Tight oil and shale gas – global implications

Washington, March 2013

Christof Rühl, Chief Economist, BP
Tight oil and shale gas: global implications

Global energy trends

- Characteristics
- Implications
Population, income and energy growth

Population

<table>
<thead>
<tr>
<th>Year</th>
<th>OECD</th>
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GDP

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Primary energy

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<td>2030</td>
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</table>
Industrialisation drives energy growth

By region

By primary use

By fuel

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Fuel shares and energy prices

Shares of world primary energy

- Oil: 50%
- Coal: 40%
- Gas: 20%
- Hydro: 10%
- Nuclear: 5%
- Renewables*: 0%

Energy prices

- Oil (Brent): $2011/boe
- Gas (basket): $281
- Coal (basket): $345

*Includes biofuels

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Energy efficiency improvements

Energy intensity by region
Toe per thousand $2011 GDP (PPP)

Energy and GDP
Billion toe
Trillion $2011 (PPP)

*Euro4 (France, Italy, Germany, UK) pre-1970

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Tight oil and shale gas: global implications

Global energy trends

- Characteristics

- Implications
Tight oil and shale gas: resources and production

Current resources

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<tr>
<th>Region</th>
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Production in 2030

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Resources data © OECD/IEA 2012

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US tight oil and shale gas: infrastructure requirements

Onshore oil & gas rigs 2011

Oil wells drilled and output

*Annualised from 1Q-3Q data

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Global supply growth and tight oil

Liquids supply by type

- OPEC share (RHS) 45%
- OPEC NGLs
- OPEC crude
- Biofuels
- Oil sands
- Tight oil
- Other non-OPEC 30%

Tight oil output

- % of total (RHS)
- China
- Russia
- S. America
- N. America

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Global supply growth and shale gas

Gas production by type and region

Shale gas production

% of total (RHS)
Tight oil and shale gas: global implications

Global energy trends

- Characteristics

- Implications
Unconventional oil and the call on OPEC

Unconventionals share of net global supply growth

- Biofuels
- Oil sands
- Tight oil

Call on OPEC & spare capacity

- Spare capacity
- Call on OPEC (RHS)

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Gas trade and market integration

LNG exports

Bcf/d

% of total consumption (RHS)

LNG

LNG diversification

Suppliers per importer

Customers per exporter

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Tight oil and shale gas uncertainties

Range of tight oil forecasts (excludes NGLs)

Share of global supply growth

Range of shale gas forecasts

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Oil and gas: reserves and production

Key:

% share of global total

- 50%
- 0%

N. America
Europe
FSU
Middle East
Asia Pacific
S. & C. America
Africa

Net importers 2011
Net exporters 2011

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Energy imbalances: import profiles

Energy imbalances

Mtoe

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<th>Year</th>
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<th>EU</th>
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Energy imbalances to GDP ratio

Toe per $Mln GDP PPP

- China
- US
- EU

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Energy imbalances: export profiles

Energy imbalances

Saudi Arabia  Africa  Russia

Mtoe

Energy imbalances to GDP ratio

Toe per $Mln GDP PPP

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Conclusion

- Economic growth needs energy
- Competition and innovation are the key to meeting this need
  - energy efficiency
  - new supplies
- Wide ranging implications

Economic growth needs energy.
Energy: prices demand growth

Energy prices

$2011/boe

- Oil - Brent
- Gas - basket
- Coal - basket

Energy and GDP

Billion toe

- GDP (RHS)
- Energy

Trillion $2011

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The power sector leads primary energy growth

Growth by sector and region, 2011-2030

Growth by sector and fuel, 2011-2030

Final energy use

Inputs to power

Billion toe

-1

0

1

2

3

Transport
Industry
Other
Power

RoW
Middle East
China & India
OECD

Hydro
Nuclear
Renew.
Electricity
Gas
Oil
Coal

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Emerging economies dominate energy production.

Billion toe

<table>
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<tr>
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Energy: prices demand growth

Energy prices

$2011/boe

- Oil - Brent
- Gas - basket
- Coal - basket

Energy and GDP

Billion toe

1965 1980 1995 2010

1970 1990 2010 2030

Trillion $2011

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Shale gas: regional growth

Sources of gas supply, by region

Bcf/d | N. America | Bcf/d | EU | Bcf/d | China

- Net pipeline imports
- Net LNG imports
- Shale gas production
- Other domestic production

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Global gas balance

Demand

- 2011: 350 Bcf/d
- OECD: 400 Bcf/d
- Middle East: 300 Bcf/d
- China: 250 Bcf/d
- Other OECD: 200 Bcf/d
- N. America: 150 Bcf/d

Supply

- 2011: 400 Bcf/d
- Non-OECD: 300 Bcf/d
- OECD: 250 Bcf/d

2030 level

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Coal consumption

Coal demand by region

Coal demand by sector

Billion toe

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Non-fossil fuels

OECD

Billion toe

Non-OECD

Billion toe

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Growth of renewables in power

Share of power generation

Renewable power

Growth 2011-30, and share of power

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Power generation and electricity use

Electricity share of final consumption

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<td>20%</td>
<td>20%</td>
<td>60%</td>
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Shares of power output

- **Oil**: 30% in 1990, 40% in 2010, 45% in 2030
- **Nuclear**: 10% in 1990, 15% in 2010, 20% in 2030
- **Hydro**: 20% in 1990, 25% in 2010, 30% in 2030
- **Gas**: 40% in 1990, 35% in 2010, 30% in 2030
- **Coal**: 5% in 1990, 10% in 2010, 15% in 2030
- **Renewable**: 5% in 1990, 10% in 2010, 15% in 2030

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*Energy Outlook 2030*
High oil prices are reducing oil’s share of primary energy

Oil share in sector

- Power
- Other
- Industry
- Transport

Fuel economy of new cars

- EU
- US light vehicles
- China

Litres per 100 km

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