Plenary session 3:
Oil & Gas market stability and change:
Investment in a New Era

Background Paper
Disclaimer

The observations presented herein are meant as background for the dialogue at the 16th International Energy Forum. They have been prepared in collaboration with The Boston Consulting Group and should not be interpreted as the opinion of the International Energy Forum or The Boston Consulting Group on any given subject.
Introduction

**Market Context**

- The low price oil regime has resulted in limited upstream investments risking a future demand-supply gap
- “Peak oil demand”, stalled FIDs and an expected decline in productivity will only exacerbate supply pressure
- Strategizing effectively with short, medium and long term in view can ensure sustained investments in new exploration projects

**Session Objectives**

- To understand that oil would continue to be a dominant energy source in the future
- To identify measures that can help drive investments into new exploration projects
- To explore how optimal capital allocation, investment into technology and scenarios based approach can provide a necessary cushion during lean phases

**Key Question:** What can companies and governments do to get investment and exploration projects moving again to cope with future demand and maintain energy security?
Oil demand will not ease pressure for new supply
Decline rates mean that ~50 mmb/d of new supply will be needed by 2040

Energy transition...?

... with oil demand?

Exajoules

mmb/d

Source: Vaclav Smil's Energy Transitions, Rystad Energy, BCG analysis
Investment challenge is exacerbated by the stall in Final Investment Decisions (FIDs) over 2015-2016

Less than 10 p.a. industry FIDs for new project development in 2015 and 2016

Number of FIDs

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>45</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>8</td>
<td>9</td>
<td>20</td>
<td>21</td>
<td>27</td>
</tr>
</tbody>
</table>

Key 2017 FIDs at
- Coral FLING (Mozambique)
- Liza (Guyana)
- R-series (India)
- Mad Dog Ph 2 (GOM)

1. Chart at right excludes anticipated unconventional project sanctions
Source: Wood Mackenzie; Goldman Sachs Investment Research; BCG CEI

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Incremental production from new start ups begins to decline after 2017, stressing the risk of a future supply gap.

### Production evolution from 2014 to 2022

<table>
<thead>
<tr>
<th>Year</th>
<th>Mboe/d</th>
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<tbody>
<tr>
<td>2014</td>
<td>307</td>
</tr>
<tr>
<td>2015</td>
<td>1,114</td>
</tr>
<tr>
<td>2016</td>
<td>1,196</td>
</tr>
<tr>
<td>2017</td>
<td>1,657</td>
</tr>
<tr>
<td>2018e</td>
<td>1,385</td>
</tr>
<tr>
<td>2019e</td>
<td>1,317</td>
</tr>
<tr>
<td>2020e</td>
<td>1,102</td>
</tr>
<tr>
<td>2021e</td>
<td>802</td>
</tr>
<tr>
<td>2022e</td>
<td>796</td>
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</tbody>
</table>

Note: Others includes Hess, Marathon Oil, Anadarko, Oxy, Apache, EOG, Noble Energy, OMV, and Repsol. Source: Rystad Ucube (September 2017 Release)
Balancing reinvestments in business with shareholder dividend expectations can provide necessary cushion for capital allocation.

TOTAL was the only Major to cut dividend following drop in price.

In contrast, most Large Integrated cut dividend.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total revenues ($ bn)</th>
<th>Dividend ($/share)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2013</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2014</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2015</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2016</td>
<td>1.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: Capital IQ
Strategic positioning between above ground risk and development cost can be used as a tool for savings

<table>
<thead>
<tr>
<th>Above ground risk</th>
<th>Development Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Best stakeholder relationship manager advantaged</td>
<td>Best explorer and Developer advantaged</td>
</tr>
<tr>
<td>Most efficient producer advantaged</td>
<td>Strong dividend offering important</td>
</tr>
</tbody>
</table>
Companies need to critically think through Risk-Cost trade-off for strategic investments into new assets

1. Average Development/boe costs include projects slated for commissioning between 2010-2030; Development costs defined as total investment costs excluding exploration and government take
2. The Fragile State Index scores 12 risk factors on 1-10 scale
3. Circle size denotes relative size of resource base

Source: Rystad (Feb 2017 release); Fund for Peace, “Fragile State Index; 2016”;
BCG CEI
New investments skew toward lower above ground risk areas BP and TOTAL are the exceptions

New source production (2017-2027)

Source: Fund for Peace Fragile State Index, Rystad Ucube (September 2017 Release), BCG CEI
Energy industry has low R&D Intensity and companies need to build on this opportunity for medium to long term gains.

