Diesel Fuel: Use, Manufacturing, Supply and Distribution

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American Petroleum Institute

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Remember when it was just a "gas station"?
Diesel Fuel: Use, Manufacturing, Supply and Distribution

- Key Considerations
- Diesel Fuel Manufacturing and Supply
  - US vs Europe
  - Diesel production technologies
- Diesel Fuel Markets
- Vehicle Issues
  - Light Duty Diesel (LDD) vehicle markets
- Summary/Conclusions
Diesel Fuel: Use, Manufacturing, Supply and Distribution

Key Considerations

- **US refineries** are designed to maximize gasoline production
  - To respond to consumer demand
  - US diesel demand is driven by heavy-duty applications

- **European refineries** are designed to maximize diesel production
  - Diesel as the primary transportation fuel
  - Heavily influenced by tax incentives for diesel
  - Europe now importing diesel and exporting gasoline
Diesel Fuel: Use, Manufacturing, Supply and Distribution

Key Considerations (Continued)

- Refinery design and equipment differences
  - Between refineries designed for maximum gasoline production versus those designed for maximum diesel production

- A major switch to diesel production in the US would require significant refinery re-design

- There are many options other than increased LDDs for improving fuel economy
Refinery “Cut of the Barrel”: US vs Europe vs Japan

US Refineries Are Designed and Constructed for Gasoline Production

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<thead>
<tr>
<th></th>
<th>US</th>
<th>Europe</th>
<th>Japan</th>
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<tbody>
<tr>
<td>Gasoline</td>
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<td>Kero/Jet</td>
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<td>Diesel/Distillate</td>
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<td>Other</td>
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Gasoline (~47%)
Fuel Manufacturing and Supply: US vs Europe

- Refinery design and equipment differences
  - Between refineries designed for **maximum gasoline** vs those designed for **maximum diesel**
  - **Gasoline**: Catalytic cracking $\rightarrow$ Volume & Octane
    - 37% of US crude capacity
    - 15% of Europe’s crude capacity
  - **Diesel**: Hydrocracking $\rightarrow$ Volume & Cetane
    - Increased by approx. 60% between 1995 and 2005

- A major switch to diesel production in the US would:
  - Require significant refinery re-design and major process unit installations
  - Cost $500 million to $1 billion at many refineries
  - Require substantial lead time, e.g., 5 - 10 years
Diesel Fuel Markets

Several Factors Have Caused a Tightening of Worldwide Diesel Supply

- Diesel demand in Europe has grown as diesel vehicles replaced gasoline vehicles.
  - Different tax treatment
  - Less severe vehicle emissions standards
  - Improved diesel vehicle performance

- Diesel demand has also been growing worldwide
  - Heavy duty diesel demand grows as the economy grows

- US highway diesel demand has been growing at a faster rate than gasoline demand
**Demand Trends: Gasoline Versus Highway Diesel**

**US 1980 - 2006**

- **Gasoline**
- **Diesel**

US diesel demand trending higher at faster rate than gasoline

Diesel estimated for 2006

Source: EIA and API Statistics
As Diesel Demand Grew in Europe, Gasoline Became Surplus and Was Exported, Much to US
Production versus Demand of Motor Gasoline and Diesel in Europe and the US
(million barrels per day)

United States

<table>
<thead>
<tr>
<th>Year</th>
<th>Gasoline Production</th>
<th>Gasoline Demand</th>
<th>Diesel Production</th>
<th>Diesel Demand</th>
<th>Imports</th>
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</thead>
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<tr>
<td>1990</td>
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Europe

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<tr>
<th>Year</th>
<th>Gasoline Production</th>
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Source: IEA, EIA
Assumed constant stocks
EU-15 Demand Mix Forecast Shows Continued Declining Gasoline Demand Which Benefits US

Source: EIA, History IEA; Forecast Purvin & Gertz
Challenges to US Light Duty Diesel Growth

- EPA and CARB emissions standards are challenging
- Consumer acceptance is uncertain
- Diesel fuel consumer cost savings advantage over gasoline vary
US Diesel Prices Are Sometimes Higher Than Gasoline

Retail Diesel vs. Gasoline Prices

Source: Energy Information Administration
LDD Vehicles Are One of Several Possible Options for Improved Fuel Efficiency

- Consumers will decide on acceptance of options based on the:
  - Cost of vehicles
  - Cost of fuels
  - Potential for recovery of incremental vehicle costs through improved fuel economy

- Cost – Effectiveness of Some Potential Options

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<th>Fuel Economy Benefit, %</th>
<th>Cost, $</th>
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<td>Improved Conventional Gasoline</td>
<td>26 - 28</td>
<td>800 - 1,000</td>
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<tr>
<td>Hybrids</td>
<td>25 - 55</td>
<td>3,900 - 5,600</td>
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<tr>
<td>Diesel</td>
<td>33 - 50</td>
<td>2,200 – 3,400</td>
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Cost Recovery Scenarios
Gasoline = Diesel

- Assumptions:
  - 15,000 mi/yr
  - Diesel vs Gas MPG = 26 vs 20 (30%)
  - $3,000 price premium for diesel engine
  - 5-year payback target
Cost Recovery Scenarios
Gasoline < Diesel

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Summary/Conclusions

- US refineries are designed to maximize gasoline production
- European refineries are designed to maximize diesel production
- A major switch to diesel production in the US would require significant investment and many years for design and construction.
- Significant challenges exist for increased passenger car diesel growth in the US
- Consumers will decide on acceptance of options based on:
  » Cost of vehicles
  » Cost of fuels
  » Potential for recovery through improved fuel economy