PETRONAS Floating LNG1 (PFLNG SATU)
Kanowit Field, Offshore Sarawak, Malaysia

PETRONAS

PETRONAS ACTIVITY OUTLOOK 2018-2020

Cautionary Statement

This report was developed based on currently available information from internal and external sources. PETRONAS believes that the expectations of its management is as reflected by such forward-looking statements are reasonable based on information currently available to it. PETRONAS makes no representation on the accuracy or completeness of any information provided in this report and expressly disclaims any liability whatsoever arising from, or in reliance upon, the whole or any part of its contents. PETRONAS undertakes no obligation to update or revise any of them, whether as a result of new information, future developments or otherwise.

Accordingly, readers are cautioned not to place undue reliance on the forward-looking statements, which speak only as of the date they were made.

Images are for illustrative purposes only.

Release Date: December 2017

CONTENT

FOREWORD

Samsudin Miskon

Vice President Group Procurement

Dear Partners,

As we usher in the year 2018, the uncertainty in the oil and gas industry remains a topic of constant debates and discussions. Thus, it is imperative for players to understand trends of key leading indicators as a barometer for the industry.

PETRONAS proudly presents the **PETRONAS Activity Outlook 2018-2020**. **Information transparency** on market activity outlook is essential and we believe this will help rebalance market dynamics and support industries like investments and financing - crucial components in promoting a thriving oil and gas ecosystem.

The pilot edition of the PETRONAS Activity Outlook 2017-2019 was released earlier this year on limited circulation. This industry-exclusive publication was well received with feedback for improvements which were incorporated in this edition.

At the time this Report is published, oil prices have strengthened to above USD60 per barrel, driven by escalating tension in the Middle East. In the short term, crude oil prices are expected to remain volatile as traders may take position to capture opportunities from gyration of oil prices. Any geopolitical events can also push up oil prices as the market is still rebalancing.

In the lower for longer environment, we have chosen to remain prudent and this is reflected in the activity level illustrated in this Report until we are confident that the current uptrend is sustainable. In our view, the oil price outlook will hover around USD50s to USD60s per barrel. The majority of analysts agree that >USD100 per barrel is now a thing of the past.

PETRONAS will continue to drive down cost and improve efficiency through CACTUS and CORAL 2.0, embracing digitalisation and industry collaboration. To date, some of these efforts have borne positive results as presented in this Report.

In the spotlight is our **Pengerang Integrated Complex (PIC)**; one of the largest oil and gas industrial developments in this region and PETRONAS' largest Downstream investment to date. Poised for overall start-up in 2019, it is an important catalyst for growth as it will almost double up activity level in Downstream operations from its sheer size.

Economies of Scale (EOS) is now seen as the way to go, through integrated work scopes and longer contracting tenures. In this edition, we have also included the perspective of operating assets to complement project-driven activities, giving full visibility of the value chain.

PETRONAS embraces technology, pursuing our imperatives to explore new frontiers with connectivity, robotics and drones. Our online crowdsourcing platform called Innovation Gateway@PETRONAS, (IG@P) allows external parties to put forth their technology proposals. Here, we aim to collaborate with external parties to introduce fast-paced, innovative solutions for businesses in our value chain.

Lastly, we hope that this Report provides crucial insights for your business and resource planning. Nonetheless, we have always advised all industry players to be prudent in making business decisions.

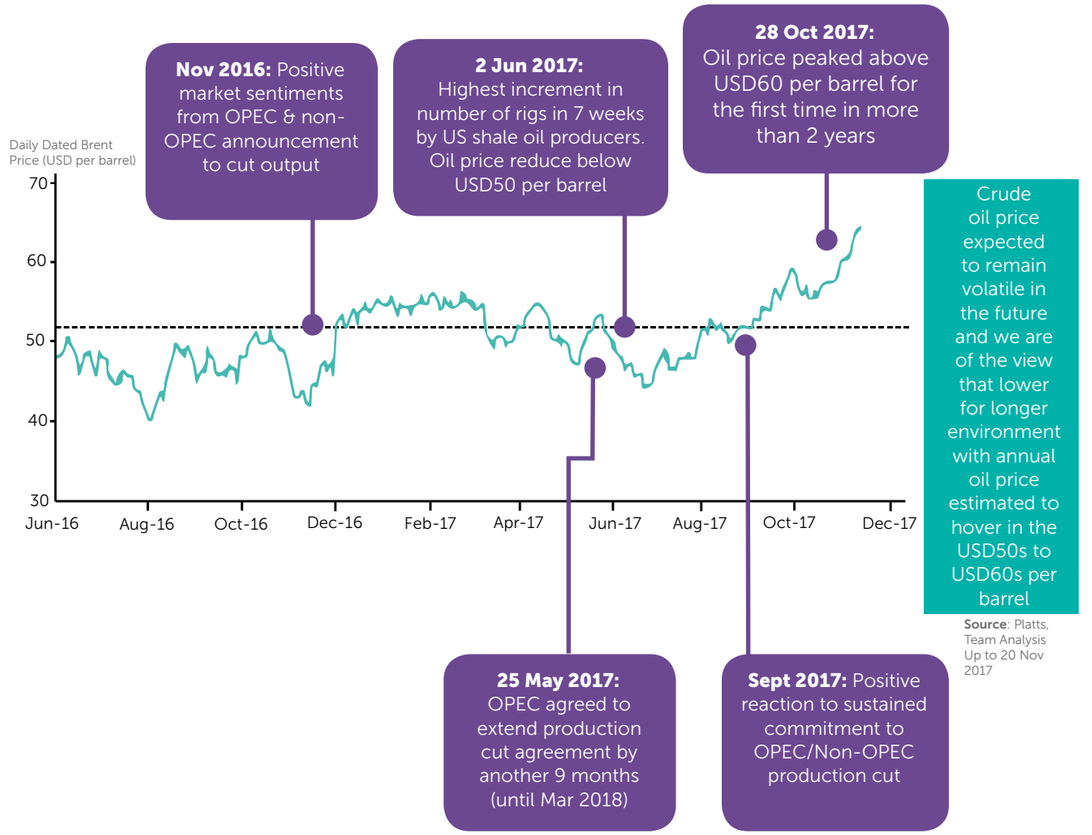
Thank you.

