Four decades of development

History, status and outlook for Norwegian oil and gas

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Twitter: @Mohnitor

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Bergen, 23 June 2015
An intriguing industry
Geology, technology, economics, and politics
Four decades of development
Substantial revenues for industry, households - and politicians

NCS oil and gas production
MMBoepd

Government Pension Fund - Global
Total capital (NOK trn; nominal)

Four decades of development

Session outline

- Oil and gas in Norway: An industry that makes a difference
- Retrospect on trends and developments on the NCS*
- Norway in the world of petroleum (benchmarking)
- Oil and gas in Norway: Industry, infrastructure, and resources
- Framework and organisation (legal, organisational, fiscal)
- Economics of exploration and production
- Oil and the economy (cyclical and structural impact)
- Corporate investment and capital market interaction

* Norwegian Continental Shelf.
Oil and gas in Norway

Two key references

Source: Norwegian Petroleum Directorate.
Oil and gas in Norway

New app available

New native apps for Android and Windows Phone are now available

- All the fields
- All the wells
- All the production
- All the operators
- All the licenses
- News, maps and more

www.oilfacts.no

Source: Norwegian Petroleum Directorate.
An industry that makes a difference

A significant role in the Norwegian economy

**Macroeconomic key figures 2012**

- Oil and gas share in...
  - GDP 23 per cent
  - Government revenue 30 per cent
  - Total export 52 per cent
  - Total fixed capex 29 per cent

**Seven winter olympic games...**

- ... every year

An industry that makes a difference

Large offshore industry

Source: Norwegian Petroleum Directorate.
Four decades of development

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*Norwegian Continental Shelf.
Oil exploration - where it all starts
A classical board-game reference

Unit cost of reserve addition
Stylised illustration

C

C(r)

t
Exploring the unknown: Geology

Wildcat drilling and the oil price

Source: Norwegian Petroleum Directorate.
Exploring the unknown: Technology

From concrete offshore to subsea & onshore

Source: Norwegian Petroleum Directorate, Statoil.
Retrospect: NCS expenditures

The peak is here

Total NCS expenditures by type
NOK bn (@2013 prices)

NCS investments...
... by field startup decade (@2013 prices)

Source: Norwegian Petroleum Directorate.
Retrospect: NCS production

Source: Norwegian Petroleum Directorate.
Retrospect: NCS players

Increasing diversity

NCS development operatorships
... by type of company (per cent)

Before 1990

1990-2009

2010 and after

NCS production operatorships
by type of company (#)

Source: Norwegian Petroleum Directorate.
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*Norwegian Continental Shelf.
Norway in the world of petroleum

Oil and gas exports compared

Oil exports by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Mmboepd (2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>7.0</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>6.8</td>
</tr>
<tr>
<td>Kuwait</td>
<td>2.0</td>
</tr>
<tr>
<td>Nigeria</td>
<td>2.0</td>
</tr>
<tr>
<td>Iraq</td>
<td>1.9</td>
</tr>
<tr>
<td>Iran</td>
<td>1.9</td>
</tr>
<tr>
<td>Norway</td>
<td>1.8</td>
</tr>
<tr>
<td>UAE</td>
<td>1.7</td>
</tr>
<tr>
<td>Angola</td>
<td>1.7</td>
</tr>
<tr>
<td>Quatar</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Gas exports by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Billion SM³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>193.9</td>
</tr>
<tr>
<td>Qatar</td>
<td>120.0</td>
</tr>
<tr>
<td>Norway</td>
<td>97.3</td>
</tr>
<tr>
<td>Canada</td>
<td>58.2</td>
</tr>
<tr>
<td>Algeria</td>
<td>50.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>38.7</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>36.9</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>32.9</td>
</tr>
<tr>
<td>Malaysia</td>
<td>31.1</td>
</tr>
<tr>
<td>Australia</td>
<td>25.2</td>
</tr>
</tbody>
</table>

Source: Norwegian Petroleum Directorate.
Global benchmarking: Oil and gas reserves

Total oil and gas reserves (bn tonnes o.e.; 2013)

- Source: Norwegian Ministry of Petroleum and Energy.
Global benchmarking: Oil
Norway in the world of oil

**Oil production million tonnes**
- Norway: 87.5
- Mexico: 143.9
- Iraq: 152.4
- Kuwait: 152.5
- United Arab Emirates: 154.1
- Iran: 174.9
- Canada: 182.6
- China: 207.5
- Russian Federation: 394.9
- Saudi Arabia: 526.2
- US: 547.0

**Oil consumption million tonnes**
- Norway: 10.8
- Canada: 104.3
- South Korea: 108.8
- Germany: 111.5
- Brazil: 125.6
- Saudi Arabia: 129.7
- Russian Federation: 147.5
- India: 171.6
- Japan: 218.2
- China: 483.7
- US: 819.9

Global benchmarking: Gas

Norway in the world of oil

Gas production
million tonnes o.e.

