







Facilities Cost Estimates Drivers in the Oil and Gas Field Development

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Abstract

-  Presentation reviews the drivers of oil and gas facilities cost estimate and concept selection. It explores the effects of varying fluid composition on the field development facilities cost estimates, processing facilities concept selection and cost impact.
-  Analysing and interpreting reservoir data and fluid composition is time -consuming exercise and remains a challenge with inherent risks and uncertainty in the outcome results.
-  Adequate analysis and understanding of the reservoir fluid composition is the driving factor and solid rock on which every field facilities development can be selected and be successful. This paper brings a clear understanding of the drivers of the oil and gas field development concept cost. This includes the various cost associated with various types of reservoir fluid composition such as Carbon Dioxide (CO₂), Hydrogen Sulphide (H₂S) and Mercury (Hg) and the areas of uncertainty with respect to estimating the cost.
-  Example of an estimate for a typical processing facility of different reservoir composition is provided. Cost comparisons are made between each development concept estimate to show cost variance along with an overview of the variances and their causes. Conclusions and recommendations for improving the quality of oil field development facilities cost estimates are provided.

Outlines (1)

- **Definitions**
 - Oil and gas reservoir
 - Reservoir fluid composition
 - Field development
- **Classifications of hydrocarbon fluid compositions**
 - Sweet
 - Sour
- **Crude API Gravity**

Outlines (2)

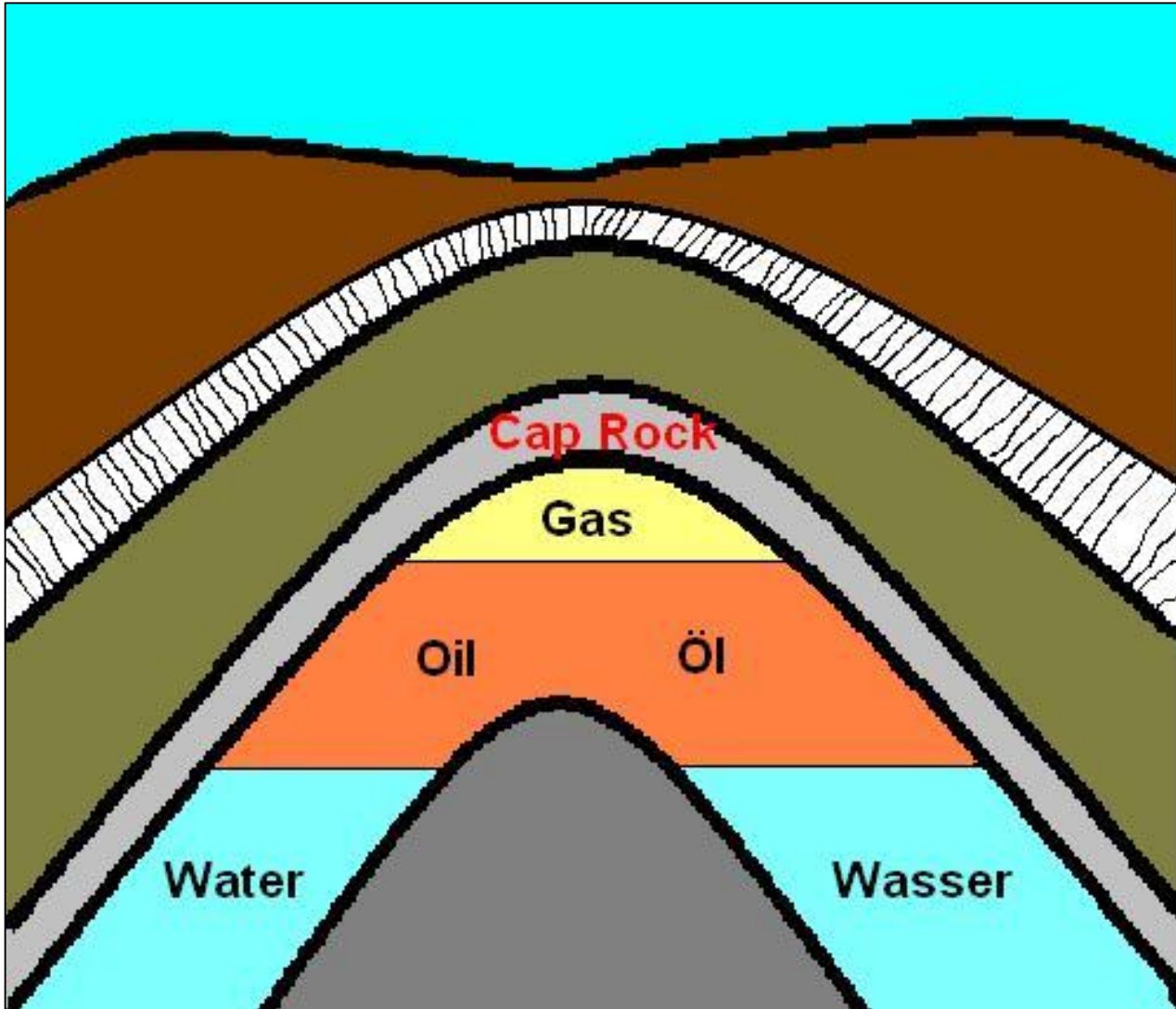
- **Geographical Crude Oil type**
- **Oil processing facilities cost driver**
- **Facilities Material Selection**
- **Example Oil processing facility cost trend based on fluid composition and type**
- **Conclusion**
- **Recommendation**
- **Reference**

