Regular Grade Gasoline Prices at Retail Outlets by Region, 2010
(dollars per gallon, including taxes)

Oil industry segments

**Upstream**

- Exploration
- Production

**Midstream**

- Gathering & Transportation

**Downstream**

- Refining & Product Distribution
- Petrochemicals

- Wells
- Tank farm
- Oil Trunk P/L
- Oil Trunk Pipeline
- Imports P/L & Waterborne
- Crude oil storage
- Bulk storage
- Retailers
- Delivery lines
### U.S. supplies of natural gas & oil

#### NATURAL GAS

<table>
<thead>
<tr>
<th></th>
<th>Annual (TCF)</th>
<th>Avg Day (BCF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Domestic Production</td>
<td>26.0</td>
<td>71.2</td>
</tr>
<tr>
<td>Dry Domestic Production</td>
<td>20.6</td>
<td>56.4</td>
</tr>
<tr>
<td>Pipeline Imports</td>
<td>3.3</td>
<td>9.0</td>
</tr>
<tr>
<td>Waterborne Imports</td>
<td>0.5</td>
<td>1.4</td>
</tr>
</tbody>
</table>

#### OIL

<table>
<thead>
<tr>
<th></th>
<th>Annual (BBBLS)</th>
<th>Avg Day (MMBLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Domestic Production</td>
<td>1.959</td>
<td>5.361</td>
</tr>
<tr>
<td>Dry Domestic Production</td>
<td>1.959</td>
<td>5.361</td>
</tr>
<tr>
<td>Pipeline Imports</td>
<td>.709 (CAN)</td>
<td>1.943</td>
</tr>
<tr>
<td>Waterborne Imports</td>
<td>2.581</td>
<td>7.070</td>
</tr>
</tbody>
</table>

### Source: EIA 2009 AER
## Well productivity comparison (EOY 2009)

<table>
<thead>
<tr>
<th></th>
<th>Total Daily Oil Production</th>
<th># of Producing oil Wells</th>
<th>BOPD/well</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USA</strong></td>
<td>5.360 mm bbl/d</td>
<td>525,998</td>
<td>10 bbl/d</td>
</tr>
<tr>
<td><strong>Saudi Arabia</strong></td>
<td>7.920 mm bbl/d</td>
<td>2,811</td>
<td>2818 bbl/d (280x)</td>
</tr>
<tr>
<td><strong>Middle East</strong></td>
<td>21.175 mm bbl/d</td>
<td>15,074</td>
<td>1,405 bbl/d (140x)</td>
</tr>
</tbody>
</table>

USA formations = brick; Middle East = concrete block in terms of porosity and permeability comparisons

More favorable geology means fewer wells, better flow rates, lower lifting costs, and longer economic lives for wells.

Result = Lower cost producer

Source: 12/06/10 O&GJ Worldwide reserves and production
Potential well stream components

- **FROM WELLHEAD**
  - Hydrogen Sulfide
  - Methane
  - Propane
  - Nitrogen Helium
  - Natural Gasoline
  - Butanes
  - Oil or Condensate
  - Ethane
  - Dirt & Rust
  - Carbon Dioxide
  - Water

- **LEASE SURFACE EQUIPMENT**

**COLOR COCODNOTATIONS:**
- **Green:** Recoverable Hydrocarbons
- **Red:** Residue Gas
- **Blue:** Non-Hydrocarbons and Contaminants
Well surface flow schematic

- Oil/Condensate Line Heater
- Separator
- Treating (CO₂, H₂S)
- Dehydration Unit
- Gas
- Oil/Condensate
- Liquid Sales
- Water
- To Disposal
- Sales Gas
Crude Oil
Midstream
Crude oil gathering: place in physical distribution network

Information Needed
- Volume of oil delivered
- BS&W content
- Sulfur/Gravity
- Temperature

Information Provided By
- Gauger (producer)
- Truck driver (buyer/transporter)
- LACT = Lease Automatic Custody Transfer
Crude oil trunk pipelines
Place in physical distribution network

FUNCTIONS / ACTIVITIES

- Provide high pressure / large volume, long distance transport of crude oil
- Uses energy from pump stations
- Safety & environmental regulation - DOT, OSHA, EPA, DOI, states
- Intrastate rate regulation – state
- Interstate rate regulation - FERC
Major crude oil trunk Lines in U.S.

