The Outlook for Energy: A View to 2040

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USAEE -- Houston
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Energy Outlook Development

100 countries
Energy Outlook Development

15 demand sectors

- Residential
- Commercial
- Lt. Transportation
- Hvy. Transportation
- Aviation
- Marine
- Rail
- Chemicals
- Asphalt
- Lubricants
- Flaring
- Energy Industry
- Agriculture
- Heavy Industry
- Power Generation
Energy Outlook Development

20 fuel types

- Motor Gasoline
- Distillate
- Naphtha
- Jet Fuel
- Fuel Oil
- LPG
- Lubes
- Asphalt
- Natural Gas
- Nuclear
- Biomass/Other
- Coal
- Hydro
- Geothermal
- Solar
- Wind
- Bio-mogas
- Bio-distillate
- Electricity
- Market Heat

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Global Progress Drives Demand

- **Population** (Billion)
  - Average Growth / Yr. 2010 – 2040: 0.8%
  - Non OECD: 12
  - OECD: 9

- **GDP** (Trillion 2005$)
  - Average Growth / Yr. 2010 – 2040: 2.8%
  - OECD: 10
  - Non OECD: 4

- **Energy Demand** (Quadrillion BTUs)
  - Average Growth / Yr. 2010 – 2040: 1.0%
  - OECD: 5
  - Non OECD: 0

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Energy Saved: ~500
People’s Living Standard Depends on Energy

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People’s Living Standard Depends on Energy
People’s Living Standard Depends on Energy
Key Growth Countries

Leading Economic Growth 2010 to 2040
Percent Share

- China: ~40%
- India: ~15%
- Key Growth: 20%
- Other: 25%
- 10 Countries
- 60+ Countries

2040 Energy Demand
QUADS

- China: 150
- India: 75
- Key Growth Countries

Countries: Brazil, Saudi Arabia, Iran, Mexico, Egypt, Turkey, Indonesia, South Africa, Thailand, Nigeria, Egypt.
Global Urbanization & Major Cities (2010)

2010 Percentage Urban

- 0-50%
- 50-75%
- 75-100%
- 10 million +

Source: United Nations and ExxonMobil estimates
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Electricity Generation Leads Growth

Energy Demand by Sector

Quadrillion BTUs

- 2010
- 2025
- 2040

Electricity Generation
Industrial
Transportation
Res/Comm

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Industrial
Industrial Energy Demand

By Region

Quadrillion BTUs

By Sector

Percent Share

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Transportation
Light Duty Vehicle Efficiency

Car Fleet by Type
Million Cars

- Elec/Plug-in
- Full Hybrid
- CNG+LPG
- Conv. Diesel
- Conv. Gasoline

Range of Average Vehicle Efficiency
On-Road Miles per Gallon

- Average Fleet
- Europe
- U.S.

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Transportation Demand

Sector Demand
MBDOE

- Rail
- Marine
- Aviation
- Heavy Duty
- Light Duty

Commercial Transportation by Region - 2010
MBDOE

- Rail
- Marine
- Aviation
- Heavy Duty

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Transportation Fuel Demand Shifts to Diesel

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Non OECD

MBDOE

45

30

15

0

2000

2020

2040

Gasoline

Ethanol

Biodiesel

Jet Fuel

Fuel Oil

Natural Gas

Other

OECD

MBDOE

45

30

15

0

2000

2020

2040

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Electricity generation
Economic Choices for U.S. Electricity

Plant Cost, Startup 2030

2013 cents/kWh

Baseload - Intermittent

Reliability Cost*

$60/tonne of CO₂

$0/tonne

*Reliability cost includes integration, backup capacity and additional transmission costs.
United States Energy Demand and Supply

By Sector
Quadrillion BTUs

- Transportation
- Industrial
- Electricity Generation
- Res/Comm

By Fuel
Quadrillion BTUs

- Oil
- Gas
- Coal
- Nuclear
- Biomass
- Other Renewables
Energy Mix Continues to Evolve

Average Growth / Yr. 2010 - 2040

1.0%

Quadrillion BTUs

- Oil: 0.7%
- Gas: 1.7%
- Coal: 0.0%
- Nuclear: 2.5%
- Biomass: 0.4%
- Solar / Wind / Biofuels: 5.9%
- Hydro / Geo: 2.0%
Emissions
**CO₂ Emissions Plateau**

Energy-Related CO₂ Emissions by Region

**Emissions per Capita**

<table>
<thead>
<tr>
<th>Year</th>
<th>OECD</th>
<th>Non OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>2040</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

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CO2 Emissions Relative to Efficiency & Fuel Mix Changes

- Billion tonnes CO2

- Thousands of BTUs per $ GDP (2005$)

- 1980 Non OECD
- 2010 Non OECD
- 2040 Non OECD
- 1980 OECD
- 2010 OECD
- 2040 OECD

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Supply
Liquids Supply

**Liquid Supply by Type**
MBDOE

- Conventional Crude & Condensate
- NGLs
- Other
- Deepwater
- Tight Oil
- Oil Sands
- Biofuels

**Crude and Condensate Resource***
Trillion barrels of oil

- Remaining Resource
- Cumulative Production through 2040

*Source: IEA

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* Source: IEA
**Liquids Supply by Region**

*Change in Liquid Production by Region from 2010 to 2040*

MBDOE

- North America
- Latin America
- Europe
- Russia/Caspian
- Africa
- Middle East
- Far East

*North American Liquid Supply*

MBDOE

- Biofuels
- Oil Sands
- Tight Oil
- Deepwater
- Other
- NGLs
- Conventional Crude & Condensate

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### Gas Resources Abundant; Supply Diversifies

#### Remaining Recoverable Resource*

<table>
<thead>
<tr>
<th>Region</th>
<th>Conventional</th>
<th>Unconventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>2500 BCFD</td>
<td>4500 BCFD</td>
</tr>
<tr>
<td>Middle East</td>
<td>2000 BCFD</td>
<td>3000 BCFD</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>3000 BCFD</td>
<td>5000 BCFD</td>
</tr>
<tr>
<td>Russia/Caspian</td>
<td>2500 BCFD</td>
<td>4000 BCFD</td>
</tr>
<tr>
<td>Europe</td>
<td>3000 BCFD</td>
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</tr>
<tr>
<td>Latin America</td>
<td>1500 BCFD</td>
<td>2500 BCFD</td>
</tr>
<tr>
<td>North America</td>
<td>2000 BCFD</td>
<td>3000 BCFD</td>
</tr>
</tbody>
</table>

*Source: IEA

#### Gas Production by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>2012</th>
<th>2020</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>100</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>Middle East</td>
<td>150</td>
<td>300</td>
<td>550</td>
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<td>700</td>
</tr>
<tr>
<td>Latin America</td>
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<td>200</td>
<td>400</td>
</tr>
<tr>
<td>North America</td>
<td>50</td>
<td>100</td>
<td>200</td>
</tr>
</tbody>
</table>

*Source: IEA

#### Gas Production by Type

<table>
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<tr>
<th>Type</th>
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<th>2020</th>
<th>2040</th>
</tr>
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<tbody>
<tr>
<td>Conventional</td>
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<td>2000</td>
</tr>
<tr>
<td>Unconventional</td>
<td>1500</td>
<td>3000</td>
<td>4500</td>
</tr>
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*Source: IEA

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*Source: IEA*
Conclusions