Market Development for Natural Gas
The New U.S. Transportation Fuel

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Discussion Items

- Global NGV Strategy
- U.S. NGV Strategy
- Potential for NGV Market Growth
Global NGV Strategy
## International NGV Growth

<table>
<thead>
<tr>
<th></th>
<th>August 2003</th>
<th>June 2008</th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global NGVs</td>
<td>2,814,438</td>
<td>8,600,000</td>
<td>300%</td>
</tr>
<tr>
<td>Global NGV Stations</td>
<td>6,455</td>
<td>13,000</td>
<td>200%</td>
</tr>
</tbody>
</table>


NGV global growth rate is increasing!
## Notable NGV Growth

<table>
<thead>
<tr>
<th>Country</th>
<th>NGVs 2003</th>
<th>NGVs 2008</th>
<th>Stations '03</th>
<th>Stations '08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1,000,000</td>
<td>1,650,540</td>
<td>1,000</td>
<td>1,753</td>
</tr>
<tr>
<td>Pakistan</td>
<td>350,000</td>
<td>1,599,940</td>
<td>200</td>
<td>1,923</td>
</tr>
<tr>
<td>Brazil</td>
<td>550,000</td>
<td>1,511,945</td>
<td>535</td>
<td>1,609</td>
</tr>
<tr>
<td>India</td>
<td>137,000</td>
<td>821,872</td>
<td>116</td>
<td>325</td>
</tr>
<tr>
<td>Iran</td>
<td>*</td>
<td>815,000</td>
<td>*</td>
<td>347</td>
</tr>
<tr>
<td>Italy</td>
<td>400,000</td>
<td>500,000</td>
<td>490</td>
<td>609</td>
</tr>
<tr>
<td>Colombia</td>
<td>*</td>
<td>251,688</td>
<td>*</td>
<td>313</td>
</tr>
<tr>
<td>China</td>
<td>69,300</td>
<td>200,873</td>
<td>270</td>
<td>486</td>
</tr>
<tr>
<td><strong>Global Total</strong></td>
<td><strong>2,814,438</strong></td>
<td><strong>8,600,000</strong></td>
<td><strong>6,455</strong></td>
<td><strong>13,000</strong></td>
</tr>
</tbody>
</table>

Worldwide: 95% NGVs are Light-duty vehicle, 2% are Trucks, 3% are Buses

76% of New CNG Stations are Public
**World Manufacturers of NGVs**

<table>
<thead>
<tr>
<th>GM/Opel</th>
<th>Chevrolet</th>
<th>Ford</th>
<th>Mercedes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volkswagen</td>
<td>Fiat</td>
<td>Citroen</td>
<td>Hyundai</td>
</tr>
<tr>
<td>Renault</td>
<td>Peugeot</td>
<td>Tata</td>
<td>Mitsubishi</td>
</tr>
<tr>
<td>Toyota</td>
<td>Honda</td>
<td>Nissan</td>
<td>Isuzu</td>
</tr>
<tr>
<td>Skoda</td>
<td>Volvo</td>
<td>Geely</td>
<td>Lifan</td>
</tr>
</tbody>
</table>

GM alone makes 18 natural gas models worldwide through their alliances with other OEMs.
OEM Product Engineering

VW Passat

Opel Zafira

Fiat Multipla
World NGV Products - Consumer Oriented
World NGV Products - Consumer Oriented
### Austria - Sample of Aug 2008 NGV Offerings

