Comparison of promotion programs for new energy vehicles

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国际清洁交通委员会

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We are a nonprofit independent international research institute
ICCT简介


**Board of Directors**  Dan Greenbaum, head of Health Effects Institute, chair of ICCT board.

**Funding**  California philanthropies plus government grants and contracts.

**Mission:** To dramatically improve environmental performance and efficiency of motor vehicles (cars, trucks, marine, aviation) and fuels by supporting government regulatory agencies in world’s top vehicle markets.

**Geographic scope:** China, US, EU, Japan, Brazil, India, Canada, Korea, Indonesia, Australia, Mexico plus smaller markets by request.
Contents

- Global trend of NEVs
- ICCT studies
  - Phase I: Global consumer incentive policy comparison
  - Phase II: US state-level incentive policy comparison
  - Next Phase
- Conclusions
Global trend of NEVs
ICCT studies
  Phase I: Global consumer incentive policy comparison
  Phase II: US state-level incentive policy comparison
  Next Phase
Conclusions
NEV on the rise, globally
新能源车在全球销量增长迅速

- Global NEV sales doubled in each of the past three years
  - US, EU and Japan China are major EV markets, China is following…

ICCT EV report: http://www.theicct.org/driving-electrification-global-comparison-fiscal-policy-electric-vehicles
NEV sales outperform hybrids

新能源车的发展势头超过当初混合动力车的情况

- EVs are still <1% of auto sales in most markets, but the EV market is growing quicker than hybrids
- More model offerings (US example)

Source: ICCT internal analysis

Source: Nic Lutsey, Actions in the US to accelerate electric vehicle deployment. June 4, 2014. GFEI/ICCT workshop
One strong motivation is the increasingly tightened vehicle efficiency standard

动力之一来自不断加严的车辆能效和温室气体标准

[1] China’s target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.
[2] US standards GHG standards set by EPA, which is slightly different from fuel economy standards due to low-GWP refrigerant credits.
[3] Gasoline in Brazil contains 22% of ethanol (E22), all data in the chart have been converted to gasoline (E00) equivalent.
Electric vehicles compare favorably to efficient ICE vehicles, and in many cases to efficiency hybrid vehicles on lifecycle carbon emissions

- Even against average US electric grid (44% coal, 23% NG, 20% nuclear, 10% renew)
- Especially on electric grids in East and West coasts with low coal, high renewable content

Help the US achieve GHG reduction goals
帮助美国达到其温室气体减排目标

Electric vehicle on average generation in US states

Sources: US EPA “Trends” report (http://www.epa.gov/otaq/fetrends.htm); US EPA eGRID (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html); Includes upstream energy extraction, transmission and distribution, charging losses
GHG reduction is one major driver in California
加州的主要动力来自温室气体减排

- Reduce GHG emissions
  - 1990 levels by 2020
  - 80% below 1990 levels by 2050
  - Transport sector represents 38% today

- Strategies
  - Fuel: Clean electricity and \( \text{H}_2 \) focus
  - Vehicles: Advanced Technologies, virtually all ZEVs by 2050
  - Transportation: Improved Efficiency
    - Reduce vehicle usage
    - City planning

- ZEV program

Source: Mike McCarthy, CARB
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Fiscal incentives driving penetration levels
财税激励拉动新能源车市场

ICCT EV report: http://www.theicct.org/driving-electrification-global-comparison-fiscal-policy-electric-vehicles
ICCT research on NEV fiscal incentives and market penetration
ICCT第一项研究着眼于国家层面财政激励和市场占有率的关系

Comparison of two pairs of passenger vehicles – a BEV and its counterpart, and a plug-in hybrid and its counterpart – in major vehicle markets in 2012 and 2013