- < 50,000 miles
- Common carriers

Map showing major crude oil trunk lines in the United States, including lines for Canadian crude, for other imports, and from a domestic origin. The map indicates state shading showing Petroleum Administration for Defense Districts (PADDs) with lines connecting various cities and states.
U.S. imports of crude oil

Source: EIA AER 2009
## Crude oil storage facilities

### GENERALIZATION

Oil stored for operational reasons, natural gas stored for seasonal demand

### OIL STORAGE FACILITIES MORE NUMEROUS & EXHIBIT GREATER SIZE VARIATIONS

<table>
<thead>
<tr>
<th>Location</th>
<th>Inventory EOM 12/10</th>
<th>Tank size (BBLs)</th>
<th>Approximate #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease storage</td>
<td>20 MM BBLS</td>
<td>100-500</td>
<td>100,000</td>
</tr>
<tr>
<td>Tank farms &amp; pipelines</td>
<td>219 MM BBLS</td>
<td>10,000-500,000</td>
<td>141 Terminals</td>
</tr>
<tr>
<td>Refinery stocks</td>
<td>89 MM BBLS</td>
<td>50,000-500,000</td>
<td>150 Refineries</td>
</tr>
<tr>
<td>Operating stocks</td>
<td>328 MM BBLS</td>
<td>(3 weeks supply)</td>
<td></td>
</tr>
<tr>
<td>Strategic Petroleum Reserve (SPR)*</td>
<td>727 MM BBLS (Cavern size) 6 to 35 MM BBLs</td>
<td>1 (62 caverns)</td>
<td></td>
</tr>
</tbody>
</table>

*Withdrawal rate: 4.4 mm bopd for 90 days; declining to 1.0 mm bopd. Oil displaced with fresh water.

Source: EIA
Downstream segment of the oil industry

**Upstream**
- Exploration
- Production

**Midstream**
- Gathering & Transportation

**Downstream**
- Refining & Product Distribution
  - Petrochemicals

- Wells
- Tank farm
- Gathering lines
- Oil Trunk P/L
- Oil Trunk Pipeline
- Crude oil storage
- Imports P/L & Waterborne
- Oil refinery
- Products Trunk P/L
- Products storage
- Petrochem
- Bulk storage
- Delivery lines
- Retailers
## Crude oil refining

### Why refine oil?

**CONSUMER**
- Cannot use crude oil
- Needs motor gasoline, petrochemicals (plastics), cosmetics, paint, etc.

**OIL PRODUCER**
- Could not sell crude oil to consumer. Must have refiner.

**REFINER**
- In business to make a margin. Sell refined products for more than cost of crude oil plus refining costs.
## US refinery receipts of crude oil

<table>
<thead>
<tr>
<th>Method</th>
<th>%</th>
<th>Domestic %</th>
<th>Foreign%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline</td>
<td>51</td>
<td>64</td>
<td>36</td>
</tr>
<tr>
<td>Tanker</td>
<td>45</td>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>Barge</td>
<td>03</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Tank cars/trucks</td>
<td>01</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Land(P/L &amp; trucks)</td>
<td>52</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>Water</td>
<td>48</td>
<td>12</td>
<td>88</td>
</tr>
</tbody>
</table>

Source: EIA
## Oil refining capacities (US-12/10)

