Economic backdrop

GDP

Contribution to GDP growth 2014-35

Trillion, $2010

2016 Energy Outlook
Global energy demand

Consumption by region

Billion toe

- Other
- Other Asia
- China
- OECD

Consumption growth by region

10 year average, % per annum

- Other Asia
- China
- World
- OECD

2016 Energy Outlook
What drives energy demand?
Global GDP and energy

World GDP and energy demand

Index (1965=100)

- GDP
- Primary energy

Energy intensity by region

Toe per thousand $2010 GDP

China
US
World
EU
India
Africa

2016 Energy Outlook

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Slower global GDP growth

Annual growth rates 2014-35

% per annum

- China
- World
- China
- World

Historical growth rates

% per annum, 20-year moving average

- GDP
- Primary energy

2016 Energy Outlook
Energy intensity and energy demand

Decline in world energy intensity

% per annum

- 0%
- -1%
- -2%
- -3%
- -4%

1965-2014

- Fastest 20-year average

1994-2014

Base case

2014-35

Flat demand

World energy demand

Billion toe

- 1965-2014
- 1994-2014
- Base case
- Flat demand

2016 Energy Outlook
Q: What drives energy demand?

A: Global economic growth
Fuel mix

Shares of primary energy

- Oil
- Coal
- Gas
- Hydro
- Nuclear
- Renewables*

Annual demand growth by fuel

Mtoe per annum

- Renew.*
- Hydro
- Nuclear
- Coal
- Gas
- Gas

*Includes biofuels

2016 Energy Outlook
Key factors shaping the fuel mix

- What have we learned about US shale?
- China’s changing energy needs
- Prospects for renewables and other non-fossil fuels
US tight oil and shale gas

US tight oil forecasts

US shale gas forecasts

Forecast year:
- 2013
- 2014
- 2015
- 2016

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2016 Energy Outlook
Global tight oil and shale gas

Ten year supply increments:

Tight oil

Shale gas

Mb/d

Bcf/d


S & C America
Middle East
Europe & Eurasia
Africa
Asia Pacific
North America
Market shares of tight oil and shale gas

Shares of total oil/gas production

- Shale gas
- Tight oil

2015 2020 2025 2030 2035
Market shares of tight oil and shale gas

Shares of total oil/gas production

- Shale gas
- Tight oil

Stronger shale case
Key factors shaping the fuel mix

- What have we learned about US shale?
- China’s changing energy needs
- Prospects for renewables and other non-fossil fuels
China’s changing energy needs

GDP and primary energy growth

% per annum

- GDP
- Primary energy

Shares of primary energy

- Coal
- Oil
- Non-fossils
- Gas
Key factors shaping the fuel mix

- What have we learned about US shale?
- China’s changing energy needs
- Prospects for renewables and other non-fossil fuels
Renewables and other non-fossil fuels

Renewables in power forecasts

Mtoe

Forecast year:
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011

2010 2015 2020 2025 2030 2035
Renewables and other non-fossil fuels

Renewables in power forecasts

Mtoe

Forecast year:
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011

2010 2015 2020 2025 2030 2035

Revisions to non-fossil fuels vs 2011 Outlook

Mtoe

- Renewables
- Hydro
- Biofuels
- Nuclear
- Total

2015 2020 2025 2030

2016 Energy Outlook
Oil demand and supply

Demand

- 2014
- OECD decline
- Non-OECD growth

Supply

- 2014
- Non-OPEC growth
- OPEC growth

2035 level

Mb/d

- 80
- 85
- 90
- 95
- 100
- 105
- 110
- 115

2014 Energy Outlook
Oil demand

Liquids fuel demand by sector

<table>
<thead>
<tr>
<th>Mb/d</th>
<th>1965</th>
<th>2000</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td></td>
<td></td>
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</table>

Vehicle fleet

<table>
<thead>
<tr>
<th>Billion vehicles</th>
<th>1965</th>
<th>2000</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-OECD</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Natural gas

Gas production by type and region

<table>
<thead>
<tr>
<th>Bcf/d</th>
<th>1990</th>
<th>2005</th>
<th>2020</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-OECD shale</td>
<td>500</td>
<td>375</td>
<td>250</td>
<td>125</td>
</tr>
<tr>
<td>OECD shale</td>
<td>0</td>
<td>125</td>
<td>250</td>
<td>375</td>
</tr>
<tr>
<td>Non-OECD other</td>
<td>375</td>
<td>250</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>OECD other</td>
<td>125</td>
<td>250</td>
<td>375</td>
<td>500</td>
</tr>
</tbody>
</table>

Shares of global gas consumption

- Total trade
- Pipeline
- LNG

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Changing outlook for carbon emissions
Carbon emissions

% per annum

1994-2014

Decline in energy intensity

2014-35

Decline in carbon intensity

Decline in carbon intensity

2016 Energy Outlook
Outlook for carbon emissions

Carbon emissions

Billion tonnes CO$_2$

- Base case
- IEA 450

1975 1995 2015 2035
Outlook for carbon emissions

Carbon emissions

Billion tonnes CO₂

- Base case
- IEA 450

Changes in intensity

% per annum

Energy intensity

-1%  -2%  -3%

Carbon intensity

1994-2014

Base case

IEA 450

2016 Energy Outlook
Outlook for carbon emissions

Carbon emissions

Billion tonnes CO₂

- Base case
- Faster transition
- IEA 450

Changes in intensity

% per annum

Energy intensity

-3%

Carbon intensity

1994-2014

Base case

Faster transition

IEA 450

Outlook for carbon emissions

2016 Energy Outlook

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Impact of faster transition case

Consumption by fuel

Annual demand growth by fuel

Billion toe

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil</th>
<th>Coal</th>
<th>Gas</th>
<th>Hydro &amp; Nuclear</th>
<th>Renewables*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>0.5</td>
<td>2.0</td>
<td>1.0</td>
<td>0.1</td>
<td>0.8</td>
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<td>2000</td>
<td>3.5</td>
<td>1.5</td>
<td>2.5</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2035</td>
<td>4.0</td>
<td>1.0</td>
<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Mtoe per annum

- **Renew.**
- **Hydro**
- **Nuclear**
- **Coal**
- **Gas**
- **Oil**
- **Total**

*Includes biofuels

2016 Energy Outlook
Conclusions

- Global demand for energy continues to rise
  - to power increased levels of activity as the world economy continues to grow
- Fuel mix changes significantly
  - coal losing, renewables gaining, and oil and gas combined holding steady
- Growth rate of carbon emissions slows sharply
  - but further policy changes are needed