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Renault Zoe</th>
<th>Renault Clio</th>
<th>Volvo V60</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BEV</td>
<td>gasoline</td>
<td>diesel-PHEV</td>
</tr>
<tr>
<td>Engine power [kW]</td>
<td>65</td>
<td>66</td>
<td>206</td>
</tr>
<tr>
<td>Engine displacement [cm³]</td>
<td>n/a</td>
<td>898</td>
<td>2,400</td>
</tr>
<tr>
<td>Acceleration time 0-100 km/h [s]</td>
<td>13.5</td>
<td>13.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Empty weight vehicle [kg]</td>
<td>1,428</td>
<td>1,009</td>
<td>1,955</td>
</tr>
<tr>
<td>Transmission type</td>
<td>automatic</td>
<td>manual</td>
<td>automatic</td>
</tr>
<tr>
<td>CO₂ emission [g/km NEDC]</td>
<td>0</td>
<td>99</td>
<td>48</td>
</tr>
<tr>
<td>Fuel consumption [l/100km NEDC]</td>
<td>0</td>
<td>4.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Electricity consumption [kWh/100km]</td>
<td>14.6</td>
<td>n/a</td>
<td>21.7</td>
</tr>
<tr>
<td>Battery range [km]</td>
<td>210</td>
<td>n/a</td>
<td>50</td>
</tr>
<tr>
<td>Vehicle base price (Germany) excl. VAT [EUR]*</td>
<td>21,422</td>
<td>13,277</td>
<td>51,571</td>
</tr>
</tbody>
</table>

* Vehicle prices are adjusted for optional equipment and, for EV, include costs for battery (four-year rent cost if the battery is not purchased)

Total cost of ownership (TOC)

评估使用周期财税激励的总影响

Total Cost of Ownership includes vehicle purchase and registration costs, as well as ownership taxes and fuel / electricity costs for 4 years. All data estimates for tax year 2013. Vehicle base prices are assumed to the identical in all countries.
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Many policy options from various stages at different levels
电动汽车推广政策在不同阶段不同层面有多种选择

Incentives and supporting policies to NEVs

Pre-production
- R&D support to vehicles
- R&D support to parts
- R&D support to charging

Production
- Vehicle efficiency standards
- ZEV programs
- LCF standards

Sales
- Subsidy or rebate
- Tax incentives
- License fees
- Education/campaign

Infrastructure
- EVSE financing
- ..... 
- ..... 
- Education/campaign

Ownership/Usage
- Utility incentive
- HOV lane access
- Fuel disincentive
- Emission test exemption
- Free charging at public stations
- LEZ incentive
- Public charger availability
- Fleet incentive (taxi, corporate)
- Annual tax/fee reduction
- Insurance incentive
- Free parking
- Education and campaign

National
Regional
Local
Private
Total state benefit available to consumers for BEVs
州政府可量化的消费者激励（纯电动车）
State benefit available to consumers for PHEVs
州政府可量化的消费者激励（PHEV）

- Emission test exemption
- Free parking
- Carpool
- Public charger
- Home charger
- Annual fee
- License fee reduction
- Subsidies
- Sales share

California, Vermont, Oregon, Michigan, Washington, Connecticut, Delaware, Maine, Massachusetts, Hawaii, U.S. average
The impact and cost-benefit of various policy measures
各种激励政策的影响和成本收益

- Total monetary benefit available to BEV owners is significantly positively correlated with BEV sales

<table>
<thead>
<tr>
<th>Variables</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(total benefit)</td>
<td>0.044</td>
</tr>
<tr>
<td>Log(vehicle sales)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Log(% income&gt;$100k)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

- Return value for public charger investment is large for BEVs but small for PHEVs due to range confidence difference
- Our cost-benefit analysis did not account for environmental, public health and climate benefits. If these are included, return values would be higher

<table>
<thead>
<tr>
<th>Benefit-cost ratios</th>
<th>BEVs</th>
<th>PHEVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct subsidies</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>HOV lanes</td>
<td>1.19</td>
<td>1.17</td>
</tr>
<tr>
<td>Public chargers</td>
<td>2.45</td>
<td>0.41</td>
</tr>
<tr>
<td>Home chargers</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Many policy options from various stages at different levels
电动汽车推广政策在不同阶段不同层面有多种选择

Incentives and supporting policies to NEVs

Pre-production
- R&D support to vehicles (National, Regional, Local, Private)
- R&D support to parts (National, Regional, Local, Private)
- R&D support to charging (National, Regional, Local, Private)