<table>
<thead>
<tr>
<th>Category</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of refineries (operable)</td>
<td>148 (309 in 1960)</td>
</tr>
<tr>
<td>Atmospheric distillation capacity</td>
<td>17.6 MM BBLs / Day</td>
</tr>
<tr>
<td>Vacuum distillation capacity</td>
<td>8.5 MM BBLs / Day</td>
</tr>
<tr>
<td>Thermal cracking capacity</td>
<td>2.6 MM BBLs / Day</td>
</tr>
<tr>
<td>Catalytic cracking capacity</td>
<td>6.1 MM BBLs / Day</td>
</tr>
<tr>
<td>Catalytic reforming capacity</td>
<td>3.7 MM BBLs / Day</td>
</tr>
</tbody>
</table>

Feed to US refineries (2009 avg) 17.3 (14.7) MM BBLS/Day

(14.7/17.6 = 84 % capacity utilization; 2008 = 81%, prior to recession = 90+ %)

2009

<table>
<thead>
<tr>
<th>Category</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total U.S. refinery &amp; blender net production</td>
<td>17.8 MM BBLs / Day</td>
</tr>
<tr>
<td>Total U.S. product supplied (=demand)</td>
<td>19.1 MM BBLs / Day</td>
</tr>
</tbody>
</table>

Source: EIA
Crude oil distillation

Refinery crude unit
(distillation tower)

Process review

Oil refining processes & units
(employing heat, pressure & catalysts)

Distillation*

Fractionation
- Atmospheric
- Vacuum

Conversion* (upgrading)
- Decomposition
  - Catalytic cracking
  - Coking/visbreaking
  - Hydro-cracking
- Unification
  - Alkylation
  - Polymerization
- Rearrangement
  - Catalytic reforming
  - Isomerization

Blending & Treating

Finished products

Simple Distillation
- Naphtha
- Middle & light Gasoil
- Residual

Avg. U.S. Refinery Yield
- Other
- Motor Gasoline
- Diesel, jet fuel, heating oil, kero
- Residual

Source: EIA

Crude Oil (Arab LT)

Separation
*Hydro treating (sulfur removal) may occur
Typical U.S. refinery products yield from crude oil

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRG</td>
<td>3.8</td>
</tr>
<tr>
<td>Motor Gasoline</td>
<td>41.5</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>9.1</td>
</tr>
<tr>
<td>Distillate Fuel Oil</td>
<td>26.1</td>
</tr>
<tr>
<td>Residual Fuel Oil</td>
<td>3.8</td>
</tr>
<tr>
<td>Petr. Coke &amp; Asphalt &amp; Other</td>
<td>15.7</td>
</tr>
</tbody>
</table>

(Yield=44.7 gals for 42 gal feed) 100

Source: EIA
Refinery margin and expense

\[
\text{Gross Refining} = \text{GRM} = \frac{\text{Refined products revenue minus feedstock costs (for same periods)}}{\text{Crude BBLS processed during period}}
\]

<table>
<thead>
<tr>
<th>GRM / BBL</th>
<th>Refinery Type</th>
<th>Refinery Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2 to +$2</td>
<td>Hydro skimmers</td>
<td>(Least complex / severe)</td>
</tr>
<tr>
<td>$4 to $19</td>
<td>Cracking</td>
<td>(More complex / severe)</td>
</tr>
<tr>
<td>$2 to $20</td>
<td>Coking</td>
<td>(Most complex / severe)</td>
</tr>
</tbody>
</table>

2010 GRM = $7.80 (Valero—composite of plants / regions) (2007=$12.33, 2009=$6.00)

**OPERATING EXPENSE** (excl. depr.)

Historical Range**: $.50-$4.50 / BBL

> with complexity

2010: $3.79 / BBL (Valero)

( $5.35/bbl including $1.56/bbl depr.)