Definitions

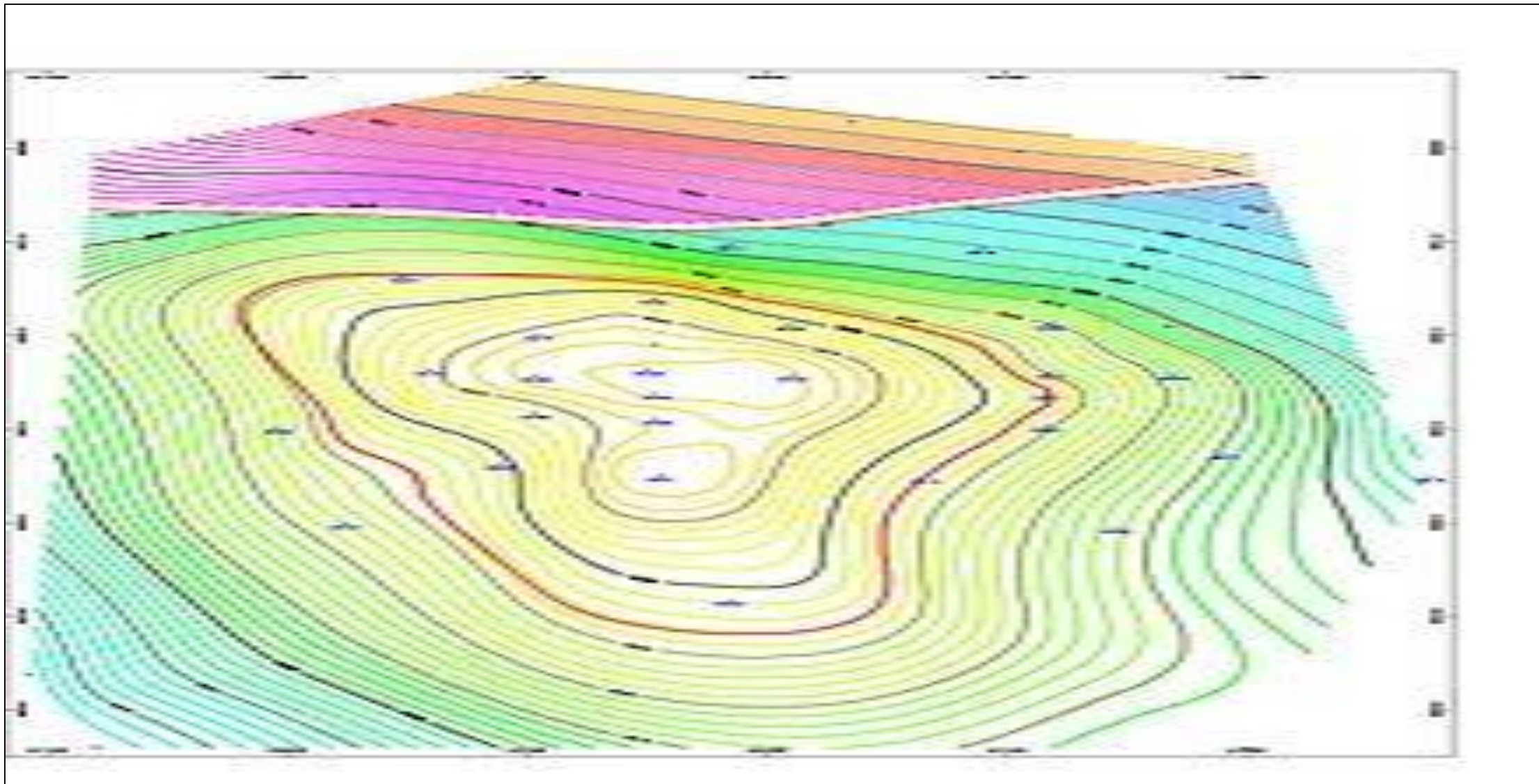
- **Oil and gas reservoir is a porous and permeable subsurface sedimentary (buried underground) rocks formed millions of years ago with a trap and a seal which stores a naturally occurring hydrocarbon/crude generated from a source rock (the kitchen).**
- **Reservoir fluid composition is a mixture of organic compounds and non-organic gas and dissolved salt from underlying aquifer. The composition defers across geographical regions.**
- **Oil and gas Field development involved selection of adequate facilities concept to produce and process a reservoir fluid for commercial purpose. Facilities development stage comes after exploration and reservoir data evaluation is completed to justify concept and material selection.**