Production
- Vehicle efficiency standards (National, Regional, Local, Private)
- ZEV programs (National, Regional, Local, Private)
- LCF standards (National, Regional, Local, Private)

Sales
- Subsidy or rebate (National, Regional, Local, Private)
- Tax incentives (National, Regional, Local, Private)
- License fees (National, Regional, Local, Private)
- Education/campaign (National, Regional, Local, Private)

Infrastructure
- EVSE financing (National, Regional, Local, Private)
- …… (National, Regional, Local, Private)

Ownership/Usage
- Utility incentive (National, Regional, Local, Private)
- HOV lane access (National, Regional, Local, Private)
- Fuel disincentive (National, Regional, Local, Private)
- Emission test exemption (National, Regional, Local, Private)
- Free charging at public stations (National, Regional, Local, Private)
- LEZ incentive (National, Regional, Local, Private)
- Free parking (National, Regional, Local, Private)
- Education and campaign (National, Regional, Local, Private)
Some untouched but important policies

- **Zero Emission Vehicle program**
  - Requires ~15% electric vehicle share (BEV, PHEV, FCV) by 2025
  - Other states following California, 8 States’ goal: 3.3 million EVs by 2025

- **Credit benefit from ZEV or fuel economy standards**
  - Tesla made $130 million by selling ZEV credits in 2013

- **US—about $7.5 billion investment to promote EVs from 2009-2019**
  - Congressional Budget Office estimates, including tax credits, technology, electrification, and manufacturing

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**Federal Incentives Available to Buyers or Producers of Electric Vehicles**

<table>
<thead>
<tr>
<th>Incentive</th>
<th>Description</th>
<th>Budgetary Cost (Billions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax Credits for New Plug-in Electric Drive Motor Vehicles</td>
<td>Tax credits of up to $7,500 for buyers of new electric vehicles</td>
<td>2.0⁴</td>
</tr>
<tr>
<td>Electric Drive Vehicle Battery and Component Manufacturing Initiative</td>
<td>Grants to manufacturers of batteries and other parts for electric vehicles</td>
<td>2.0³</td>
</tr>
<tr>
<td>Transportation Electrification Initiative</td>
<td>Grants to establish development, demonstration, evaluation, and education projects to accelerate the introduction and use of electric vehicles</td>
<td>0.4⁴</td>
</tr>
<tr>
<td>Advanced Technology Vehicles Manufacturing Program</td>
<td>Up to $23 billion in direct loans to manufacturers of automobiles and automobile parts to promote the production of high-fuel-efficiency vehicles</td>
<td>3.1⁴</td>
</tr>
</tbody>
</table>

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ZEV program: [http://www.arb.ca.gov/msprog/zevprog/zevprog.htm](http://www.arb.ca.gov/msprog/zevprog/zevprog.htm)
CBO: [http://www.cbo.gov/sites/default/files/cbofiles/attachments/09-20-12-ElectricVehicles_0.pdf](http://www.cbo.gov/sites/default/files/cbofiles/attachments/09-20-12-ElectricVehicles_0.pdf)
Forecast: NEV price parity by 2050
先进机动车技术成本在长期会有所下降

- Affordable NEVs in the future
  - ICE cost goes up due to stricter requirements to emission and efficiency;
  - NEV cost drops due to economy of scale, learning curve, and infrastructure readiness, with aggressive NEV promotion policies in place

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Deeper dive to review and analyze city-level policies in the US
Extend the existing methodology to monetize non-fiscal policies
Continue to explore the “unknown” type of policies
Summary best local policy practices to accelerate NEV deployment