<table>
<thead>
<tr>
<th>Standard Factory Models</th>
<th>Retrofit Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citroen (3)</td>
<td>Audi (2)</td>
</tr>
<tr>
<td>Fiat (7)</td>
<td>Cadillac (4)</td>
</tr>
<tr>
<td>Ford (3)</td>
<td>Chevrolet (1)</td>
</tr>
<tr>
<td>Ivec (1)</td>
<td>Chrysler (2)</td>
</tr>
<tr>
<td>Mercedes (3)</td>
<td>Dodge (3)</td>
</tr>
<tr>
<td>Opel (3)</td>
<td>Fiat (2)</td>
</tr>
<tr>
<td>Peugeot (2)</td>
<td>Jeep (3)</td>
</tr>
<tr>
<td>Renault (1)</td>
<td>Mercedes (13)</td>
</tr>
<tr>
<td>Skoda (1)</td>
<td>Opel (9)</td>
</tr>
<tr>
<td>Volkswagen (4)</td>
<td>Saab (2)</td>
</tr>
</tbody>
</table>

**Total 28 Factory Models**

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>Volkswagen (7)</td>
</tr>
</tbody>
</table>

**Total 50 Retrofit Models**
U.S. NGV Strategy
U.S. Market Development

- Strategic focus on return to base, high fuel use fleet vehicles
  - Air quality benefits
  - Economic benefits

- Key market segments
  - Transit, Refuse, Airport (shuttles and taxis), Regional Trucking

- Allows **profitable, simultaneous** development of infrastructure and fleets

- Public access allows market expansion to collateral fleets

**Compressed Natural Gas**

- Taxis
- Government Vehicles
- Airport Transit

**Liquefied Natural Gas (LNG)**

- Regional Trucking
- Refuse Hauling
- Public Transit
Recent Market Development Drivers

- Petroleum reduction and Greenhouse Gases
  - Add to Air Quality and Economics
  - California Low Carbon Fuel Standard
- Petroleum price spikes of 2008 showed growing interest for consumer vehicles
- Recognition by goods movement industry that petroleum price respite is temporary
- Supply / Availability of Natural Gas
High Fuel Use Fleets
Heavy-duty Vehicles
U.S. NGV Vocational Applications
Expanding Products and Markets

- Technology exists around the world and in U.S.
- Expand the numbers of engines & OEM available product
- Adapt technology to new engines and vehicle platforms
- Adapt technology for existing and future emission requirements
- Adapt NGV technology to include hybrid technologies
Potential for NGV Market Growth
“NG Shift from Power Generation to NGVs”
Opportunity for NGV Market Growth

- ~70% oil imports to U.S.
- 175 billion gallons/yr of on-road transportation fuel
  - 135 billion gallons gasoline/yr for on-road applications
  - 40 billion gallons diesel/yr for on-road applications
- 6.87 TCF/yr natural gas for power generation
  - could be displaced by renewables to fuel NGVs
- Adding NG as transportation fuel
  - Full U.S. NG demand greater than 80 year supply
  - Without any natural gas imports
Opportunity for Petroleum Displacement

- What can 7 TCF of Natural Gas Displace?
  - 40% of on-road diesel = 16 billion gallons of diesel = 1 million trucks
  - 28% of on-road gasoline = 38 billion gallons of gasoline = 30-50 million LD vehicles

- Natural gas is only fuel that can achieve significant foreign oil displacement
Deployment Strategy
Deployment Strategies

- **Heavy-duty**
  - Target 1 million Class 7/8 trucks
  - Cornerstone is LA/LB Ports – Goods Movement (40% of U.S. trade)
  - Enables shift of regional trucking for other Class 5/6 vehicles
  - Fosters urban “cluster to cluster” bridges both CNG and LNG
  - Ultimately coast to coast

- **Light-duty – page from OEM Hydrogen Handbook**
  - Target regional cluster deployment strategy for 30-50 million vehicles
  - Educate society and dealer networks within clusters
  - Focus on regional sales and advertising
  - Lever cluster for mutual OEM and fuel provider sustainability
Deployment Strategies - Infrastructure

- **HD Trucks – 16 billion DEGs**
  - Primarily LNG for Class 7/8 trucks
  - Network of 2,000 – 5,000 stations nationwide – (ref: 9,000 truck stops in U.S.)
  - $14-20 billion for station infrastructure
  - $20-30 billion for LNG production facilities

