FACT BOX

Energy Fundamentals

An overview of energy-related developments and facts

Luca Franza, Coby van der Linde and Pier Stapersma

Primary energy consumption by fuel – 1965-2016

Shares of primary energy consumption

© BP
Simplified oil value chain

Extraction → Crude Pipeline → Refining → Product Pipeline → Distribution Pipeline → Consumer

- Oil Products: Gasoline, Diesel, Naphtha, Fuel oil, etc.
- Mobile Transportation

Storage of crude oil

Simplified gas value chain

Extraction → Processing → Transmission Pipeline → Consumer

- Flared gas
- Propane, butane (LPGs), heavy fractions

Transmission Pipeline → Liquefaction plant → LNG tanker → Regasification plant → Consumer

- GTLs
- Mobile Transportation

Storage of crude oil

© CIEP
Simplified coal value chain

Oil and gas reserves by region

World proven oil reserves:
1,706 billion barrels

Middle East
811 bn barrels

Latin America
325 bn barrels

OECD Americas
233 bn barrels

World proven gas reserves:
216 trillion cubic metres

Middle East
81 tcm

E. Europe
and Eurasia
73 tcm

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Production of oil and gas by region – 2015

<table>
<thead>
<tr>
<th>Region</th>
<th>Oil production by region</th>
<th>Natural gas production by region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle East</td>
<td>10</td>
<td>OECD Americas</td>
</tr>
<tr>
<td>OECD Americas</td>
<td>20</td>
<td>E. Europe/Eurasia</td>
</tr>
<tr>
<td>E. Europe/Eurasia</td>
<td>30</td>
<td>Middle East</td>
</tr>
<tr>
<td>Africa</td>
<td>40</td>
<td>Asia</td>
</tr>
<tr>
<td>Asia</td>
<td>20</td>
<td>Latin America</td>
</tr>
<tr>
<td>Latin America</td>
<td>10</td>
<td>OECD Europe</td>
</tr>
<tr>
<td>OECD Europe</td>
<td>50</td>
<td>OECD Asia Oceania</td>
</tr>
<tr>
<td>OECD Asia Oceania</td>
<td>75</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040</td>
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Consumption of oil and gas by region – 2016

Oil: Consumption by region
Million barrels daily

Natural gas: Consumption by region
Billion cubic metres

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Coal reserves and production by region

World proven coal reserves: 968 billion tonnes

- China produces and consumes nearly half of all the world’s coal
- India’s coal consumption is on the rise

Major interregional oil trade flows

Major trade movements 2016
Trade flows worldwide (million tonnes)
Major interregional natural gas trade flows

Major trade movements 2016
Trade flows worldwide (billion cubic metres)

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Major interregional coal trade flows

Coal trade around the world

How much coal?
- 100 Mt
- 50 Mt
- 10 Mt

Top coal exporters
- Indonesia
- Australia
- Former Soviet Union
- North America
- Central and South America
- Africa
- Other exporters
- North Korea

Electricity generation by source – world

World Electricity Production from All Energy Source in 2014 (TWh)

<table>
<thead>
<tr>
<th>Electricity Source</th>
<th>TWh</th>
</tr>
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<tbody>
<tr>
<td>Others</td>
<td>1 520</td>
</tr>
<tr>
<td>Oil</td>
<td>1 968</td>
</tr>
<tr>
<td>Nuclear</td>
<td>2 417</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>3 789</td>
</tr>
<tr>
<td>Gas</td>
<td>4 933</td>
</tr>
<tr>
<td>Coal</td>
<td>8 726</td>
</tr>
</tbody>
</table>
Coal vs. Gas in Electricity generation

<table>
<thead>
<tr>
<th>Source: IEA (2012:41)***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>These values represent the average grammes of CO₂ of per KWh electricity produced in the OECD member countries between 2008 and 2010.</strong></td>
</tr>
<tr>
<td><strong>Range of bituminous coal (860 gr/kWh) and sub-bituminous coal (920 gr/kWh)</strong></td>
</tr>
<tr>
<td><strong>Available at <a href="http://www.iea.org/co2highlights/co2highlights.pdf">www.iea.org/co2highlights/co2highlights.pdf</a></strong></td>
</tr>
</tbody>
</table>

Energy from wind & solar is ‘variable’ (1/2)

- Generation from solar/wind in **Germany** in the month of **April 2017**
- Every day **solar energy** (yellow) emerges, and fades away when daytime ends
- Many days, too, **wind energy** (blue) is produced, but some days is barely available
- Different seasons are characterized by different generation patterns

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Energy from wind & solar is ‘variable’ (2/2)

- Generation from solar/wind in Germany in the month of February 2017
- Every day solar energy (yellow) emerges, and fades away when daytime ends
- Many days, too, wind energy (blue) is produced, but some days is barely available
- Different seasons are characterized by different generation patterns
Consumption of nuclear and hydroelectricity by region

Nuclear energy consumption by region
Million tonnes oil equivalent

Hydroelectricity consumption by region
Million tonnes oil equivalent

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Consumption of ‘other renewables’ (wind, solar, etc.) by region and their share in power generation

Renewable energy in power generation (not including hydro) grew by 14.1% in 2016, slightly below 10-year average, but the largest increment on record (32.5% since 2009). Wind provided more than half of the growth, while solar energy contributed almost a third despite accounting for only 18% of the total. Asia Pacific contributed 43% of growth, with China overtaking the United States to become the world’s largest renewable power producer. Renewable energy accounted for 7.6% of power generation, up from 6.7% in 2015. Europe & Eurasia has the highest share of power from renewables at 11.9%, but its share rose by the smallest increment on record in 2016.

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