- Malaysia: 58.7
- Indonesia: 64.0
- Algeria: 73.4
- Saudi Arabia: 92.5
- China: 96.5
- Norway: 103.4
- Canada: 140.9
- Qatar: 141.3
- Iran: 144.5
- Russian Federation: 533.0
- US: 619.2

Gas consumption
million tonnes o.e.

- Norway: 3.9
- Germany: 67.7
- United Kingdom: 70.5
- Mexico: 75.3
- Canada: 90.6
- Saudi Arabia: 92.5
- Japan: 105.1
- China: 129.5
- Iran: 140.5
- Russian Federation: 374.6
- US: 654.0

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* Norwegian Continental Shelf.
Oil and gas in Norway

Not only the North Sea

- 2,039,951 square kilometers
  - Three times mainland Norway
- Three ocean areas
  - North Sea (142’ sqkm; 60 fields)
  - Norwegian Sea (287’ sqkm; 16 fields)
  - Barents Sea (772’ sqkm; 1 field)
- Developments started in the North Sea
- Gradual northward movement
  - Barents Sea is the new frontier

Source: Norwegian Petroleum Directorate.
Gas transportation

2013 total: 107 bcm

Norwegian gas exports
By delivery point (per cent)

- Belgium Zeebrugge Terminal 13.2%
- Denmark Nybro 0.4%
- Germany Norsea Gas Terminal 5.5%
- Germany Europipe 2 Terminal 18.5%
- Germany Europipe 1 Terminal 16.8%
- United Kingdom Easington Terminal 15.7%
- United Kingdom Other terminals 11.5%
- France Dunkerque Terminal 14.4%
- LNG 4.0%

Source: Norwegian Petroleum Directorate.
Classification of oil and gas resources

The system of the Norwegian Petroleum Directorate

Source: Norwegian Petroleum Directorate.
Classification of oil and gas resources
The system of the Norwegian Petroleum Directorate
Petroleum resources on the NCS

Volume estimates by category (2013)

<table>
<thead>
<tr>
<th>Total recoverable potential</th>
<th>Project status category</th>
<th>Resource accounts per 31.12.2013</th>
<th>Changes from 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total mill Sm³</td>
<td>Oil bill Sm³</td>
<td>Cond mill Sm³</td>
</tr>
<tr>
<td>Produced</td>
<td>3897</td>
<td>1874</td>
<td>160</td>
</tr>
<tr>
<td>Remaining reserves*</td>
<td>834</td>
<td>2049</td>
<td>129</td>
</tr>
<tr>
<td>Contingent resources in fields</td>
<td>337</td>
<td>185</td>
<td>22</td>
</tr>
<tr>
<td>Contingent resources in discoveries</td>
<td>679</td>
<td>330</td>
<td>14</td>
</tr>
<tr>
<td>Potential from improved recovery**</td>
<td>155</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Undiscovered</td>
<td>1330</td>
<td>1490</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>7232</td>
<td>6018</td>
<td>325</td>
</tr>
</tbody>
</table>

Source: Norwegian Petroleum Directorate.
Petroleum resources on the NCS

Volume estimates and uncertainty intervals

Source: Norwegian Petroleum Directorate.
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Framework and organisation

Industrial policies marked by vision and ambition

St. meld. nr. 25
(1975-76)

Petroleummøtesmøte: plan i det
nedre smelte

Source: Norwegian Ministry of Finance.
Framework and organisation

1. National supervision and control must be ensured for all operations on the NCS.
2. Petroleum discoveries must be exploited in a way which makes Norway as independent as possible of others for its supplies of crude oil.
3. New industry will be developed on the basis of petroleum.
4. The development of an oil industry must take necessary account of existing industrial activities and the protection of nature and the environment.
5. Flaring of exploitable gas on the NCS must not be accepted except during brief periods of testing.
6. Petroleum from the NCS must as a general rule be landed in Norway, except in those cases where socio-political considerations dictate a different solution.
7. The state must become involved at all appropriate levels and contribute to a coordination of Norwegian interests in Norway’s petroleum industry as well as the creation of an integrated oil community which sets its sights both nationally and internationally.
8. A state oil company will be established which can look after the government’s commercial interests and pursue appropriate collaboration with domestic and foreign oil interests.
9. A pattern of activities must be selected north of the 62nd parallel which reflects the special socio-political conditions prevailing in that part of the country.
10. Large Norwegian petroleum discoveries could present new tasks for Norway’s foreign policy.