PETRONAS makes no representation on the accuracy or completeness of any information provided in this report and expressly disclaims any liability whatsoever arising from, or in reliance upon, the whole or any part of its contents.

Industry Overview

Lower for Longer Environment

Since the last update of PETRONAS Activity Outlook 2017-2019, crude oil price has improved to the average Year to Date of USD53 per barrel.



Source: Platts, Team Analysis Up to 20 Nov 2017

Since November last year, oil price has improved driven largely by sustained compliance by OPEC and non-OPEC members to the agreed production output cut of 1.8 million barrels per day, pledged in November 2016. In the last week of October 2017, Dated Brent oil price has strengthened to above USD60 per barrel driven by geopolitical events in the Middle East.

Did you know?

OPEC's mission is to coordinate and unify the petroleum policies of its Member Countries and ensure stability of oil markets.

In September 2017 OPEC produced 32.75 million barrels per day

OPEC Top 5 Producers
Saudi Arabia (30.5%) | Iraq (13.7%) | Iran (11.7%) | UAE (8.8%) | Kuwait (8.2%)

Source: OPEC Monthly Oil Market Report (Oct 2017)

Three (3) Key Factors are Critical for Oil Prices to Gain Strength

1 Compliance by OPEC and Non-OPEC on Output Cut Accord

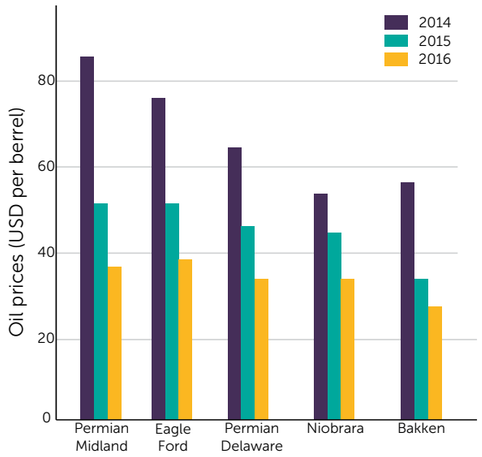
In order for oil prices to continue improving, OPEC and non-OPEC need to demonstrate commitment to the production output cut level pledged in November 2016 of 1.8 million barrels per day. Saudi Arabia is the largest contributor to the output cut in OPEC with 0.5 million barrels per day. For Non-OPEC, Russia has pledged the largest cut of 0.3 million barrels per day. Malaysia has also committed to reduce its oil production by 20 thousand barrels per day.

2 Agility of US Tight Oil Producers

The response from the US tight oil players is also key to price recovery. So far, the US tight oil producers have been agile to capture the opportunities from higher crude oil prices. In latest Short-Term Energy Outlook (STEO) report published by US Energy Information Administration (EIA) in November 2017, US crude oil production is expected to increase from 9.2 million barrels per day in 2017 to 9.9 million barrels per day in 2018, 0.7 million barrels per day or 8 per cent increment.

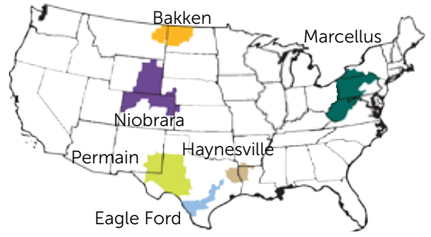
Ability to reduce breakeven cost from collaboration with service providers especially deployment of innovative technology have sustained the level of tight oil drilling activities in the US. US tight oil producers can quickly respond to oil price fluctuations as their business model is different from those of conventional. New production from tight oil producers can reach the market in shorter time and with less investment.

Average breakeven oil price of US tight oil producers by selected field (USD/bbl)



Source: Rystad Energy, Team Analysis

Location main shale oil and gas producers in the USA



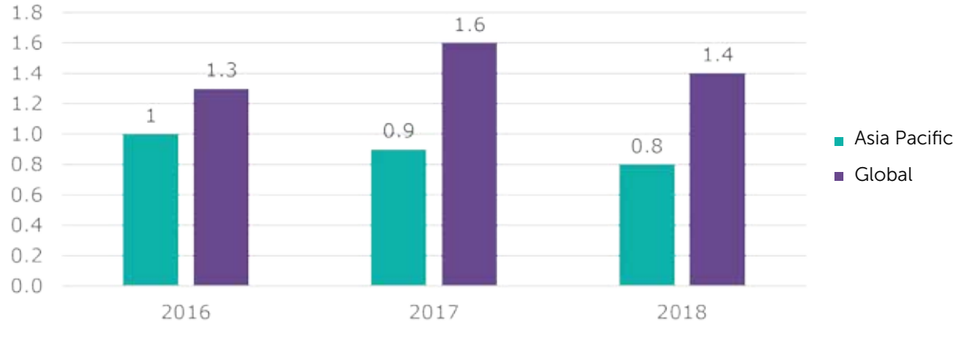
Source: US Energy Information Administration (EIA)

3 Sustained Healthy Level of Oil Demand Growth

On the demand side, sustained healthy global demand growth will facilitate oil stock drawn down and subsequently, hasten global oil market rebalancing. Currently, global oil demand is recorded at 98 million barrels per day and is expected to grow by 1.4 million barrels per day in 2018. 57 per cent of the demand growth contributed by Asia Pacific region mainly from China and India.

Global Oil Demand Growth Trending

(Mil bpd)



Source: EIA (Oct 2017), Team Analysis

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Integrated Business Model:
Opportunities in Downstream

For oil and gas companies with integrated Upstream and Downstream business portfolio, the impact of low oil price can be cushioned. In the refining sector, lower crude oil prices would reduce the cost of feedstock, and this would strengthen refining margin.

