From Wellhead to Gasoline Pump

Petroleum Value Chain

Acquisition & Exploration → Production → Transportation → Refining → Sales

Using technology to find new oil resources

Bringing oil to the surface using natural and artificial methods

Moving oil to refineries and consumers with tankers, trucks and pipelines

Converting crude oil into finished products

Distributing and selling refined products
OUTLINE

• INTRODUCTION

• ELEMENTS OF THE VALUE CHAIN
  – Exploration and Production
  – Transportation
  – Refining
  – Marketing

• SOURCES OF REVENUE

• LOCAL CONTENT AND PARTICIPATION FRAMEWORK
Sources of Oil and Gas Production 2012

Oil Production 2012, (000 barrels a day)

- Total Asia Pacific: 10%
- Total Africa: 11%
- Total Middle East: 33%
- Total North America: 18%
- Total S. & Cent. America: 8%
- Total Europe & Eurasia: 20%
Sources of Oil and Gas Production 2012

Natural Gas Production, 2012 bcf per day

- Total North America: 27%
- Total S. & Cent. America: 5%
- Total Europe & Eurasia: 31%
- Total Middle East: 16%
- Total Africa: 6%
- Total Asia Pacific: 15%

Sources:

- Total North America: 27%
- Total S. & Cent. America: 5%
- Total Europe & Eurasia: 31%
- Total Middle East: 16%
- Total Africa: 6%
- Total Asia Pacific: 15%
Historical Crude Oil Prices 1970 to present

Crude oil prices react to a variety of geopolitical and economic events

price per barrel
(real 2010 dollars, quarterly average)

Sources: U.S. Energy Information Administration, Thomson Reuters
Trends in Gas Prices

US$ per million BTU

Japan (LNG)
Average German import price (LNG)
Henry Hub †
T&T Oil Production

Production and Nominal Price of Oil 1955-2012

- total production (000 barrels)
- Nominal oil prices
Trinidad and Tobago Gas Production

Production, Billion cubic feet per day (T&T)
<table>
<thead>
<tr>
<th>Year</th>
<th>Petroleum FDI as a % of Total FDI</th>
<th>Petroleum GDP as a % of Total GDP</th>
<th>SITC 3+5 exports as % of Total Exports</th>
<th>Oil revenues as a % of Total Revenue</th>
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<tr>
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What do we do now that its all gone?

Reserve to Production Ratios for Oil and Gas and Petroleum GDP as a Proportion of Total

R/P in years

% of GDP

R/P Oil

R/P Gas

Petroleum GDP as a % of Total GDP
## Where does the Oil Windfalls go?

### Financial Position of the IRSF

<table>
<thead>
<tr>
<th>Year</th>
<th>Value (US$ mn)</th>
<th>Addition to HSF</th>
<th>Oil Windfall (mns)</th>
<th>Addition to HSF as % of Oil Windfall</th>
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<td>4426.3</td>
<td>235.1</td>
<td>422.70</td>
<td>55.62</td>
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INTRODUCTION

ELEMENTS OF THE VALUE CHAIN
- Exploration and Production
- Transportation
- Refining
- Marketing

SOURCES OF REVENUE

LOCAL CONTENT AND PARTICIPATION FRAMEWORK
From Wellhead to Gasoline Pump

Petroleum Value Chain

- Acquisition & Exploration: Using technology to find new oil resources
- Production: Bringing oil to the surface using natural and artificial methods
- Transportation: Moving oil to refineries and consumers with tankers, trucks and pipelines
- Refining: Converting crude oil into finished products
- Sales: Distributing and selling refined products
EXPLORATION AND PRODUCTION

• Elements of the Petroleum System

• Lease Acquisition

• Exploration Methods

• Development and Production
A Petroleum System encompasses an active source rock and all related oil and gas and which includes all the geologic elements and processes that are essential for hydrocarbon accumulations to exist.

The essential elements include source rock, reservoir rock, seal rock and overburden rock and the processes are trap formation and the generation-migration-accumulation of petroleum.
ELEMENTS OF THE PETROLEUM SYSTEM

• SOURCE ROCKS

• SEDIMENTS CONTAINING
  – Reservoir Rocks
  – Sealing Rocks

• BASIN HISTORY
  – Structures – Traps
  – Source Rock Maturity
  – Timing of Migration
Origin of Oil and Gas

- About 0.1% of this organic matter escapes this fate. Transported by currents, this matter sometimes sinks to the bottom of the sea or great continental lakes and preserved in these poorly oxygenated environments, well away from tidal currents. It mixes with mineral matter (clay particles and very fine sand) and with dead marine plankton and transformed into organic mud by anaerobic bacteria.

- Over time, this mud accumulates and hardens. Mud that contains >2% of organic matter can be transformed into source rock which eventually produces oil and gas deposits.