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<tr>
<th>Fiscal incentives</th>
<th>Non-fiscal benefits</th>
<th>EV penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV sales rebate or tax credit</td>
<td>Exemption from annual registration fee</td>
<td></td>
</tr>
<tr>
<td>Vehicle sales tax exemption</td>
<td>Subsidized installation of residential charging</td>
<td></td>
</tr>
<tr>
<td>Exemption from emission testing</td>
<td>Carpool lane access</td>
<td></td>
</tr>
<tr>
<td>EV sales rebates or tax credits</td>
<td>Public EV charger availability</td>
<td></td>
</tr>
<tr>
<td>Vehicle sales tax exemptions</td>
<td>Free parking availability</td>
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<tr>
<td>Exemption from annual registration fee</td>
<td>Annual fee for EVs</td>
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<td>Non-fiscal benefits</td>
<td>EV penalty</td>
</tr>
<tr>
<td>City A</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>City B</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>City C</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>City D</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>City E</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>City F</td>
<td>X</td>
<td>X</td>
</tr>
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Conclusions

At present, national level policies such as stringent vehicle fuel economy standards are necessary but not sufficient to drive NEVs into marketplace in significant numbers.

State-level incentives are playing a significant early role in reducing the effective cost of ownership and driving electric vehicle sales.

Both fiscal and non-fiscal measures (HOV lanes, charging stations, etc) are playing important roles in driving NEV sales; sometimes the latter can be more effective.

Cost-benefit of various incentive policies is valuable information for policy making.

Our understanding of international best practices for NEV policies is evolving; more research needed.

Consideration of upstream emissions must eventually be taken into account to address local air pollution and climate change.

In the long-term, we can expect BEVs (and FCVs) to become cost competitive with internal combustion engines, thus eliminating the need for fiscal subsidies.
Research team

Peter Mock
Berlin office director

Zifei Yang
Analyst

Stephanie Searle
Senior Policy Analyst

Nic Lutsey
Program director
Other resources

- Two reports
  - [http://www.theicct.org/evaluation-state-level-us-electric-vehicle-incentives](http://www.theicct.org/evaluation-state-level-us-electric-vehicle-incentives)
- Global EV grid emissions
  - [http://www.theicct.org/calculating-electric-drive-vehicle-ghg-emissions](http://www.theicct.org/calculating-electric-drive-vehicle-ghg-emissions)
- Comparison of companies, technology, CO$_2$ emissions in EU countries
  - [http://eupocketbook.theicct.org](http://eupocketbook.theicct.org)
- US EV grid emissions and long-term vehicle policy
- EV grid integration in US, China, Europe (MJ Bradley)
- Japan hybrid vehicle market breakthrough
- Long-term light-duty vehicle fleet transition modeling to electric vehicles (Greene/ORNL)
  - [http://www.theicct.org/analyzing-transition-electric-drive-california](http://www.theicct.org/analyzing-transition-electric-drive-california)
- Electric heavy-duty vehicles (DLR, CE-Delft)
  - [http://www.theicct.org/zero-emission-trucks](http://www.theicct.org/zero-emission-trucks)
- Associated blogs, webinars
  - [http://www.theicct.org/blogs/staff/if-subsidies-are-no-panacea-how-incentivize-electric-vehicles-china-cn](http://www.theicct.org/blogs/staff/if-subsidies-are-no-panacea-how-incentivize-electric-vehicles-china-cn)
  - [http://www.theicct.org/blogs/staff/if-subsidies-are-no-panacea-how-incentivize-electric-vehicles-china](http://www.theicct.org/blogs/staff/if-subsidies-are-no-panacea-how-incentivize-electric-vehicles-china)
  - [http://www.theicct.org/blogs/staff/show-vehicles-or-all-differing-electric-vehicle-strategies-emerge](http://www.theicct.org/blogs/staff/show-vehicles-or-all-differing-electric-vehicle-strategies-emerge)
  - [http://about.bgov.com/events/the-state-of-the-u-s-electric-vehicle-market-webinar/](http://about.bgov.com/events/the-state-of-the-u-s-electric-vehicle-market-webinar/)
  - [http://www.theicct.org/blogs/staff/electric-vehicles-rise-california](http://www.theicct.org/blogs/staff/electric-vehicles-rise-california)
  - [http://www.theicct.org/integrating-electric-vehicles-grid](http://www.theicct.org/integrating-electric-vehicles-grid)
Thank You!
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