Similarly, with low retail prices, consumption of petroleum products increases and this would boost revenue. Integration with petrochemical operation would further add value and improve profit margin.

In the past years, Downstream players have embarked on various initiatives to maximise value and opportunities in the current low oil price environment by pursuing Downstream projects particularly petrochemical.

"We need to reshape the Malaysian oil and gas ecosystem so that the companies that operate here will be more ***efficient****, with the size and* ***economies of scale*** *that will also make them more* ***resilient*** *and* ***competitive globally****."*

Tan Sri Wan Zulkiflee Wan Ariffin
President & Group
Chief Executive Officer

Responding to Lower for Longer Environment
Turning crisis into opportunities

Amidst the uncertainty and inherent pressure of project feasibility, initiatives like cost compression and industry collaborations are currently on top of everyone's agenda.

This drives a rallying call for everyone in the ecosystem to build a robust, globally competitive Malaysian Oil and Gas Services and Equipment (OGSE) industry that will sustain the market turbulence and emerge stronger. A resilient industry will promote a healthy industry ecosystem and safeguard strategic national interests through the pursuit of enhancing industry's competitiveness, resilience, leadership and meaningful participation of its players.

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Increase Competitiveness

The long-term vision for Malaysian OGSE industry is to be able to **compete with the best** in the world **across multiple categories** in terms of **cost and quality**. Performance driven local players offering **value-adding suite of services** would help increase offerings, lower production costs, thus maximising contribution of oil and gas to the economy.

Economies of Scale (EOS) through integrated work scopes and longer contracting tenures is now the general approach to support sustainability of the industry. Thus it is imperative for local players to have the right mix of **technology** and **talent**, in propelling them to compete and most importantly win against more sophisticated competitors. Access to the right infrastructure and support from a **strong enabling environment** are also essential to drive this success.

Heighten Resilience

To build a truly strong industry, not only must players be competitive; but their level of competitiveness must be **sustainable**. Game changers like **Industrial Revolution 4.0** will further subject players to intense global open market competition.

In addressing these challenges, **phased consolidation** and value chain integration are strongly encouraged, supported through contracting strategies; among others to reduce costs and increase profitability, translating into **improved resilience and flexibility.**

Position Malaysia as OGSE Leader

A core aspiration for Malaysia's economic development, articulated in both the Economic Transformation Programme (ETP) and the 11th Malaysia Plan (RMK-11), is for the country to become an OGSE hub in Asia-Pacific. Malaysia must both be home to **strong**, **globally competitive Malaysian firms,** and the **location of choice** for international players serving the region.

A strong enabling environment is a prerequisite to develop regional and global champions. Access to competitive **key enablers** such as financing, human capital development, innovation, industry standards and **market information** must be improved. This Report for example, is a conscious effort by PETRONAS in **improving the market information flow to aid planning** of resources and growth strategies.

Nurture Local Participation

It is equally important that Malaysians **continue to participate** in the growth of Malaysian OGSE industry and eventually reach competitive benchmark. Creating **meaningful opportunities** with clear **entry points** and **growth pathways** for **deserving entrepreneurs and SMEs** will continue to be in our agenda.

In the Spotlight

Pengerang Integrated Complex (PIC):
Catalyst for Business Opportunities & Growth

PIC is one of the largest oil and gas industrial developments in this region, as well as PETRONAS' largest downstream investment to date. It houses the Refinery and Petrochemical Integrated Development complex (RAPID) comprising integrated crude oil refinery, naphtha cracker and petrochemical complex. It is supported by Associated Facilities which comprises Pengerang Co-generation Plant (PCP), Regasification Terminal (RGT2), Projek Air Mentah RAPID (PAMER), Air Seperation Unit (ASU), Pengerang Deepwater Terminal (PDT2), as well as Centralised Utilities and Facilities (UF).

The Refinery, a sour full conversion facility with a processing capacity of 300,000 bpd is also capable of processing different blend of crudes with a wide range of light to heavy, sweet and sour crude oils. It will serve as the primary feedstock supplier to the Petrochemical Complex as well as produce petroleum products such as low sulphur jet fuel, motor gasoline and diesel. Propane, LPG and naphtha products coming from the Refinery will be used as feedstock to the Steam Cracker. The Steam Cracker Complex consists of pyrolysis cracking and recovery facilities. It will have a combined annual production capacity of more than 3 million tonnes of Ethylene, Propylene, C4 and C6 olefin products. These will be further upgraded to produce highly differentiated and specialised polymers, glycols and other chemical products.

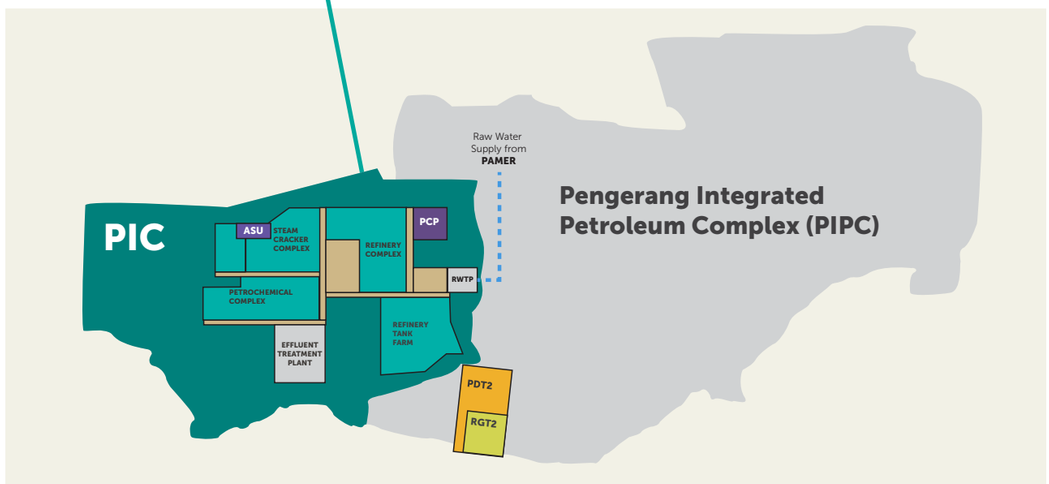
With an investment of USD27 billion, PIC supports the Malaysian Government's overall Economic Transformation Programme (ETP) and will spur the growth of Malaysia's oil and gas downstream sector, propelling Malaysia into a new frontier of technology and economic development.