- The proportion of liquids and gas generated in this way depends on the type of source rock.
Exploration Methods - Seismic

3D Seismic Survey

Satellite navigation antenna

Sounder source

Underwater phones detect seismic echoes from rock layers

Bottom mud

Seafloor

Rock layers

Rock layers
Exploration Methods - Seismic

Seismic Survey Vessel

Airgun Source:
- 3000 cubic inches
- 2000 psi
- two airgun arrays
- 28 airguns per array

Streamers:
- 6-10 streamers
- streamer length approximately 6km
- hydrophone arrays
Exploration Methods - Seismic
Exploration Methods - Drilling
Exploration Methods - Drilling
Pumping Wells
Steam Injection Wells
Offshore Platform
Crude Oil Gathering Station
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TRANSPORTATION

- Pipelines
- Rail Cars
- Tankers
Crude Oil Tanker
Pipeline Transport
Crude Oil Tank Farm
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REFINING

Conversion of crude oil into saleable products by:

1. **Crude distillation** – boiling and fractionating of crude oil into specific boiling point components – fuel oil, diesel, kerosine (jet fuel), naptha, gasoline, LPG.

2. **Vacuum distillation** – HT/LP to further fractionate heavy residues from the CDU

3. **Catalytic cracking** – HT/HP/Catalyst to break and reconfigure chemical bonds into other products, principally gasoline.

4. **Reforming** – HT/HP/Catalyst to convert naptha to gasoline

5. **Petrochemicals** – conversion of naptha, olefins and aromatics into plastics, synthetic rubber, detergent alcohols, polyester, polyurethane etc.
Crude oil is heated until it vaporises – to 350°C plus. The resulting gas is pumped into a tall, thin tower called a fractioning column, or pipestill. The vapour rises up the tower, passing through a series of trays with holes in them; as it rises, it cools down, condensing back into several distinct liquids. Lighter fractions, such as kerosene and naphtha, collect near the top of the tower; heavier fractions, such as lubricants and waxes, fall through weirs to trays at the bottom. Engine fuels such as gasoline are then processed further elsewhere in the refinery, before being trucked out to filling stations or other market outlets. The heavy bottom fractions often undergo further treatment to convert them into more useful products (see p90).
Crude Distillation Unit
Vacuum Distillation Unit
What you get from a barrel of crude oil

Based on average output of refinery products in the US in 2007
Atlantic LNG Gas Processing
PPGPL Gas Processing
NGC Gas Receiving Facility
Tobago
Methanol Plant
Ammonia Plant
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MARKETING

• Upstream Marketing
  – Crude for refinery feedstock
  – Gas to LNG Plants
  – Gas to Conversion Plants

• Downstream Marketing
  – Sale of products from refinery to retail points
  – Sale of Gas Conversion Products
Refinery Products Tanker
Refinery Port Tug
LNG Tanker
Road Tank Wagons
Gasoline Retail Prices

The true cost of gasoline

Source — Opec (based on 2007 data). *fob = free on board.
## T&T LNG Export Markets

Atlantic’s top 10 LNG export destinations 1999 to 2010 (US$mn).

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2005</th>
<th>2010</th>
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<td>USA</td>
<td>93.87</td>
<td>1912.25</td>
<td>433.05</td>
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<tr>
<td>Spain</td>
<td>39.48</td>
<td>62.36</td>
<td>137.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35.29 Spain</td>
<td>151.12</td>
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<td>16.44</td>
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<td></td>
<td></td>
<td>10.46</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.94 Brazil</td>
<td>65.38</td>
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<td>8.79</td>
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<td></td>
<td></td>
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</table>

Source: Data compiled from UNCOMTRADE database.
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SOURCES OF REVENUE IN THE VALUE CHAIN

- Acquisition Costs
- Crude Oil and Natural Gas Sales
- Transportation Tariffs
- Ex-refinery Product Sales
- Product Retail Sales
UPSTREAM ECONOMICS

CASHFLOW = REVENUES – CAPEX – OPEX – GOVT TAKE

• Govt Take is dependent on type of licencing arrangement
  – Exploration and Production License (Royalty/Tax System)
  – Production Sharing Contract (PSC)

• Probability of Successful Exploration
How the barrel is shared

Government gets 89% of the shareable surplus
Exploration and Production License

- It is based on competitive bidding.
- Exploration Term of 6 years divided into two 3-year phases.
- Production Term of 25 years upon successful completion of the Minimum Work Programme.
- Payment of Royalty to the mineral rights owner.
Exploration and Production License (cont’d)

• Surrender Obligation – 50% of the original area by year 3 and 25% of the original area by year 5. License to keep only the discovered and producing fields including a 0.5 km halo around same.
Production Sharing Contracts

• There are two basic types of PSCs
  • Indonesian Model – includes cost recovery, royalty, payment of taxes etc.
  • Peruvian Model – does not consider cost recovery

**Peruvian Type PSC**

• The petroleum production from a field within the contract area is shared proportionately between the Government and the Contractor who is the oil company.
Production Sharing Contract (cont’d)

• The government does not put up any finances for the exploration, development, production nor operating costs.

