Energy in 2016: short-run adjustments and long-run transition

Mark Finley
Primary energy and energy intensity

Annual change, %

-4% -2% 0% 2% 4% 6% 8%

Primary energy
Energy intensity

5-year average

Energy consumption growth

Contributions to annual growth, %

- Other
- India
- China
- OECD

China industrial output and energy demand

Outputs of iron, steel and cement

Annual change, %

<table>
<thead>
<tr>
<th>Year</th>
<th>Iron</th>
<th>Crude steel</th>
<th>Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-14</td>
<td>16%</td>
<td>12%</td>
<td>8%</td>
</tr>
<tr>
<td>2014-16</td>
<td>0%</td>
<td>2%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Contributions to energy demand growth

Annual change, %

<table>
<thead>
<tr>
<th>Year</th>
<th>Iron, steel and cement</th>
<th>Other sectors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-14</td>
<td>6%</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Includes data from the National Bureau of Statistics of China
Fuel mix: growth and shares in primary energy

Growth by fuel

Annual change, Mtoe

Consumption Production

-250 -200 -150 -100 -50 0 50 100 150 200 250

Oil Gas Coal Nuclear Hydro Renew.

Shares of primary energy consumption


Oil Gas Coal Nuclear Hydro Renew.
Oil
Oil market in 2015 and 2016

Consumption

Annual change, Mb/d

Exporters
Importers

Total

Production

Annual change, Mb/d

OPEC
Non-OPEC

Total

10-year average
2015
2016

10-year average
2015
2016
Largest changes to oil demand and supply

Oil consumption

Annual change, Kb/d

-200 0 200 400

<table>
<thead>
<tr>
<th>Country</th>
<th>Importers</th>
<th>Exporters</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Korea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td></td>
<td></td>
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<tr>
<td>South Africa</td>
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<tr>
<td>Venezuela</td>
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<td></td>
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<tr>
<td>Mexico</td>
<td></td>
<td></td>
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<tr>
<td>Japan</td>
<td></td>
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<tr>
<td>Brazil</td>
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<td></td>
</tr>
</tbody>
</table>

Oil production

Annual change, Kb/d

-500 0 500

<table>
<thead>
<tr>
<th>Country</th>
<th>OPEC</th>
<th>Non-OPEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iran</td>
<td></td>
<td></td>
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<tr>
<td>Iraq</td>
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<td></td>
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<tr>
<td>Saudi Arabia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UAE</td>
<td></td>
<td></td>
</tr>
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<td></td>
</tr>
<tr>
<td>Venezuela</td>
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<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
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<tr>
<td>US</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Oil market: balance and inventories

Oil production and consumption

- Consumption
- Production

OECD commercial inventories

Source: includes data from the International Energy Agency © OECD/IEA 2017
US Tight Oil
US tight oil rigs

Change in US tight oil rig count

Monthly change in rig count

Jan-14  Jan-15  Jan-16  Jan-17

Prices start to fall

Prices start to rise

Source: includes data from Baker Hughes and the US Energy Information Administration
“OPEC remains an important catalyst to the stability and sustainability of the market… but history has also demonstrated that intervention in response to structural shifts is largely ineffective… that’s why Saudi Arabia does not support OPEC intervening to alleviate the impacts of long-term structural imbalances, as opposed to addressing short-term aberrations….”

HE Khalid Al-Falih
Minister of Energy, Industry and Mineral Resources, Saudi Arabia
CERAWeek, March 2017
Coal
Chinese coal production and prices

Coal production growth

Annual change, %

-10% -5% 0% 5% 10% 15% 20%


Steam coal prices

$/tonne

Qinhuangdao, China

Jan-13 Jan-14 Jan-15 Jan-16 Jan-17

Source: includes data from IHS McCloskey
Chinese coal production and global prices

Coal production growth

Annual change, %

-10% -5% 0% 5% 10% 15% 20%


Steam coal prices

$/tonne

120 100 80 60 40

Jan-13 Jan-14 Jan-15 Jan-16 Jan-17

Qinhuangdao, China
Newcastle, Australia
Japan
Northwest Europe
US East Coast

Source: includes data from IHS McCloskey
UK coal

Source: includes data from the UK Department for Business, Energy & Industrial Strategy
Natural gas
Growth in natural gas demand and supply

**Gas consumption**

<table>
<thead>
<tr>
<th>Annual change, %</th>
<th>10-year average</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>2.5%</td>
<td>1.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Rest of world</td>
<td>-0.5%</td>
<td>0.5%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