Framework and organisation

Legal framework

- The Petroleum Act (1996)
  - Legal basis of licensing system
  - Disposal and de-commisioning
  - Liability for pollution damage
  - Safety aspects

- NCS petroleum: state property
  - All activities require approval
  - A license grants the (time-constrained) right to explore, develop, and produce
  - EIAs required for area openings and field development (PDO)

Framework and organisation

State organisation of petroleum activities

Framework and organisations

Triad of fiscal instruments and institutions

- Petroleum taxation
- The State’s Direct Financial Interest
- Government Pension Fund - Global

Framework and organisation

State revenues from petroleum activities

Calculation of petroleum tax

Operating income (norm price)
- Operating expenses
- Linear depreciation for investments (6 years)
- Exploration expenses, R&D and decom.
- CO₂-tax, NOₓ-tax and area fee
- Net financial costs

= Corporation tax base (27 %)
= Uplift (5.5 % of investment for 4 years)
= Special tax base (51 %)

Government net cash-flow...
...from petroleum activities (NOK bn)

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*N Norwegian Continental Shelf.
Hubbert’s peak

The geophysical approach to oil exploration and production

Cumulated oil discoveries
Stylised example

Oil production
Stylised example


University of Stavanger

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Economists know better

Modifying factors for the geophysical approach

- E&P activity governed by profit-maximising companies
  - Technology and unit cost
  - Market developments
  - Policy constraints
- Hubbert approach augmented with economic models and variables
- Integrated models provide better explanations

Hubbert’s peak

The geophysical approach to oil exploration and production

Source: Hubbert (1962), Mohn (2008): "Elastic oil: A primer on the economics of exploration and production".
Example: The exploration process

Drilling activity on the NCS

Cumulative growth in discovered resources

A “Creaming curve” for the NCS

Annual resource additions - and production

The time-derivative of the “Creaming curve”

Efforts and efficiency in oil exploration

A vector error-correction approach

- Exploration output:
  \[ R(P, X) = D(P, X) \cdot S(P, X) \cdot M(P, X) \]

- Three channels of impact:
  \[ \varepsilon^r_p = \varepsilon^d_p + \varepsilon^s_p + \varepsilon^m_p. \]

- Simultaneous econometric approach

The oil price matters...

... for demand, supply, and future price dynamics

Oil price review
Brent blend, USD/bbl (@2012 prices)

- 4-fold increase since 2000
- Impact on demand
  - Income effect
  - Substitution effect
  - Policy response
- Impact on supply
  - Conventional
  - Unconventional
- New technologies

Source: Reuters EcoWin.
The oil price matters...

... for demand, supply, and future price dynamics

**Oil price review**
Brent blend, USD/bbl (@2012 prices)

**Offshore supply services**
by global region, USD bn (nominal)

Source: Reuters EcoWin, Rystad Energy.
The oil price matters...

... for activity, production, and recoverable reserves

Oil price and reserve potential
Revenues, cost, and field-life

Oil price and IOR activities
Revenues, cost, and field-life
The oil price matters...

...for NCS activity, production, revenues - and costs

NCS oil and gas investments...
...and the oil price (NOK bn; USD/bbl)

NCS oil and gas production...
...and the oil price (mmboe/day; USD/bbl)

Source: Statistics Norway, Norwegian Petroleum Directorate, Reuters EcoWin.
The oil price matters...

... for NPD expectations

**Outlook for NCS oil and gas production**
NPD forecast by year of release (MMBoepd)

**NCS oil and gas production...**
... and the oil price (mmboe/day; USD/bbl)

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Oil and the economy

Petroleum and the Norwegian business cycle

- Global economic effects
  - Oil and the macro economy
  - Importers vs exporters
- Domestic demand effects
  - Resource movement
  - Public (and private) spending
- Mixed results for GDP impact in Norway
Oil and the economy

Longer-term issues: The Dutch disease

- Resource revenues appreciates the real exchange rate
  - Crowd-out of manufacturing
  - Erosion of competitiveness
- Aggravates the cost of (structural) re-adjustment
- Two channels of transmission
  - Spending effect
  - Resource movement effect
Stemming the spending effects

The background

- **Oil and gas production**
  - Norwegian continental shelf (mmboepd)

- **Government net cash-flow...**
  - ... from petroleum (NOK bn)