- **LD Vehicles – 38 billion GGEs**
  - Predominantly CNG
  - Hydrogen network -12,000 stations address 70% of nation
  - Network of 20,000 to 45,000 stations (ref: 170,000 retail gasoline stations)
  - $40-70 billion for station infrastructure
California Port Truck Traffic

Estimated Average Annual Daily Truck Traffic: 1998

US Department of Transportation
Federal Highway Administration
Office of Freight Management and Operations
Freight Analysis Framework

CALIFORNIA

Truck Volume Scale
50,000  25,000  12,500
Truck Traffic 1998

Estimated Average Annual Daily Truck Traffic
(1998)

US Department of Transportation
Federal Highway Administration
Office of Freight Management and Operations
Freight Analysis Framework

Truck Volume Scale
50,000 25,000 12,500
Los Angeles Infrastructure - Example Cluster

- 29 Stations on map
- 65 Stations in greater Los Angeles area
- Plus over 200 additional private stations
- **GREAT MARKET OPPORTUNITY TO INTRODUCE PRODUCT**
- **California Infrastructure can support 200,000+ additional vehicles**

Southern California Natural Gas Fueling Stations
Los Angeles Basin
Conclusions

- **Future demands a New Market Development Strategy**
  - Not the way it was done in the 1990s
- Focus on targeted regional market development effort
  - Not a national product/infrastructure roll-out
- Large metropolitan areas
  - Select OEM dealerships
  - Minimize training and spare parts logistics
  - Co-op advertising with fuel providers
- Achieve successful deployment of vehicles and infrastructure
- With success – move to other metropolitan areas
Thank you!

For more information, please contact:

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Following are additional slides that discuss 1) Oil Supply and Demand, Per Capita Vehicles in World, Pickens Plan, and Gas Shale Plays that Increase U.S. Supply of Natural Gas for the Future.
Global Oil Challenge

2007 4th Qtr. OIL DEMAND

88 Million bbl/day

grows annually in a healthy world economy

2030 Projections: 120 104 mmbpd

PRODUCTION reaches a maximum & then declines

(2030: 28 mmbpd current prod.)
(2030: 53 mmbpd incl. undeveloped fields)

85 Million bbl/day

Supply cannot meet demand

- PRICES INCREASE
- SHORTAGES DEVELOP
Global Oil Demand Will Continue to Grow

**Figure:** Vehicles per Capita Around the World

**Source:** Transportation Energy Data Book
IT'S TIME TO STOP AMERICA'S ADDICTION TO FOREIGN OIL

America is in a hole and it's getting deeper every day. We import 70% of our oil at a cost of $700 billion a year - four times the annual cost of the Iraq war. I've been an oil man all my life, but this is one emergency we can't drill our way out of. But if we create a new renewable energy network, we can break our addiction to foreign oil. On January 20, 2009, a new President gets sworn in. If we're organized, we can convince Congress to make major changes towards cleaner, cheaper and domestic energy resources. To get this done, I need your help. Check out the plan. If you think it's worth fighting for, please join our effort.

“To put it plainly, T. Boone Pickens is out to save America.”
-Carl Pope, Executive Director, Sierra Club
Potential for Renewable Power Generation

WIND CORRIDOR

SOLAR CORRIDOR
An Ocean of Natural Gas

- Only a few of the 22 top shale basins in the United States have been significantly explored.

- Explosive growth in U.S. gas shales - Production increase from 0.3 Tcf/year in 1998 to 1.1 Tcf/year in 2007.

- Since late 1990s, the largest producer of shale gas has been the Barnett Shale in the Fort Worth Basin = 6%.

- Rapid increase in production rates in the Barnett, Fayetteville, Woodford, Haynesville and Marcellus Shale plays have spurred investment in pipeline infrastructure to bring this gas to the market.

- **2240 TCF = 118 years**