The PIC will not only meet domestic demand for petroleum products and the Malaysian Government's future legislative requirements with the implementation of Euro5 specifications for Gasoline and Diesel, expected to capitalise on the growing need for petrochemical products in Asia in the next 20 years.

The PIC will occupy an area of 6,242 acres, signifying the development as the largest integrated greenfield development in a single location. The PIC aims to become a regional downstream oil and gas hub by leveraging on its strategic location with accessible major shipping routes, land availability and natural deepwater harbour.

The PIC is poised for start-up in early 2019. Upon completion, PIC will be the only integrated refinery and steam cracker plant in Malaysia and is expected to be ranked the fourth largest in Southeast Asia with the capacity to provide reliable supply of feedstock.

The PIC aims to become a regional Downstream oil and gas industrial hub by leveraging on its strategic port location on major shipping routes for crude oil and refined products, its proximity to Singapore which is Asia's largest oil-trading hub, land availability and deepwater marine accessibility.



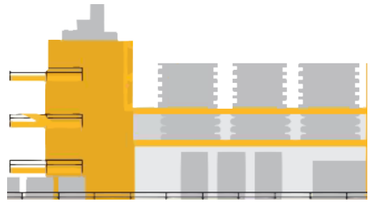
Upon completion, PIC will be the only integrated refinery, steam cracker & petrochemical plants in Malaysia and is expected to be ranked the fourth largest in Southeast Asia.

Did you know?

This project involves >40 Engineering, Procurement, and Construction (EPC) packages, >200 suppliers and contractors, >60,000 manpower at peak and ~350 million project manhours.

Record Breakers

PIC is designed at such mega proportions. The development has achieved four entries in the Malaysia Book of Records to date.

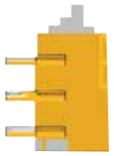


Tallest & Heaviest Process Column

A propylene fractionator process column for the Steam Cracker facility was recognised as the tallest and heaviest process column in Malaysia. The process column measures **121.3 metres high** and **weighs 1,808.6 tonnes** – as tall as a 37-storey building and as heavy as two fully-fuelled A380 Airbus and a Boeing 747 airplane combined. It had travelled eight days aboard the MV Fairmaster from the Hyundai Mipo Dockyard in South Korea, before arriving on 25 June 2016 at the Material Offloading Facility (MOLF) port in Tanjung Setapa, Johor.

Biggest Crude Heaters

Two modularised furnaces, commonly known as crude heaters, were certified as the biggest heaters to ever land on Malaysian shores. The furnaces are an important component of the crude distillation unit within the refinery, and critical in providing feed for other process units of the refinery. Codenamed F-001 A and B, they were constructed at Liantong facility in Ningbo, China and arrived at site on 20 January 2017. Each weighs about **1,000 tonnes** and has a processing capacity of **150,000 barrels per day** respectively. Their successful installation signified an important milestone in the overall development of PIC.



Biggest Crude Distillation Colum

Malaysia's biggest Crude Distillation Column (CDU) was installed at the refinery in PIC on 10 June 2017. The CDU Column is designed to process 300,000 barrels per day of medium heavy sour crude oil in a single distillation column. It is the heart of refinery as it is the first process unit to receive crude and is among the biggest single CDU Column installations in the refining industry. The column was designed by Sinopec Engineering and fabricated by KNM Process Systems Sdn Bhd in Gebeng, Pahang. It spans almost **10 metres in width and 66 metres in height**, exceeding the leaning tower of Pisa by 3 storeys and weighs **1,300 tonnes.**

Biggest Waste Heat Boilers

Two modularised waste heat boilers, installed at the refinery on 21 March 2017, hold the record for being the biggest in Malaysia. The boilers are an important component of the residual fluid catalytic cracking unit (RFCC) within the refinery, which function to crack hydro-treated atmospheric residue into feedstock for the Steam Cracker facility. Fabricated in Kaohsiung, Taiwan, each waste heat boiler weighs about **2,000 tonnes**. Construction of the waste heat boilers and the RFCC was awarded to the consortium of CTCI Corporation, Chiyoda Corporation, Synerlitz Malaysia Sdn Bhd and MIE Industries Sdn Bhd.

Material & Services Outlook

Plants and facilities built for long useful life can support sustainable growth and provide long term economic benefits to industry players. As a mega-scale integrated petroleum complex, PIC and its other neighboring facilities will be supported by a broad range of services for its operations. Local players need to seize this opportunity to grow in size and capability, to undertake more complex scopes.

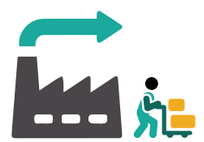
Core Services (Turnaround and Operations & Maintenance)

- Mechanical static (maintenance of heat exchangers, vessels, boilers, etc.)
- Mechanical rotating (maintenance of gas turbines, compressors, etc.)
- Instrumentations (maintenance of DCS, valve, actuators, custody metering, etc.)
- Electrical (maintenance of substations, electrical motors, etc.)
- HSE equipment (relief valves, fire & gas detector, etc.)

Supporting Services

- Civil, structural & infrastructure hardware & services (scaffolding, plumbing, painting, repair of office buildings, etc.)
- Housekeeping & office administration
- Cleaning services (e.g.: high pressure water jet works, general cleaning, etc.)
- Forwarding services
- Catering, food & beverages
- Interior design & landscaping

Material Supplies



- Equipment spare parts & consumables (mechanical, electrical, instruments, etc.)
- Transit storage (ISO-tanks, chemical drums, etc.)
- Polyethylene (PE) woven bags
- Site equipment, general tools & stationaries
- Office furniture, electrical & electronics (computers, projectors, etc.) supplies

Did you know?