Reservoir Structural (1)

Hydrocarbon Traps



Reservoir Structure (2) Contour Map



Classifications of hydrocarbon fluid compositions

- **Hydrocarbon fluid in its natural occurrence is classified into two:**
 - **Sweet : low sulphur content**
 - **Sour: High sulphur content**
- **Sweet crudes are more cost- effective to development**
- **Sour crude tend be more expensive based on processing facilities concept selection.**
- **The cost impact for the two are explained further in the later slides.**

Crude Oil API Gravity

- **API Gravity measure how heavy or light a crude is compared to water.**
- **API measure crude tendency to float on water, flow freely at a room temperature in relation to its viscosity.**
- **Higher the Crude API Gravity the better the crude quality and cost-effective to produce.**
- **No Clear cut on definition of light crude oil API gravity classification, variation occurs among producing countries.**
- **Acceptable international classification:**
 - **Light crude oil – high API, 32-42 API degrees**
 - **Medium crude oil- low API, 22-31 API degrees**
 - **Heavy Crude oil – API less than 22 degrees**

Geographical Crude Oil Type and composition

Nature's Given

- **Crude type and composition defers across geographical regions. Every region is faced with the challenge of processing this nature's given deposit into a useful and profitable product irrespective of the content.**
- **Some regional crude types used as a benchmark (reference price) in oil pricing are:**
 - **West Texas Intermediate (WTI); light, sweet crude with an API gravity of 39.6 degrees. It contains 0.24% sulphur with a specific gravity of 0.827.**
 - **Brent Crude; from the North Sea; a light, sweet crude with an API gravity of 38.06 degrees, sulphur content is 0.37%.**
 - **OPEC Reference Basket (ORB)- mixture of light and heavy crude from OPEC members.**

Geographical Crude Oil Type and composition

Nature's Given

- **Dubai Crude; medium and sour crude, with an API gravity of 31 degrees and a specific gravity of 0.871. Its sulphur content is 2%, making facilities concept more expensive because of the sulphur content.**
- **Bonny Light; comes from Nigeria and is a light, sweet oil. It has an API gravity of 32.9 and a sulphur content of 0.16%, associated with low field development and processing cost with challenged of sand production**
- **Worldwide benchmark crude oil are widely light crude, with WTI been prominent**

Oil processing facilities costs drivers

We Can't Change Nature (1)

- **Oil processing facilities concept entirely depend on the following:**
 - **fluid composition and content.**
 - **Hydrogen sulphide**
 - **Carbon dioxide**
 - **Mercury**
 - **Others**
 - **Crude category**
 - **Light**
 - **Medium**
 - **Heavy**

Oil processing facilities costs drivers

We Cannot Change Nature (2)

- Recoverable reserve volume
- **Natural occurring composition cannot be altered**
 - Explore Options to produce with at profitable margin as reasonable practical