Stemming the spending effects

Fund mechanism and fiscal policy rule

Net cash flow → Investment returns

Government Pension Fund Global

Transfer to finance non-oil budget deficit

Government budget

Fiscal policy rule
(Expenditure in line with expected real returns, i.e. 4% per year)

Source: Norwegian Ministry of Finance.
Stemming the spending effects

Budget deficit, policy rule, and investment returns

**Budget deficit and fiscal policy rule**

NOK bn (@2013 prices)

- Non-oil budget deficit
- 4% returns
- (3% returns)

**Oil revenues and investment returns**

Ratios to GDP (%)

Source: Norwegian Ministry of Finance.
Less attention on resource movement

Significant macro impulse from oil-related activity

NCS oil and gas investments...
...and the oil price (NOK bn; USD/bbl)

Value-added in manufacturing
volume index (2008=100)

Less focus on resource movement effects

From re-positioning to real appreciation

Demand from the petroleum sector
Ratio to mainland GDP (%)

Competitive position under pressure
Wages per hour, manufacturing industries

Vulnerabilities vary across regions

Petroleum exposure is not uniformly distributed

Petroleum-related employment 2012
Total: ~220,000 persons

- Sub-suppliers
- Suppliers
- Processing
- Oil companies

What about wealth effects?
Indicators of Government and private sector wealth

**Government Pension Fund - Global**
Cumulated capital (NOK bn)

- Returns
- Transfers

**Share prices and housing prices**
Indices (1995 = 100)

What about wealth effects?

Is government saving offset by the private sector?

What about wealth effects?

Ricardian equivalence revisited

**Government vs households**
Net financial wealth, NOK bn

**Government vs private sector**
Net financial wealth, NOK bn

Source: Statistics Norway (National accounts)
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IOC returns fall short of expectations

Unimpressive share price developments

Source: http://www.statoil.com/IR.
The NCS cost challenge

Selected sample field example

Operating cost and production
NOK bn (@2013 prices)

Unit production cost
NOK/SM³ oe (@2013 prices)

The NCS cost challenge

Cost indicators

Well cost and rig rates
NOK bn (@2013 prices); USD per day

Petroleum project cost indices
2000 = 100 (global indices)

IOC revenues fall short of expenditures

More capital is required for each barrel of production capacity

Exxon, Shell and Chevron have been spending at record levels as they seek to boost their oil and gas output. It has yet to pay off.

Below, change in production and capital expenditures since 2009:

IOC production falls short of promises

Production growth versus targeted growth last four years

Source: Enskilda Securities (Oil companies’ E&P budgets, 20 August 2013).
IOC cash-flows fall short of investments

Only BP funded its capex with cash-flow in 2013
Planning prices are up, but so are costs

Planning and budgeting price for oil (Brent blend, USD/bbl)

Source: Enskilda Securities (Oil companies’ E&P budgets, 20 August 2013).
The comfort zone is narrowing

Difference between current price and planning price (USD/bbl)

Source: Enskilda Securities (Oil companies' E&P budgets, 20 August 2013).
**Investment choked by financial markets**

Increasing focus on cash-flow management and capital discipline

- Shareholder skepticism
  - Production short of targets
  - Sky-rocketing costs
  - Erosion of returns
- Worries over oil price outlook
  - Weak economic growth
  - New floods of supplies
  - Policy uncertainty looms
- Business model under pressure
  - Scarcity and access dilemmas
  - «Carbon bubble» challenge
- “Cash is King!”

Source: Citibank (chart).
The Statoil example

Cash-flow 2013

Source: http://www.statoil.com/IR.
Statoil’s revised capex plans

Tracing the NCS activity impact: A thought experiment

Capital expenditures

NOK bn

Capex


Capex cut dilution...

NOK bn

...and NCS re-leverage

Statoil share

Source: http://www.statoil.com/IR, author’s calculations.
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Longer-term oil industry challenges
Will the world turn its back on fossil fuels?

- Energy and climate policies
- Role of oil in transport
- Eastward bound energy
- Shale gale globalisation
- Emerging technologies
- Access, returns, and risk
- Changes in OPEC behaviour

Concluding remarks
Build resilience, prepare for change

- Energy is getting more expensive
- Oil price outlook is very uncertain
- The oil price matters for activity
- Boom arrested by market concerns
- New shocks and cycles in the cards
- IOC business model under pressure

Uncertain outlook
Brent blend, USD/bbl (@2012 prices)

Source: US Energy Information Administration.
Thank you for your attention!

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References I

References II

References III