As part of our aspirations to have a LEAN* operations, we highly encourage initiatives to minimize equipment stocking and spares e.g.: Vendor Managed Inventory (VMI).

**Six Sigma methodology*

Employment & Human Capital Development

During the project stage, manpower requirements at site will focus on main-mechanical workers like fitter, rigger, welder, scaffolder, etc. to cater for construction works.

Moving towards operations stage, more management, technical, supervisory skills including Project Management will be in high demand as well as a good base of semi-skilled manpower like plant technicians from various key disciplines.

In anticipation of this exponential growth, it is imperative for industry players to enhance collaboration effort with institutions to strengthen industry human capital.

Did you know?

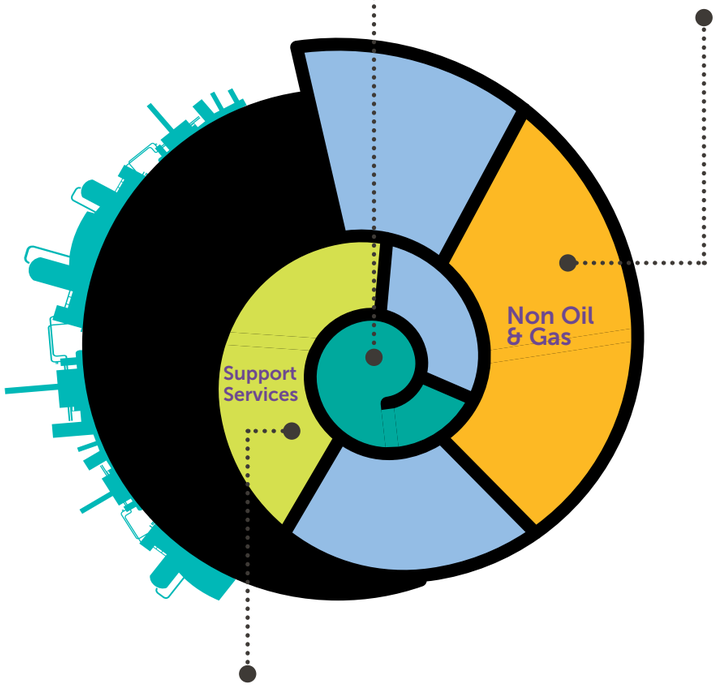
Average manpower requirement at site for project stage is about 50,000 – 60,000 people, at operations stage, about 6,000 – 8,000 people

Spurring Local Economy

PIC promotes high-growth of new urban development for at least in the next 5-10 years, to accommodate communities in the region. It presents huge spin-off opportunities for locals especially in support services and non oil & gas development areas; which is expected to continue throughout the useful life of the plants.

PIC
Development

- Properties & residential areas
- Hotels
- Schools & educational institutions
- Commercial centers
- Healthcare
- Food & beverages



- Local vocational & higher education institutes
- Logistics & warehousing
- Centralised Maintenance, Repair & Overhaul (MRO) facilities

- Consultation and certification training centers
- Foreign direct investments
  - Operation branches
  - Service centers
  - Training centers

*"To thrive in this challenging environment, **Technology** is key for us to **unlock value** and deliver **sustainable solutions** for our industry."*

Mazuin Ismail
Senior Vice President
Project Delivery & Technology

Embracing Technology

Be Bold
Be Different
Be THE Leader

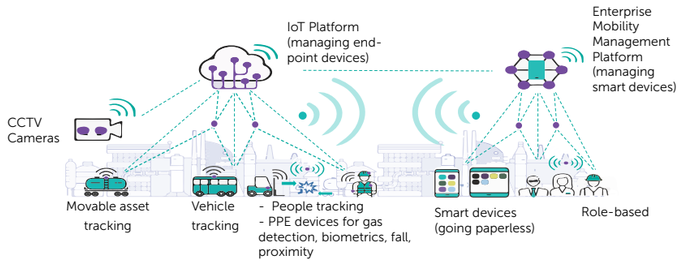
PETRONAS Technology Imperatives
Our commitment for a better tomorrow...

Autonomous: Revolutionising Inspection & Maintenance using Robotics & Drones

Traditional plant inspection & maintenance approach is labour intensive with high HSE risk using scaffold, rope-access and working-at-height. The evolution in robotics & drones technologies will not only minimise risk of Lost Time Injuries (LTI) and cost effectiveness but also increase asset and operational efficiency through Predictive and Prescriptive Analytics.

Connected Workers: Creating new work experience for our frontline operations

In a typical day at work, plant operation personnel are always on the move collecting multiple data from structured rounds to equipment inspections and performing maintenance activities. Mobile technology with intelligent and smart sensors in the connected environment allows predictive maintenance elevating efficiency and productivity.



In due time, robotics and drones utilisation will increase significantly. Data analytics supported by predictive maintenance will exponentially increase plant reliability, leading to less repair and maintenance requirements. These elements combined, may result in fewer contract opportunities.

Innovation Gateway@PETRONAS (IG@P)
Your Solution Could Be The Next Game Changer...

PETRONAS embraces open innovation through crowdsourcing, challenging innovative minds from across the globe. The online crowdsourcing platform Innovation Gateway@PETRONAS, (IG@P) calls for proposal from external parties.

It promotes collaboration with external parties to introduce fast-paced, innovative solutions to solve our business challenges.

PETRONAS TECHNOLOGY CHALLENGE

This need-driven solution will be solicited through open invitation via a series of PETRONAS Technology Challenges. Submission of technology proposal will be evaluated and winner will be announced.

24/7 TECHNOLOGY MARKET PLACE

This is an opportunity driven solution, anyone can submit ideas and solution in this Marketplace 24/7. Proposals will be evaluated based on PETRONAS Technology Management System.

