Energy Outlook: A View to 2040

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This presentation includes forward-looking statements. Actual future conditions (including economic conditions, energy demand, and energy supply) could differ materially due to changes in technology, the development of new supply sources, political events, demographic changes, and other factors discussed herein and under the heading "Factors Affecting Future Results" in the investors section of our website at: www.exxonmobil.com. The information provided includes ExxonMobil's internal estimates and forecasts based upon internal data and analyses as well as publically-available information from external sources including the International Energy Agency. This material is not to be used or reproduced without the permission of Exxon Mobil Corporation. All rights reserved.
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

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Energy Outlook Development

- 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

20 fuel types
Energy Outlook Development

Technology & Policy
Energy Outlook Development

Trade Flows
Global Progress Drives Demand

**Population**
- Billion
  - Average Growth / Yr.
    - 2010 – 2040
      - OECD: 0.8%
      - Non OECD: 2.8%

**GDP**
- Trillion 2005$
  - Average Growth / Yr.
    - 2010 – 2040
      - OECD: 1.0%
      - Non OECD: 2.8%

**Energy Demand**
- Quadrillion BTUs
  - Average Growth / Yr.
    - 2010 – 2040
      - OECD: 0.8%
      - Non OECD: 2.8%

- Energy Saved ≈ 500

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Electricity Generation Leads Growth

Energy Demand by Sector

Quadrillion BTUs

- Electricity Generation
- Industrial
- Transportation
- Res/Comm

2010 - 2025 - 2040

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Industrial
Industrial Energy Demand

By Region
Quadrillion BTUs

- OECD
- China
- India
- Rest of Non OECD

By Sector
Percent Share

- Heavy Industry
- Chemicals
- Energy Industry
- Other

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Industrial Energy Demand

By Region
Quadrillion BTUs

- OECD
- Rest of Non OECD
- India
- China

By Fuel
Percent Share

- Electricity
- Naphtha
- NGLs
- Other Oil
- Gas
- Coal
- Other

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Transportation
Transportation Demand

Sector Demand
MBDOE

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

2000 2010 2020 2030 2040

Commercial Transportation by Region - 2010
MBDOE

- Rail
- Marine
- Aviation
- Heavy Duty

Asia Pacific  North America  Europe  Latin America  Middle East  Rest of World

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Technologies for Light Duty Transport

Technologies for fuel production

- **shorter-term**
  - energy efficiency
  - flare reduction
  - cogeneration

- **longer-term**
  - second generation bio-fuels
  - Carbon Capture and Storage (CCS)

Technologies for consumers’ use of fuel

- **shorter-term**
  - conventional vehicle technology improvements
    - engines (e.g. adv. lubricants); efficient transmissions
    - others (e.g. tire liners, low weight plastics)

- **advanced vehicles**
  - hybrid (e.g. lithium ion battery materials)
  - advanced diesel
  - CNG

- **longer-term**
  - breakthrough vehicles
    - “HCCI” or “CAI”; fuel cell (e.g. on-board H₂ generator)
    - plug-in hybrid and EV (e.g. lithium ion battery materials)

Source: U.S. Basis - WTW Study, Argonne National Lab, 2005
### Light Duty Vehicle Efficiency

#### Car Fleet by Type

<table>
<thead>
<tr>
<th>Year</th>
<th>Elect Plug-in</th>
<th>Full Hybrid</th>
<th>CNG+LPG</th>
<th>Conv. Diesel</th>
<th>Conv. Gasoline</th>
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<tbody>
<tr>
<td>2010</td>
<td>100</td>
<td>800</td>
<td>500</td>
<td>100</td>
<td>1700</td>
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<tr>
<td>2015</td>
<td>120</td>
<td>1000</td>
<td>500</td>
<td>120</td>
<td>1700</td>
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<tr>
<td>2020</td>
<td>140</td>
<td>1200</td>
<td>500</td>
<td>140</td>
<td>1700</td>
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<tr>
<td>2025</td>
<td>160</td>
<td>1400</td>
<td>500</td>
<td>160</td>
<td>1700</td>
</tr>
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<tr>
<td>2040</td>
<td>220</td>
<td>2000</td>
<td>500</td>
<td>220</td>
<td>1700</td>
</tr>
</tbody>
</table>

#### Range of Average Vehicle Efficiency

<table>
<thead>
<tr>
<th>Year</th>
<th>On-Road Miles per Gallon</th>
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</thead>
<tbody>
<tr>
<td>2010</td>
<td>15</td>
</tr>
<tr>
<td>2020</td>
<td>30</td>
</tr>
<tr>
<td>2030</td>
<td>45</td>
</tr>
<tr>
<td>2040</td>
<td>75</td>
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</tbody>
</table>

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Electricity generation
Electricity Demand