Field Development Facilities Types (1)

Offshore Platform Processing Facilities



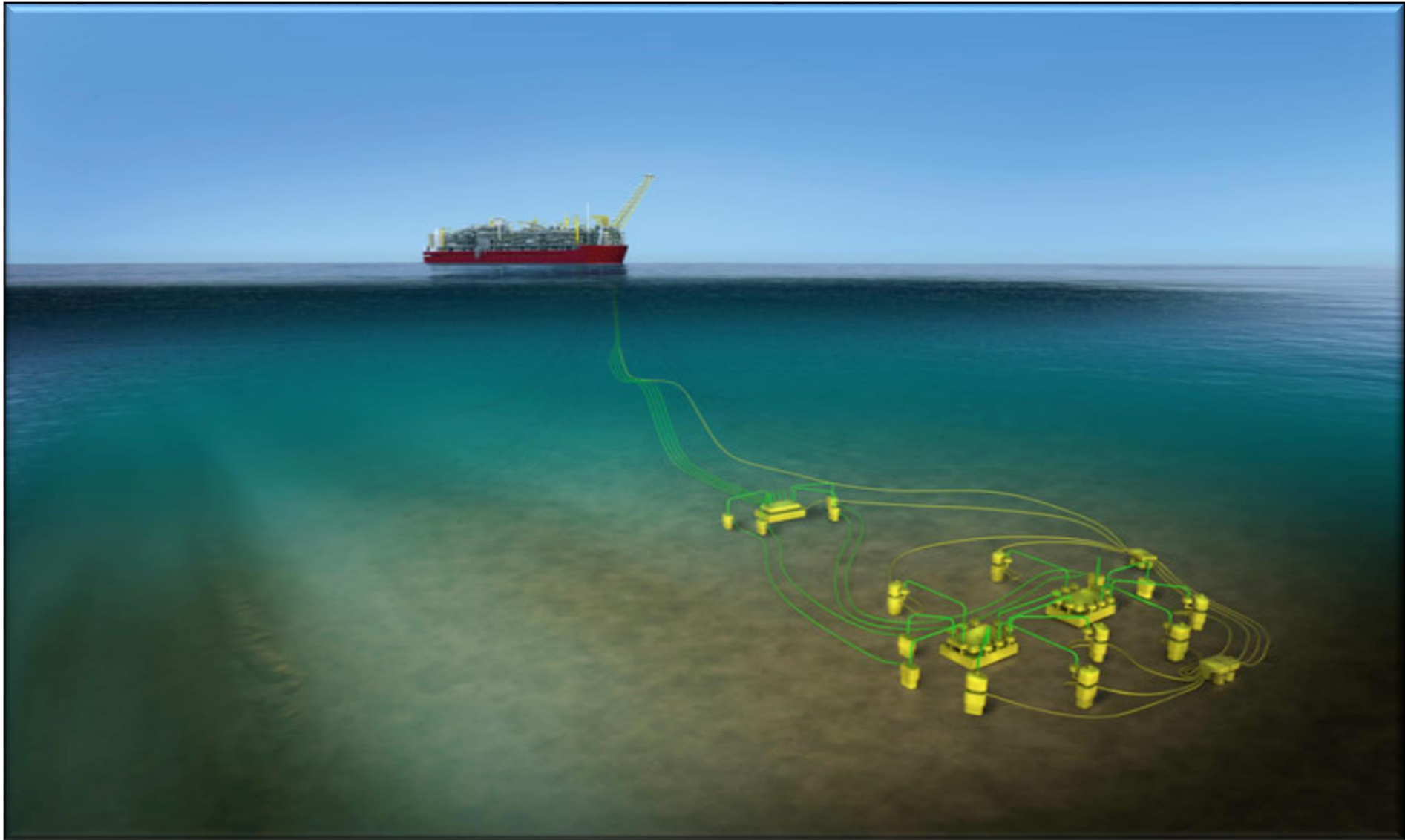
Field Development Facilities Types (2)

Onshore Central Processing Facilities



Field Development Facilities Types (3)

Subsea Tie-back to FPSO



Facilities Materials Selection

- **Material selection considers fluid type and adverse impacts:**
 - **Sweet Crude Oil**
 - **Low facilities corrosion**
 - **Mostly carbon steel material**
 - **Sour Crude Oil**
 - **Consider high corrosion**
 - **Mostly Stainless Steel Material**
 - **Sulphur removal unit**
 - **Mercury removal unit**