PETRONAS TECHNOLOGY FOCUS AREAS

- Geo Imaging
- Enchanced Oil Recovery
- High CO2 & Contaminants Removal
- Facilities of the Future
- Unconventional
- Fluid Solutions
- Petrochemical Derivatives & Specialty Chemical

What's in it for you ?

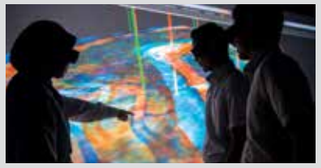
Opportunity to prove technology success.

Opportunity to collaborate with PETRONAS for potential commercialisation

TECHNOLOGY CHALLENGE

PETRONAS seeks innovative solutions from across the globe for our complex business challenges. Stay tuned as we publish new Technology Challenge from time to time.

TECHNOLOGY MARKETPLACE



PETRONAS wants to know if you have new value adding technologies. This is a single submission point for any innovative solutions that you want to bring to our attention.

For More Detail Check Out our Website
http://www.petronas.com.my/IG@P/Pages/default.aspx

Category Specific **Outlook**

Methodology

a) Scope of Coverage

This section provides activity outlook for **core categories;** serving as **leading indicators** to many other supporting services. Given the **interdependencies** of these activities, it presents **multiplier-effects** across the value chain.

For **Upstream**-related information, the Report covers the activity outlook for Malaysia. This includes activities from **PETRONAS Group of Companies** and other **Petroleum Arrangement Contractors (PACs)**. Activities governed under the Malaysia-Thailand Joint Development Area (MTJDA) are excluded from this Report.

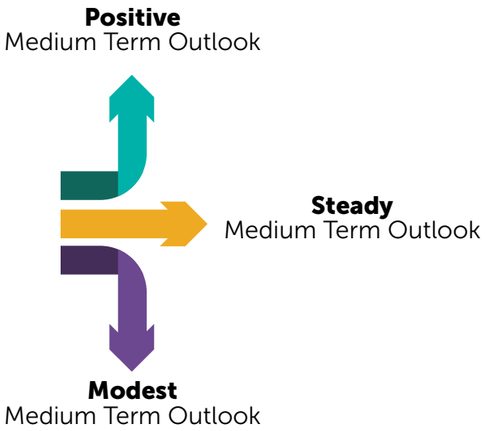
For **Downstream**-related information, this Report covers the activity outlook for PETRONAS Group of Companies in Malaysia only.

b) Time Horizon

The Report provides information on activities within a **3-year period, from 2018 to 2020**. Information is accounted for when a **specific activity begins** and **not by contract award**. Using Offshore Fabrication as an example, we report the date of the first steel-cut instead of the date of Engineering, Procurement, Construction, Installation and Commissioning (EPCIC) contract award.

Outlook numbers include activities which may have been contracted at the time of reporting. Optimisation, sequencing efforts (e.g. impact of contracting strategy or long-term activity sequence) and multi-year activities are not reflected. For example, an installation project from December 2018 to January 2019 only accounted for once in 2018.

Directional narratives are provided for the medium-term (i.e. post-2020), to support outlook analysis using the following signposts:



c) Low & High Case Scenarios

Outlook numbers for most categories are provided via a lower and upper band:

Low Case – Activities with **high probability** of occurrence; high project maturity and certainty of requirement

High Case – **Includes** activities with **lower probability** of occurrence; lower project maturity and certainty of requirement

Upstream Malaysia

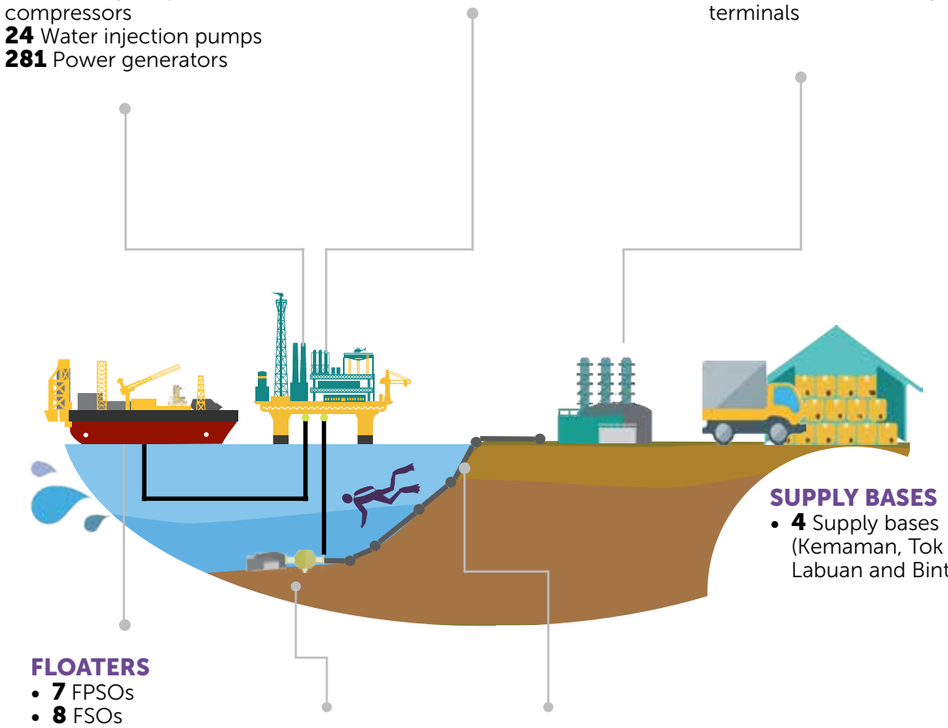
As the custodian of Malaysia's petroleum resources, PETRONAS is focused on pursuing sustainable value-driven production growth, monetising oil and gas resources, strengthening core capabilities and building niche competencies.

Below is a snapshot of Upstream Malaysia facilities dimensions, operated by 26 PAC Operators.