Global Electrical Demand by Sector
Thousand TWh

- Residential
- Commercial
- Heavy Industry
- Other Industry
- Transportation

Global Electrical Demand by Fuel
Thousand TWh

- Wind & Solar
- Oil
- Coal
- Nuclear
- Other Renewables
- Gas

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Electricity Use by Region

Growth in Electricity Demand
2010 – 2040
~90%

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Economic Choices for U.S. Electricity

Plant Cost, Startup 2030
2013 cents/kWh

Gas
$60/tonne of CO₂
$0/tonne

Coal
$0/tonne

Nuclear
Gas

CCS

Onshore Wind
Reliability Cost*

Solar PV Utility

*Reliability cost includes integration, backup capacity and additional transmission costs.
CCS Use for Power Generation

Least Cost Generation Technology Zones

Gas CCGT-CCS
Gas CCGT
Supercritical Coal-CCS
Supercritical Coal

Source: Society of Petroleum Engineering, SPE-139716-PA
Emissions
CO₂ Emissions Plateau

Energy-Related CO₂ Emissions by Region
Billion Tonnes

- Asia Pacific
- Middle East
- Africa
- Latin America
- Russia/Caspian
- Europe
- North America

Emissions per Capita
Tonnes / Person

- 2010
- 2040

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Energy Mix Continues to Evolve

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Supply
Liquids Supply

Liquid Supply by Type

MBDOE

Crude and Condensate Resource*
Trillion barrels of oil

* Source: IEA

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* Source: IEA
Gas Resources Abundant; Supply Diversifies

Remaining Recoverable Resource*

<table>
<thead>
<tr>
<th>Region</th>
<th>Thousand TCF</th>
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<tbody>
<tr>
<td>Conventional</td>
<td>Unconventional</td>
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<tr>
<td>Africa</td>
<td>300</td>
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<tr>
<td>Middle East</td>
<td>200</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>100</td>
</tr>
<tr>
<td>Russia/Caspian</td>
<td>90</td>
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<tr>
<td>Europe</td>
<td>80</td>
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<tr>
<td>Latin America</td>
<td>70</td>
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<tr>
<td>North America</td>
<td>60</td>
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Gas Production by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>BCFD</th>
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</thead>
<tbody>
<tr>
<td>Africa</td>
<td>600</td>
</tr>
<tr>
<td>Middle East</td>
<td>500</td>
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<tr>
<td>Asia Pacific</td>
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<tr>
<td>Russia/Caspian</td>
<td>300</td>
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<tr>
<td>Europe</td>
<td>200</td>
</tr>
<tr>
<td>Latin America</td>
<td>100</td>
</tr>
<tr>
<td>North America</td>
<td>0</td>
</tr>
</tbody>
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Gas Production by Type

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</thead>
<tbody>
<tr>
<td>ROW</td>
<td>600</td>
</tr>
<tr>
<td>Unconventional</td>
<td>500</td>
</tr>
<tr>
<td>Conventional</td>
<td>400</td>
</tr>
</tbody>
</table>

* Source: IEA

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* Source: IEA
LNG Demand Triples and LNG Supply Diversifies

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Liquids Trade

North America

Latin America

Europe

Middle East

Russia/Caspian

Asia Pacific

MBDOE

Net Exports

Net Imports

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Natural Gas Trade

North America

Latin America

Europe

Middle East

Russia/Caspian

Asia Pacific

Net Exports

Net Imports

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Technology Evolution Summary

• Technology development requires longer-term focus and is unpredictable
  – Benefits from a portfolio approach; Learning from failure advises future projects
  – May require business model innovation, especially in “new-to-world” applications
  – Sometimes driven by science and technology developments in other unrelated areas
  – Extent, pace, and source of future cost reduction cannot be precisely predicted
    • Unconventional gas – current low costs were not expected a few years ago
    • Batteries – 5x energy density increase in two centuries – another 15x increase = gasoline
• Technologies are likely commercialized in higher value segments before they are used in lower value segments
  – Lithium ion batteries – cell phones > power tools > hybrids > electric vehicles
  – CCS – NG separation/EOR > Power plants/storage > Refineries/storage
  – Butanol: Bio-n-butanol – displaces chemical n-butanol > fuel additive > neat fuel
• Technology evolution typically crosses national boundaries but government funding is frequently driven by desire to create national competitive advantage, E.g. Li-ion battery
  – Lithium ion batteries concept, Whittingham, Exxon Corporate Lab, NJ in 1970s
  – Anode – Yazimi – France/ Cathode – Goodenough – Texas, USA in 1980s
  – Separator Film, Tonen in Japan in 1980s, former Exxon and Mobil Affiliate
  – Li-ion use in consumer devices, cell phone use, Sony in Japan in 1990s
• Global widespread technology adoption is driven by long-term economic fundamentals
• Market driven selection of the solutions will ensure longer-term viability

Conclusions

The Outlook for Energy: A View to 2040

2014