A Peek at the Peaks (Oil and others)

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Introduction

- World Energy Usage
- National Energy Situation and Prognosis
- Peak Oil and other Fossil Fuel Peaks
World Energy Use to 2030

Projected Growth is ~70%

Source: EIA, Jun 2009
Where are the Energy Resources?

- **USA**: 6,329 EJ
- **Russia**: 5,098 EJ
- **China**: 2,502 EJ
- **Australia**: 2,104 EJ
- **Saudi Arabia**: 1,691 EJ
- **India**: 1,582 EJ
- **Canada**: 1,486 EJ
- **Iran**: 1,380 EJ
- **Germany**: 1,023 EJ
- **Venezuela**: 1,023 EJ

- **Uranium**
- **Coal**
- **Natural gas**
- **Crude oil**
Where was the Oil Endowment?

[Map showing the distribution of oil endowment around the world, with different color codes indicating the amount of oil in billions of barrels.]
U.S. Energy Flows 2007 (Quads)

Source: DOE/EIA 2008
US Energy Use (Quads)

Total Energy up 18% by 2030
World-wide demand yielded to the pressures of high prices and the collapse in the global economy.
Projected Consumption Change

World Liquid Fuels Consumption

- Total Consumption
- Annual Growth

Million barrels per day


Forecast

China | United States | Other Countries

Short-Term Energy Outlook, June 2009
Actual Production

2002 – 28.10 Gb
2003 – 29.05 Gb
2004 – 30.34 Gb
2005 – 30.86 Gb
2006 – 30.86 Gb
2007 – 30.82 Gb
2008 – 31.19 Gb
2009 – 30.43 Gb
<table>
<thead>
<tr>
<th>Amount</th>
<th>Gb</th>
<th>Annual Production - Regular Oil</th>
<th>Total</th>
<th>Peak Date</th>
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</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Regular Oil</td>
<td></td>
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</tr>
<tr>
<td>Past</td>
<td>1054</td>
<td>Future</td>
<td>736</td>
<td>110</td>
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<tr>
<td>Known Fields</td>
<td>846</td>
<td>New</td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>1900</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Liquids</td>
<td>1156</td>
<td></td>
<td>1269</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2425</td>
<td></td>
<td></td>
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<tr>
<td>World</td>
<td>64</td>
<td>61</td>
<td>54</td>
<td>47</td>
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<tr>
<td></td>
<td>1900</td>
<td>2005</td>
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</table>

### 2008 Base Scenario

<table>
<thead>
<tr>
<th></th>
<th>Gb</th>
<th>Mb/d</th>
<th>2008</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>Total</th>
<th>Peak Date</th>
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</thead>
<tbody>
<tr>
<td>Regular Oil excludes Heavy Oils (inc. tarsands, oilshales); Polar &amp; Deepwater Oil; &amp; gasplant NGL and Refinery Gains of ~3% Reference date : end 2008 Revised 10/03/2009</td>
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<tr>
<td>Heavy etc.</td>
<td>4.3</td>
<td>5.0</td>
<td>6.5</td>
<td>7.2</td>
<td>7.7</td>
<td>226</td>
<td>2030</td>
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<td></td>
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<tr>
<td>Deepwater</td>
<td>5.9</td>
<td>6.6</td>
<td>8.1</td>
<td>8.1</td>
<td>4.7</td>
<td>89</td>
<td>2013</td>
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<tr>
<td>Polar</td>
<td>1.4</td>
<td>1.5</td>
<td>1.7</td>
<td>2.0</td>
<td>2.3</td>
<td>52</td>
<td>2030</td>
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<td></td>
</tr>
<tr>
<td>Gas Liquid</td>
<td>5.1</td>
<td>5.5</td>
<td>5.6</td>
<td>5.9</td>
<td>5.6</td>
<td>156</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>81</td>
<td>80</td>
<td>75</td>
<td>70</td>
<td>55</td>
<td>2425</td>
<td>2008</td>
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</tbody>
</table>
World oil production by source in the Reference Scenario

Even if oil demand was to remain flat to 2030, 45 mb/d of gross capacity – roughly four times the capacity of Saudi Arabia – would be needed just to offset decline from existing fields.
World Energy Outlook 2008

mb/d

1990 2000 2010 2020 2030

- Natural gas liquids
- Non-conventional oil
- Crude oil - additional EOR
- Crude oil - fields yet to be found
- Crude oil - fields yet to be developed
- Crude oil - currently producing fields
The Hubbert Curve can not predict geopolitical actions.
Illinois Natural Gas Prices

- Commercial
- Residential
- Industrial

Source: DOE/EIA 2009

Dollars per Million Btu

Graph showing the trend of natural gas prices from 1967 to 2009 for commercial, residential, and industrial sectors.
Figure 4.4: World Proven Reserves of Natural Gas

World total: 180 tcm as of 1 January 2004

Source: Cedigaz (2004).
Unconventional Gas Production

NATURAL GAS IN NORTH AMERICA – SUPPLY AND DEMAND

Demand for natural gas in North America and sources of gas supply. Source: CRA International

- Rising demand for gas
- Imported liquefied natural gas (LNG)
- Gas from deepwater sources
- Coal bed methane
- Tight gas
- Gas from Arctic
- Gas from conventional sources

Volume (billions of cubic feet per day)

Year

1990  2000  2010  2020
Major Tight Gas Plays, Lower 48 States

Source: Energy Information Administration based on data from various published studies
Updated: April 8, 2009
Horizontal Wells to Fracture Shale
Historical Average Weekly Coal Commodity Spot Prices (Dollars per Short Ton)

Key to Coal Commodities by Region:

<table>
<thead>
<tr>
<th>Regional Coal Commodity</th>
<th>Description</th>
<th>Btu</th>
<th>lbSO2/mmBtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Appalachia (CAP)</td>
<td>Big Sandy/Kanawha</td>
<td>12,500</td>
<td>1.2</td>
</tr>
<tr>
<td>Northern Appalachia (NAP)</td>
<td>Pittsburgh Seam</td>
<td>13,000</td>
<td>&lt;3.0</td>
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<tr>
<td>Illinois Basin (ILB)</td>
<td>11,800</td>
<td>5.0</td>
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</tr>
<tr>
<td>Powder River Basin (PRB)</td>
<td>8,800</td>
<td>0.8</td>
<td></td>
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<tr>
<td>Uinta Basin in Colo.</td>
<td>11,700</td>
<td>0.8</td>
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</tbody>
</table>
The Bottom Line

• The rise in fossil energy prices was driven by structural changes in the world economy that produced rapidly increasing demand at the same time rising costs of production.
• We have a dip now, but higher prices will return once the world economy recovers.
• We have entered interesting times.
• Instability in energy price and availability will dominate our future.
Solutions

• Get as efficient as you possibly can as fast as you can.
• Move to renewables (not based on food sources).
• Consider life-style options – live more simply and lower on the food chain.