ROTATING EQUIPMENTS
- **182** Major compressors
- **166** Crude oil transfer pumps
- **71** Gas lift/gas injection compressors
- **24** Water injection pumps
- **281** Power generators

PLATFORMS
- **349** Offshore platforms (~30% are CPPs)

TERMINALS
- **4** Onshore crude terminals
- **7** Onshore gas terminals
- **2** Onshore crude and gas terminals



SUPPLY BASES
- **4** Supply bases (Kemaman, Tok Bali, Labuan and Bintulu)

FLOATERS
- **7** FPSOs
- **8** FSOs
- **1** FPS, **1** FSU
- **2** MOPUs
- **1** PFLNG

WELLS
- **4,154** Total strings (2,217 Producing strings)

PIPELINES
- **610** Lines
- **10,105** Pipeline length (km) *equivalent to KL-London

Did you know?

To date there are ~100 awarded contract areas, operated by 26 PAC Operators. Biggest PAC Operator is PETRONAS Carigali Sdn Bhd with ~60% of total Malaysian assets.

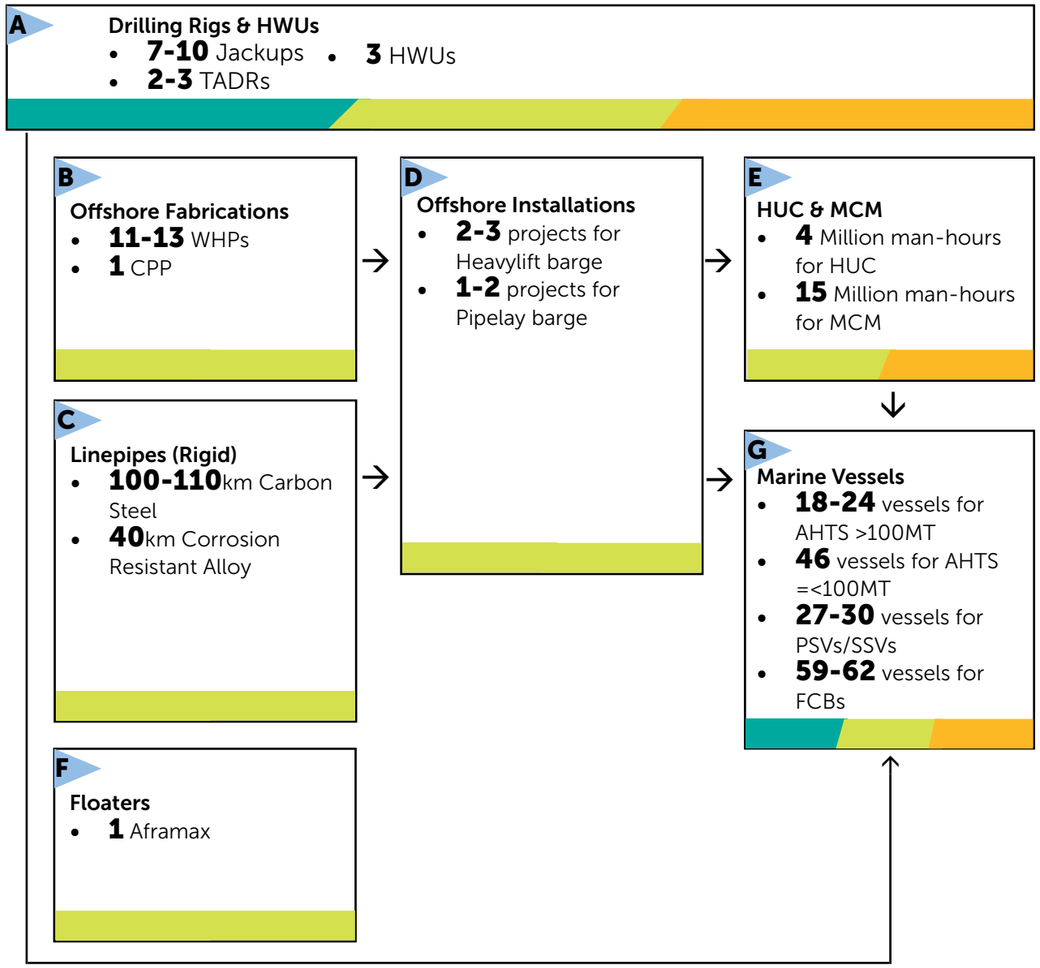
*Refer PAC list in Glossary

Project Portfolio

An average of ~1.7Mboe/d production is forecasted over the next 5 years. Upstream Malaysia has a robust pipeline of potential projects focused on developing new growth areas or "Greenfield Projects" and maximising ultimate recovery of existing fields or "Brownfield Projects". PETRONAS and its PACs will continue to mature potential Development projects technically and commercially, within its portfolio to sustain the desired production level.

Projection of Development portfolios between 2018-2020 are as follows:

Quick Reference for 2018
Upstream Activity Outlook



Activity phase:

- Exploration
- Development
- Production

Note

→ Interdependent activity

PETRONAS expressly disclaims any liability whatsoever arising from, or in reliance upon, the whole or any part of this Report

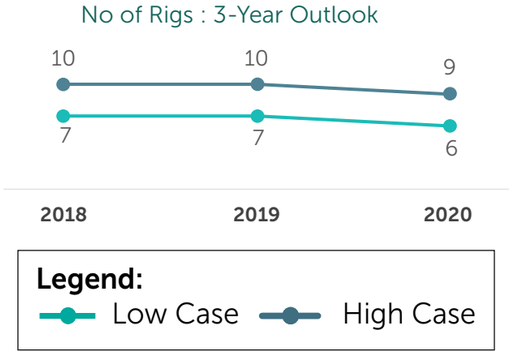
A Drilling Rigs and Hydraulic Workover Units (HWUs)

A drilling rig refer to the machine used to drill a wellbore. For the purpose of this Report, activity outlook will be provided for the most widely used drilling rig types in Malaysia i.e. Jackup Rigs and Tender Assisted Drilling Rigs (TADRs).

Workover refers to any well intervention process which helps to repair the wells using an invasive technique.

