>3.0%</td>
<td>4.0%</td>
<td>6.0%</td>
<td>8.0%</td>
<td>10.0%</td>
<td>14.0%</td>
<td>16.0%</td>
</tr>
</tbody>
</table>
Starting From 2018 California will adopt the new ZEV Credit Formula; so will China

**ZEVs**

<table>
<thead>
<tr>
<th>Credits per Vehicle</th>
<th>Zero Emission Range (UDDS Test Cycle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>250</td>
</tr>
</tbody>
</table>

- **200 mile ZEV**
  - EPA Label = 200
  - km = 4.64
  - Credits for 2018 MY = 3

- **2015 Hyundai Tucson FCV**
  - EPA Label = 265
  - Approx. AER = 360
  - Credits for 2018 MY = 4
  - China 576 km = 5

- **2016 Nissan LEAF (30 kWh)**
  - EPA Label = 107
  - Approx. AER = 160
  - Credits for 2018 MY = 2
  - Leaf in China 256 km = 3.87

- **70%**

2018-2020NEV Credits Requirements: 8%, 10%, 12%.

<table>
<thead>
<tr>
<th>Passenger Vehicle Types</th>
<th>Electric Range R (Driving Cycle, km)</th>
<th>R=&gt;350</th>
<th>R=&gt;50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.012*R+0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEVs</td>
<td>/</td>
<td>5</td>
<td>/</td>
</tr>
<tr>
<td>PHEVs (including REEVs)</td>
<td>/</td>
<td>/</td>
<td>2</td>
</tr>
<tr>
<td>FCEVs</td>
<td>/</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
The Differences Between the Old and New NEV Credit Policy Proposals

The formula changes from steps to linear with more credits for BEVs

- A: 100–150 km
- B: 183–250 km
- C: 267–350 km

Diagram showing the transition from step changes to linear changes with old and new credit systems.
## Comparison Between ZEV and Proposed NEV Credit Policies: Similar?

<table>
<thead>
<tr>
<th></th>
<th>California</th>
<th>MIIT (Proposal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory Territory</strong></td>
<td>10 states, about 28% of the U.S. market</td>
<td>Nationwide</td>
</tr>
<tr>
<td><strong>OEM’s Regulated</strong></td>
<td>Sales &gt; 20,000; and 4,500 and ≤ 20,000</td>
<td>Production/Imports &gt; 50,000</td>
</tr>
<tr>
<td><strong>2018-2020 Minimum Mandate in Credits</strong></td>
<td>4.5%, 7%, 9.5%..................22% (2015)</td>
<td>8%, 10%, 12%</td>
</tr>
<tr>
<td>If an OEM with 100,000 Passenger Cars in either sales or production in 2018</td>
<td>i.e. Nissan Leaf (R = UAER 160 Miles=2) Will need 2250 vehicles</td>
<td>A BEV with 256 km=3.87 will need 2066 vehicles</td>
</tr>
<tr>
<td>Target each year</td>
<td>Sales Volume</td>
<td>Production Volume</td>
</tr>
<tr>
<td>The minimum and maximum limits for PHEVs (blended vs PHEVs)</td>
<td>10 miles = 0.4/0.6 credits. 50 miles PHEVs = 0.8 or non-blended=1.0</td>
<td>50 km = 2 Credits</td>
</tr>
<tr>
<td><strong>Life of Credits</strong></td>
<td>Permanent</td>
<td>Valid only in the same year</td>
</tr>
<tr>
<td>Exchangeable between CAFÉ/CAFC</td>
<td>No; but the same PEV in CAFÉ counts as zero/low energy consumption</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Minimum ZEV Requirement (BEVs and FCEVs)</strong></td>
<td>Yes, 2% (2018); 4% (2019); 6% (2020)</td>
<td>No. PHEVs alone can meet the NEV Requirements</td>
</tr>
<tr>
<td>Fine</td>
<td>One ZEV Vehicle in Deficit: $37,500</td>
<td>No. (No law supports this)</td>
</tr>
<tr>
<td>Administrative Penalty</td>
<td>If there is a proof that OEMs didn’t try to meet the ZEV requirement, then they will be suspended from selling vehicles in California</td>
<td>OEMs will be forced to reduce the production of high consumption vehicles, at least the same number of the NEV credits in deficit (1 credit = 1 V)</td>
</tr>
</tbody>
</table>