Oil Processing Facilities Costs Trend

Cannot be Avoided

- **Field development cost is based on the reservoir crude composition.**
- **Assume a facilities capital cost to produce a sweet crude with a total reserve of 54 million barrel of oil equivalent (MMBOE) cost \$37million.**
- **Sour crude facilities capital cost for equivalent reserve of 54 MMBOE would be higher, requires installation of:**
 - **corrosion resistant material**
 - **sulphur and mercury content removal**

Oil Processing Facilities Costs Trend (2)

Cannot be Avoided

- **Assume sulphur removal facilities cost impact; 10% of \$34 million = \$46.81 million**
- **Assume mercury removal facilities cost impact; 5% of \$46.81 = \$49.15 million.**
- **Facilities capital cost for equivalent sour crude total \$49.15 million**
- **Comparing \$49.15 million sour facilities with \$37 million for sweet crude. The cost increase would be \$12.15 million or 24.72% increase.**

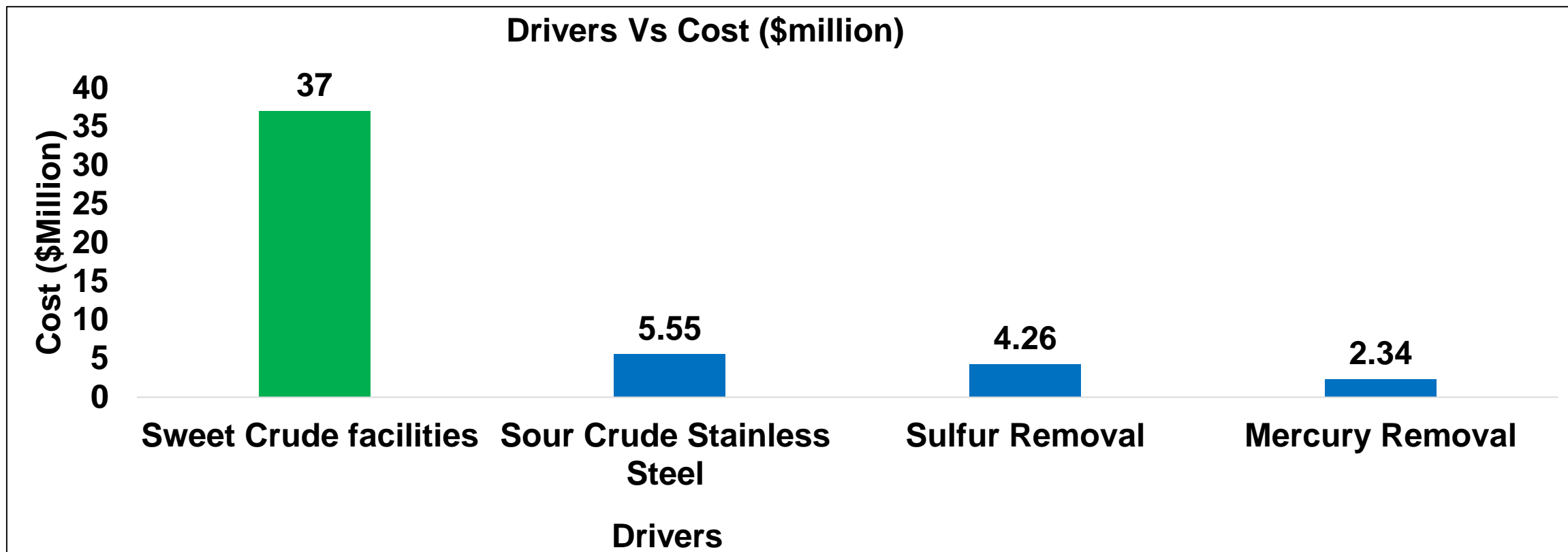
Oil Processing Facilities Costs Drivers

Cost impact

Sweet Crude Oil Facilities Capital cost	Sour Crude oil cost Impact		
	Stainless Steel material 15%	Sulphur removal facilities 10%	Mercury content removal Facilities 5%
\$37 M	\$5.55M	\$4.26M	\$2.34M

