Financing the Infrastructure to Support Alternative Fuel Vehicles

Joshua Cregger, Center for Automotive Research
Ellen Hughes-Cromwick, Ford Motor Company

20th Annual Automotive Outlook Symposium
Federal Reserve Bank of Chicago
Detroit Branch

May 31, 2013

The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
INFRASTRUCTURE INVESTMENT FOR ALTERNATIVE FUEL VEHICLES

Good Fiscal Policy In Any Global Setting

- Most major markets globally are using some form of public support to achieve expansions of infrastructure necessary to support growth
- Role for public investment in supporting infrastructure build outs
- Job creation and manufacturing retention rates

Convergence of Public Finance Principles, Policy and Politics

- Sustainability
- Energy security
- Energy independence
- Competition and productivity
- Innovation

Using Public Investment or Public-Private Partnerships Could Advance Goals of Energy Independence and Sustainability
FUTURE MOBILITY ATTRIBUTES AND WHY INFRASTRUCTURE SUPPORT IS CRITICAL

China
- Government goal to achieve 5 million “new energy vehicles” (NEVs) by 2020
- Reduction in pollution a top priority (20% comes from transport)
- Already China imports over 50% of their domestic oil consumption
- At the current pace of transportation growth, by 2020, China would be importing 80+% of oil consumption

Technology Development and Infrastructure
- Battery switching stations
- CNG options for taxis, busses, heavy trucks
- NEVs all have common attributes of reducing particulate matter and greenhouse gas (GHG) emissions

China Has Set a Goal of 5 Million NEVs by 2020

The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
**Simplified Clean Fuels Outlet Equation**

Number of Stations Required = \( \frac{AVMT \times LDV}{MPG/e \times \text{Average Fuel Volume per Station}} \)

Where:

- AVMT = Average vehicle miles traveled
- LDV = Number of light-duty vehicles
- MPG/e = Miles per gallon equivalent

**Rewritten in Terms of “Vehicles/Station”**

\( \frac{LDV}{\text{Required Station}} = \frac{MPG/e \times \text{Average Fuel Volume per Station}}{AVMT} \)

Based on the Equation Used in California Clean Fuels Outlet Regulation
### Number of Light-Duty Vehicles per Station by Fuel Type

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Vehicles/Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas (CNG)</td>
<td>940</td>
</tr>
<tr>
<td>Flex-Fuel (E85)</td>
<td>350</td>
</tr>
<tr>
<td>Plug-in Electric (BEV &amp; PHEV)</td>
<td>1,950</td>
</tr>
<tr>
<td>Hydrogen (Fuel Cell)</td>
<td>520</td>
</tr>
<tr>
<td>Gasoline</td>
<td></td>
</tr>
<tr>
<td>Projection</td>
<td>540</td>
</tr>
<tr>
<td>Actual (U.S.)</td>
<td>1,500</td>
</tr>
</tbody>
</table>
INFRASTRUCTURE COST PER VEHICLE

Infrastructure Cost per Vehicle by Fuel Type

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas (CNG)</td>
<td>$1,560</td>
</tr>
<tr>
<td>Flex-Fuel (E85)</td>
<td>$240</td>
</tr>
<tr>
<td>Plug-in Electric (BEV &amp; PHEV)</td>
<td>$2,160</td>
</tr>
<tr>
<td>Hydrogen (Fuel Cell)</td>
<td>$4,840</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas (CNG)</td>
<td>$1,250</td>
<td>$2,500</td>
</tr>
<tr>
<td>Flex-Fuel (E85)</td>
<td>$250</td>
<td>$500</td>
</tr>
<tr>
<td>Plug-in Electric (BEV &amp; PHEV)</td>
<td>$875</td>
<td>$1,625</td>
</tr>
<tr>
<td>Hydrogen (Fuel Cell)</td>
<td>$3,438</td>
<td>$5,375</td>
</tr>
</tbody>
</table>

Estimates from Research Are Similar to Other Estimates
AFV SALES, 2030

AFV Sales in 2030 by Fuel Type by Country

Europe
- 9.6% of total sales
- Natural Gas (CNG): 1,000,000
- Flex-Fuel (E85): 160,000
- Plug-in Electric (BEV & PHEV): 1,500,000
- Hydrogen (Fuel Cell): 21,000

United States
- 17.4% of total sales
- Natural Gas (CNG): 460,000
- Flex-Fuel (E85): 2,800,000
- Plug-in Electric (BEV & PHEV): 830
- Hydrogen (Fuel Cell): 77,000

China
- 6.4% of total sales
- Natural Gas (CNG): 530,000
- Flex-Fuel (E85): 1,500,000
- Plug-in Electric (BEV & PHEV): 1,000,000
- Hydrogen (Fuel Cell): 160,000

2030 Scenario Suggests Strong Sales for PEVs in All Countries, CNG in Europe and China, Flex-Fuel Vehicles in United States

The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
VEHICLE SALES BY COUNTRY, EUROPE

Scenario Based on Trends and Forecasts

The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
VEHICLE SALES BY COUNTRY, CHINA

Scenario Based on Trends and Forecasts

The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
AFVS IN OPERATION, 2030

Total AFVs in Operation in 2030 by Fuel Type and Market

Europe
- 160,000 Natural Gas (CNG)
- 1,600,000 Flex-Fuel (E85)
- 11,000,000 Plug-in Electric (BEV & PHEV)
- 11,000,000 Hydrogen (Fuel Cell)

United States
- 5,100 Natural Gas (CNG)
- 4,700,000 Flex-Fuel (E85)
- 30,000,000 Plug-in Electric (BEV & PHEV)
- 740,000 Hydrogen (Fuel Cell)

China
- 12,000,000 Natural Gas (CNG)
- 5,300,000 Flex-Fuel (E85)
- 15 Million Plug-in Electric (BEV & PHEV)
- 5,100 Hydrogen (Fuel Cell)

2030 Scenario Suggests Substantial Fleets in All Countries

The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan
The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.
The information contained herein does not constitute the Company’s forecast of financial performance and has been prepared solely for business planning purposes to determine actions the Company may take to meet its plan.

FUNDING REQUIREMENT THROUGH 2030

Infrastructure Cost by Country in 2013 $U.S. Billions

Europe  $42.1 Billion
      $38.5 B
       $3.6 B

United States $18.5 Billion
      $16.5 B
       $2.0 B

China $34.2 Billion
      $31.6 B
       $2.6 B

Past Spending  Future Spending

$8 Billion Spent So Far, $87 Billion to Go
FUNDING OPTIONS FOR INFRASTRUCTURE SPENDING

Public Support

• Direct government expenditures
• Bond issuance
• Subsidies
• Infrastructure banks

Public-Private Partnership

• Government loans to private entities
• Collateralized support for private issuance
• “Green” bonds

Private

• Electric utilities’ funding of grid upgrades and charging stations through privately issued bonds

Many Publicly Supported Infrastructure Projects Have Provided Positive External Impacts Through Employment Gains and Business Growth
**SUMMARY**

- Through 2030, an estimated $90 billion would be needed to support AFV volume projections in the U.S., Europe, and China.

- China’s central government has committed to expanding “new energy vehicles” in order to reduce pollution and its dependence on oil imports.

- Historically, most major markets have relied on public funding to support infrastructure investments.

---

*Using Public Investment or Public-Private Partnerships Could Advance Goals of Energy Independence and Sustainability*