![2016 R&D Spend (Billion USD)](image)

Note: R&D Intensity is total R&D spend as a percentage of Revenues; Size of bubble represents total revenues.
Source: Capital IQ; BCG CEI
Investment into technology will optimize the entire value chain for all industries including Oil & Gas

<table>
<thead>
<tr>
<th>Exploration</th>
<th>Mining &amp; Processing</th>
<th>Supply chain/Logistics</th>
<th>Marketing &amp; Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Developed Well Advisor to leverage operational data &amp; advanced analytics</td>
<td>2. Remote operations center decreases per unit costs</td>
<td>3. Through use of digital technologies MOL expects to increase yields more than 5%, decrease energy consumption year by year by 2%, and reduce hydrocarbon losses in the refinery by 30%</td>
<td>4. Commercial revolution in the diamond business through blockchain initiated by large diamond producer; could be applied for other mine materials</td>
</tr>
<tr>
<td>• Combining IT and Operational technology reduced analytical cycle from months to few weeks. This has helped make decisions faster, improved operations efficiency in an uncertain market</td>
<td>3. Through predictive maintenance Aker BP would reduce production platform employees. It hopes to lower production cost to $7/bbl</td>
<td></td>
<td>7. Digitalized marketing/ trading allows for big data enabled strategies, algorithm enabled opportunity capturing and potentially revolutionizing distribution models</td>
</tr>
<tr>
<td></td>
<td>4. Precision farming as use case for more precise mining, decreasing operational costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Deployed real-time production optimization in 200+ wells</td>
<td>6. Through use of digital technologies MOL expects to increase yields more than 5%, decrease energy consumption year by year by 2%, and reduce hydrocarbon losses in the refinery by 30%</td>
<td>7. Digitalized marketing/ trading allows for big data enabled strategies, algorithm enabled opportunity capturing and potentially revolutionizing distribution models</td>
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Technological application close to commercial use

- Centralized data repository helped the company to extend well field life and generate revenue

Technological application with disruptive potential in the future

- Research on smart robots and swarm intelligence decreases employees required
- Lab for 4D-printing enabling multi-material & self-assembling devices
- Universal quantum computers could allow for data assessment on currently unimaginable scale optimizing routing and interaction among all supply chain elements
- Fewer accidents through:
  - Smart helmets to assist the overall aging workforce
  - LiDAR sensors to autonomous trucks, recognizing humans within range
O&G majors clearly focused on technology with diverging approaches
Other players can also choose to create their own path to digital

**Digital Upstream Company**
- Very strong emphasis on modernization and transformation through digitization and automation
- Looking to become the “Digital Upstream company”

**Improve performance through Technology**
- Focused on technologies that can improve Chevron’s base business operations
- Established a venture capital arm (Chevron Technology Ventures)

**Improve profitability through Technology**
- Additional focus on R&D with $1 billion invested annually on innovated technologies (Algea, Fuel Cells, CCS, etc.)

**Start-up mentality in technology investments**
- Venture capital arm (Shell Technology Ventures) and a technology center Techworks at MIT

**Climate focused Innovation**
- Emphasis on renewable technologies to meet the demands of the future

Source: Company disclosures
Different views on energy trends for the Oil demand leaves O&G industry directionless and investor confused

- **Low priority**
  - There is still a good connection between economic growth, prosperity, and consumption of energy
  - Demand may peak between 5 to 10 years but oil & gas will continue be part of the energy mix for many decades to come
  - Not a game changer for over 20 years. Possible to see forces leading to a faster transition coming from a number of different fronts (policy, technology ...)

- **High priority**
  - Oil demand will peak in the 2020s followed by shrinking oil industry
  - Energy is a vital, constantly changing resource that has accompanied major shifts in society throughout time. And energy must continue to adapt if it is to play a key role in addressing the complex challenges facing the world today

Source: BCG analysis
Only few companies have long-term energy scenarios based approach which other players must choose to consider

ExxonMobil
- Investing in innovative energy solutions (Biofuels, Algae, CCS) on a comparatively small scale

Shell
- Shell has launched its New Energies unit, announced as one of its two levers for growth in the mid term (together with shales), gathering wind and solar power generation, biofuels, hydrogen and connected energy. It will dedicate ~200 $M per year

Total
- “Becoming the Responsible Energy Major”
- Total has made moderate investments in solar energy (SunPower, 1.4 $Bn), energy storage (Saft Batteries, 1.1 $Bn) and Retail (Lampiris) to potentially grow in renewables/distributed generation

SK
- SK is actively transforming its portfolio for Energy transition, focusing on generating cash from its core businesses to fuel growth with investments in its battery business

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Source: BCG analysis
Key Questions

1. How can governments provide an environment or support O&G companies to continue to invest in new exploration projects during a low price regime?

2. What measures must O&G Industry as a whole consider for increased investments in R&D, where it has lagged traditionally?

3. Is it time to move from a traditional O&G company to an Energy company?
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