**CATEGORIES**

Energy (more than 50%)
Labor
Chemicals & catalysts
Environmental Compliance

**CAPITAL**

New Plant: $15-$20k per BBL/D***
Large: >100,000 BBL / Day
Lead Time: 5 Years
Permits: Environmental
Crude Supply: Secure / known price
Competition: Lower cost foreign

Sources: *IEA Oil Market Report, EIA; ** Baker and Obrien, 2005
O&GJ Nelson Farrar Index
Refined Products
Distribution & Marketing
About 60% of refined products move via pipeline
About 30% of refined products move via water
Final leg is by truck
Petroleum product transport costs

Cost/mile increases as size and distance of shipment decreases...

Illustrative cost to transport gasoline from US Gulf Coast to a Boston service station

<table>
<thead>
<tr>
<th>Transport Segment</th>
<th>No. of Miles</th>
<th>Cents per Gallon</th>
<th>Cents per Mile-Gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-B Pipeline to N.Y. Harbor</td>
<td>1,500</td>
<td>2.3</td>
<td>0.0015</td>
</tr>
<tr>
<td>B-C Barge to Boston</td>
<td>250</td>
<td>1.2</td>
<td>0.0048</td>
</tr>
<tr>
<td>C-D Truck to Service Station</td>
<td>40</td>
<td>1.5</td>
<td>0.0375</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,790</td>
<td>5.0</td>
<td>0.0028</td>
</tr>
</tbody>
</table>

NOTE: Barge 3 times Pipeline Cost for 250 Miles
      Truck 25 times Pipeline Cost for 40 Miles

NPC—National Petroleum Council
Refined products pipeline batching

- **Fungible** (most common on large trunk lines)
- **Segregated**

Products:
- "Reformulated regular gasoline"
- "Low sulfur diesel"
- "Kerosene / Jet fuel"
- "High sulfur diesel"
- "Conventional regular gasoline"
- "All premium gasoline grades"

Interfaces:
- "Compatible"
- "Transmix (reprocess)"
Motor gasoline specifications

<table>
<thead>
<tr>
<th>Products</th>
<th>Geographic Area</th>
<th>Gasoline Product Codes (Specs)</th>
<th>Diesel Product Codes (Specs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline</td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Colonial</td>
<td>South/Midwest/East</td>
<td>13 (38 Voc/RVP) 4 (12 RVP)</td>
<td>4</td>
</tr>
<tr>
<td>TEPPCO</td>
<td>South/Midwest</td>
<td>4</td>
<td>4 (8)</td>
</tr>
<tr>
<td>Explorer</td>
<td>South/Midwest/East</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Kinder Morgan</td>
<td>West (TX to CA)</td>
<td>12 (48 RVP)</td>
<td>4</td>
</tr>
</tbody>
</table>
Refined products—issues

- Motor gasoline—octane, RVP, additives
  - Number of grades (specifications) – supply/cost
  - Seasonal change in RVP, etc.
- Motor gasoline—ethanol (E(10), E(85))
- Diesel—low sulfur, biodiesel
  - Increasing distillate demand in U.S. & worldwide
  - Historically mutually beneficial U.S. & Europe diesel / motor gasoline demand & relationship
- Seasonality of demand
Gasoline pump price

What do we pay for in a gallon of Regular Grade gasoline?

2000 to 2009
Average Retail Price: $2.09

- Distribution & Marketing: 12%
- Refining Costs & Profits: 15%
- Federal & State Taxes: 22%
- Crude Oil: 51%

2009
Average Retail Price: $2.34

- Distribution & Marketing: 10%
- Refining Costs & Profits: 11%
- Federal & State Taxes: 18%
- Crude Oil: 61%

Source: U.S. Energy Information Administration.

More recent price

What We Pay For In A Gallon Of Regular Gasoline (January 2011)
Retail Price: $3.10/gallon

- Taxes: 13%
- Distribution & Marketing: 9%
- Refining: 11%
- Crude Oil: 67%

Dec. 08 = $1.61
Dec. 09 = $2.61
Thank You

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