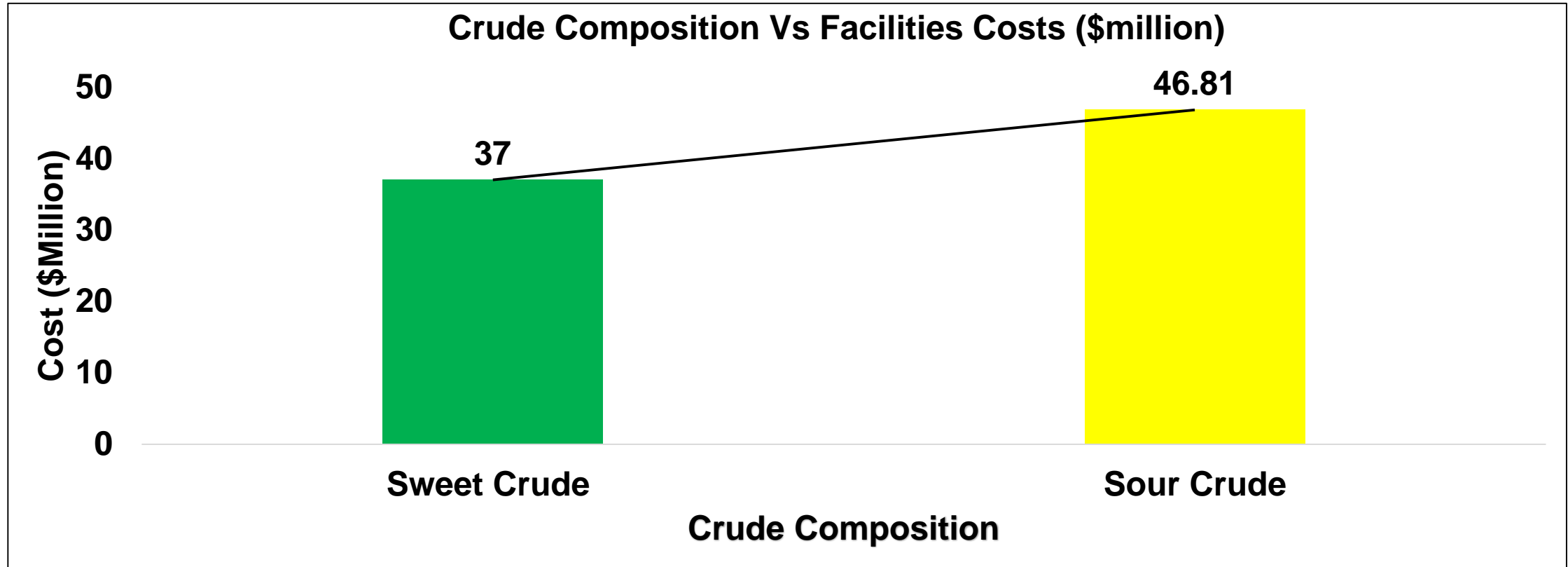
The table above showed the assumed facilities for producing and processing a 54 MMBOE of a sweet crude and also showed the increasing cost of processing a sour crude of the same volume based on the fluid composition

Oil Processing Facilities Costs Drivers



The above chart showed the facilities cost comparison for sweet and sour crude cost impact due to cost of stainless steel, sulphur, and mercury removal.

Oil Processing Facilities Costs Drivers



The above chart showed the total facilities cost for the sweet crude compared with sour crude. The increase in sour facilities cost is driven by the stainless steel, sulphur and mercury removal cost.

Conclusions

- **Reservoir fluid compositions driver oil and gas field development facilities concept selection.**
 - **Material selection**
 - **Processing units**
 - **Capital cost**

Recommendations

- **Do not rush into facilities cost estimating.**
- **First, understand the reservoir fluid composition to underpin facilities concept selection and cost impact.**
- **Ignoring to under reservoir data, cause project cost growth and ripple effect to entirely field development plan.**
- **Commit adequate time to analyse and interpreted reservoir fluid composition to obtain vital data; then go fast in facilities concept selection and cost estimating.**

References

- <http://www.petroleum.co.uk/benchmarks> - oil Benchmark 06/09/16
- http://benergypartners.com/Facts_About_Crude_Oil.html - 06/09/16