• The ownership of petroleum remains at all times with the Gov’t via the Minister in charge of petroleum throughout the production and transmission processes.
Production Sharing Contract (cont’d)

- Title to petroleum does not pass to the oil company but the proceeds from the sale of petroleum is taken by the company as the contractor’s share which is due to the contractor in consideration of the work carried out.

- This PSC is very simplistic and is found in T+T context in the 1970s version of the PSC. Blocks offered at that time; Block 1 I Gulf of Paria, Blocks 5 and 6.
Production Sharing Contract (cont’d)

**Indonesian Style PSC**

- It includes a cost recovery and budget approval provision.
- The contractor puts up all of the risk capital required to enable a discovery of petroleum.
Production Sharing Contract (cont’d)

• This cost recovery share is split into **Cost Oil** and **Profit Oil**

• Cost Oil is a device that allows the contractor to recover expended costs. (say 40%)

• Profit Oil is the remaining of the share (60%) that is split between the Gov’t and the contractor based upon negotiations.
Capital Expenditures (CAPEX)

• These are funds used to purchase an asset.

• Funds are *amortised* (written off) over time. E.g. drilling a well is Capital Expenditure.

• Amortisation leads to the recovery of the initial cost of an asset as an allowance against taxes to be paid.
Operating Expenditures (OPEX)

- These are categorised as cost related to:
  - Labour
  - Materials
  - Contract Payments
  - Utilities
  - Sundries

- There are two types of OPEX: Fixed and Variable
Overhead Costs

• Related to charges that are relatively constant and which will continue independent of production of petroleum.

• It is composed of:
  – Head Office costs
  – Insurance
  – Warehousing etc.
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Governments and Nations capture value on two fronts from oil and gas business activities by IOCs. These are through:

- **Fiscal Measures**
  - Royalties, Taxes, PSCs, bonuses etc.

- **Non-Fiscal Measures**
  - Local participation in local ownership, control and financing
  - Local content in the usage of local goods, services, people and businesses
  - Local capability development in education, training and transfer of technology, methodology and know-how

Norway, Brazil, Nigeria and others are examples of Nations with workable local content legislation and regulations.
Categories of Local Content

Ownership

Management

Design and Engineering

Construction and Operation (Skilled Labour)

Non Skilled Support
LOCAL CONTENT AND PARTICIPATION

PURPOSE

• Economic Sustainability is the major driver for local content and participation

• Education, Training, Experience and Business Opportunities are key prerequisites for maximisation of local value capture

• The Energy Business is characterised as requiring high levels of skills, know-how, technology and capital, much of which are transferable to other sectors
LOCAL CONTENT AND CAPABILITY

GUIDING PRINCIPLES

These must include:

- Major mechanisms for local content, participation and capability development
  - Legislation and Regulations
  - Definition of local company and local content
  - Preference to local goods and services
  - Incentives
  - Education and training obligations
  - Industry experience at all levels for nationals including more value-added, analytical and decision making roles locally and overseas
  - Development of high end contractual skills in engineering, project management and construction
  - Work permit regulations and What happens to Understudies
LOCAL CONTENT AND PARTICIPATION

GUIDING PRINCIPLES cont’d

• Where, how and by whom these mechanisms will be delivered
  – Energy Companies
  – International Contractors
  – Universities
  – Craft and Technology institutes

• Performance measurement, assurance, and reporting processes with rewards and sanctions

• Key areas for priority focus
IMPORTANCE OF EDUCATION, TRAINING AND EXPERIENCE

• Giving preference to local suppliers if cost and quality of goods and services are equal to international competitors cannot by itself help in local value capture in developing nations as only those who are already globally competitive will succeed.

• Local capability development is therefore essential and can only be achieved by
  – Education and training in key areas
  – Promoting localisation of services traditionally provided from overseas
  – Development of relevant business opportunities
  – Providing relevant experience for nationals
From Wellhead to Gasoline Pump

Petroleum Value Chain
Skills

Acquisition & Exploration
Production
Transportation
Refining
Sales

Geoscience
Geoscience Petroleum Engineering
Petroleum & Chemical Engineering
Process Engineering
Process Engineering

Civil, Mechanical, Electrical, Chemical Engineering and Construction skills

Finance, HR, Legal, HSE, Commercial Skills
Ways of Developing Capability

• **Education and Training**
  - Craft
  - Technician
  - Engineers
  - Health, Safety and Environment
  - Legal, Financial etc
  - Continuous Improvement and Certification

• **Experience**
  - Internships
  - Apprenticeships
  - Joint Venture Secondments – locally and Overseas
  - Local Business Opportunities

• **Other**
  - Research and Development and opportunities to pilot the results.
  - Virtual Centre of Excellence for Petroleum with cooperation from Training Suppliers.
CFO asks CEO:
What happens if we invest in our people and then they leave us?

CEO responds:
What happens if we don’t and they stay?