**Gas production**

<table>
<thead>
<tr>
<th>Annual change, %</th>
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<tr>
<td>US</td>
<td>2.5%</td>
<td>1.5%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>Rest of world</td>
<td>0.5%</td>
<td>1.5%</td>
<td>-0.5%</td>
</tr>
</tbody>
</table>
LNG trade

**Exports**

<table>
<thead>
<tr>
<th></th>
<th>Annual change, Bcm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td></td>
</tr>
</tbody>
</table>

2010-15 | 2016
---|---

**Imports**

<table>
<thead>
<tr>
<th></th>
<th>Annual change, Bcm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>New markets*</td>
<td></td>
</tr>
</tbody>
</table>

2010-15 | 2016
---|---

* Includes Egypt, Pakistan, Poland, Jordan, Jamaica, Colombia and Lithuania
LNG market characteristics

### Contract length

<table>
<thead>
<tr>
<th>Share of total</th>
<th>2006</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10 years</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>&lt;10 years</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>

### Contract size

<table>
<thead>
<tr>
<th>Share of total</th>
<th>2006</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2 Bcm</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>&lt;2 Bcm</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>

### Flexible supply*

<table>
<thead>
<tr>
<th>Share of total</th>
<th>2006</th>
<th>2011</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>30%</td>
<td>40%</td>
</tr>
</tbody>
</table>

*includes spot supply and supplies without fixed destination in the contract

Source: IHS, PIRA
European gas imports

Annual change, Bcm

-40 -20 0 20 40


Russia  Other pipeline  LNG  Total

Annual change, Bcm:
-40  -20   0   20   40


Russia  Other pipeline  LNG  Total
Growth and diffusion of renewables

Growth by country

Annual change, TWh

<table>
<thead>
<tr>
<th>Year</th>
<th>Japan</th>
<th>US</th>
<th>China</th>
<th>EU</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2016</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Diffusion of power technologies

Share of countries*

<table>
<thead>
<tr>
<th>Year</th>
<th>Wind</th>
<th>Solar</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The proportion of the 67 countries that are individually listed in the Statistical Review with power generation of at least 50 GWh from the specified technology.
Power
OECD GDP and electricity consumption

Annual change, %

-4%  -2%  0%  2%  4%  6%


GDP  Electricity
Growth of power generation by fuel

Annual change, TWh

- **2001-06**
  - Other: 100 TWh
  - Gas: 200 TWh
  - Coal: 300 TWh
  - Renewables: 200 TWh

- **2006-11**
  - Other: 150 TWh
  - Gas: 250 TWh
  - Coal: 300 TWh
  - Renewables: 200 TWh

- **2011-16**
  - Other: 100 TWh
  - Gas: 150 TWh
  - Coal: 300 TWh
  - Renewables: 350 TWh
Carbon emissions
Growth in carbon emissions

Growth in GDP and carbon emissions

Annual change, %

Fuel mix
Energy intensity

GDP
CO₂

Changes in growth in carbon emissions

Factors slowing growth in CO₂

Annual change, %

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>Rest of world</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013-16</td>
<td>1.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Conclusions

Energy in 2016: short-run adjustments and long-run transition

• weak growth in energy demand and carbon emissions driven by both factors

• strong growth in oil demand as market adjusted to excess supplies

• rapid growth in renewables and further falls in coal driven by energy transition
Backups
Refinery throughput and capacity

**Refinery throughput**

- **Annual change, Mb/d**
  - 2015
  - 2016

**Refining capacity**

- **Annual change, Mb/d**
  - 2010
  - 2012
  - 2014
  - 2016

* S&C America and Mexico
UK coal

- Production
- Consumption

1800: Richard Trevithick builds first tracked steam locomotive

1882: World’s first centralized coal-fired power station opens in Holborn

1921 / 1926: Miners’ strike and general strike

1947: Coal industry nationalized

1956: Clean Air Act passed in response to London smog

1968: Conversion of town gas to natural gas begins

1984: Miners’ strike

1991: ‘Dash for gas’

2016: Last deep coal mine closes

Source: includes data from the UK Department for Business, Energy & Industrial Strategy
Growth in carbon emissions

Growth in GDP and carbon emissions

Annual change, %

-4%
-2%
0%
2%
4%
6%
8%


Carbon intensity of GDP

GDP

CO₂