Jackup Rigs

Activity Phase: Exploration, Development
Application: The most common type of offshore rig due to its flexibility. Jackup Rigs are self-elevating with movable legs that can be extended ("jacked") above or below the hull.
Associated Services: Supporting vessels, OCTG, third party drilling services e.g. drilling fluids, DD/MWD/LWD, surface wellheads, drill bits, cementing, fishing, slickline, etc.



Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook numbers are based on a full-year utilisation. Actual number may vary based on campaign duration or optimisation.
- In comparison, activities in 2018-2020 are ~50% lower than peak activity level in 2013/14.

Medium Term Outlook – Post 2020

- Steady outlook for Jackup Rigs and expected to increase slightly with the increase of new Development projects and Exploration activities.
- It is imperative for local Jackup Rigs to remain competitive and to withstand cost pressures from international players.

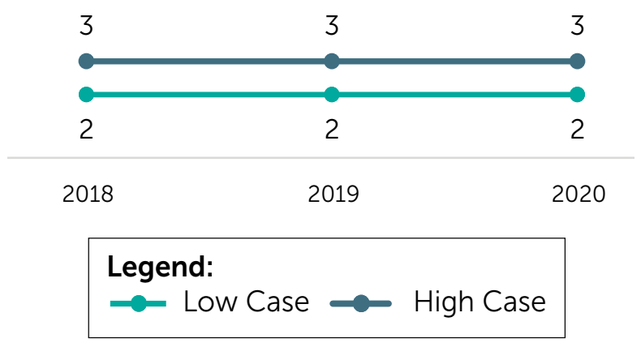
Did you know?

For Development projects, selection of rig types are normally done during concept select stage and cost will remain as the key driver.

Tender Assisted Drilling Rigs (TADRs)

Activity Phase: Development
Application: Typically used on platforms designed for tender assisted rigs where a Jackup Rig cannot be used due to water depth/approachability limitations.
Associated Services: Supporting vessels, OCTG, third party drilling services e.g. drilling fluids, DD/MWD/LWD, surface wellheads, drill bits, cementing, fishing, slickline, etc.

No of Rigs : 3-Year Outlook



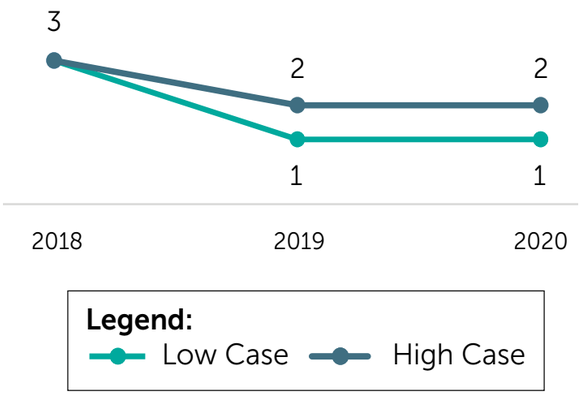
Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook numbers are based on full-year utilisation. Actual number may vary based on campaign duration or optimisation.
- In comparison, activities in 2018-2020 are ~60% lower than peak activity level in 2013/14.

Medium Term Outlook – Post 2020
- Steady outlook can be expected for TADRs, mostly from infill drilling campaigns. Its demand is highly dependent on platform design and cheaper cost options like Jackup Rigs.

Hydraulic Workover Units (HWUs)

Activity Phase: Production
Application: Performs various workover operations e.g. well casings and casing levels repair, sand cleanout, change out completions, etc.
Associated Services: Supporting vessels, OCTG, third party drilling services e.g. drilling fluids, DD/MWD/LWD, surface wellheads, cementing, fishing, slickline, etc

No of HWUs : 3-Year Outlook



Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook numbers are based on full-year utilisation. Actual number may vary based on campaign duration or optimisation.
- In comparison, activities in 2018-2020 are similar to peak activity level in 2013/14 to support operational requirements.

Medium Term Outlook – Post 2020
- Modest outlook can be expected for HWUs. Its application is driven by cost competitiveness as it can be substituted by rigless solutions.

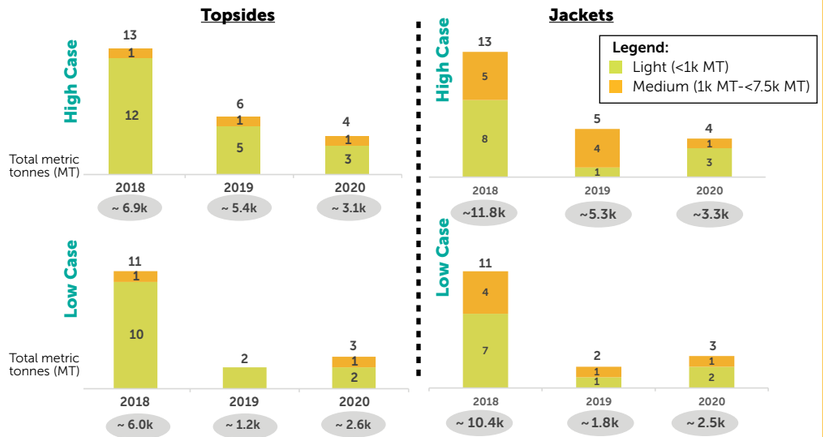
B Offshore Fabrications

Offshore Fabrication refers the construction of offshore structures (e.g., Topsides, Jackets) and first steel-cut as the indicator for commencement of construction activity.

Wellhead Platforms (WHPs)

Activity Phase: Development
Application: Used to produce oil or gas or serve as a platform for drilling activities. Typically, it can be linked to CPPs, FSOs/FPSOs or directly to onshore processing facilities.
Associated Services: Engineering, structural steel, bulk materials (e.g. piping, cables, etc.), equipment supplies (e.g. mechanical, electrical, instruments, etc.)

No of Structures : 3-Year Outlook



The majority of new Development projects may opt for lightweight structure or minimum facilities platform design (<1k MT), mainly attributed by cost effectiveness.

Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- Weight provided excludes piles and conductors.

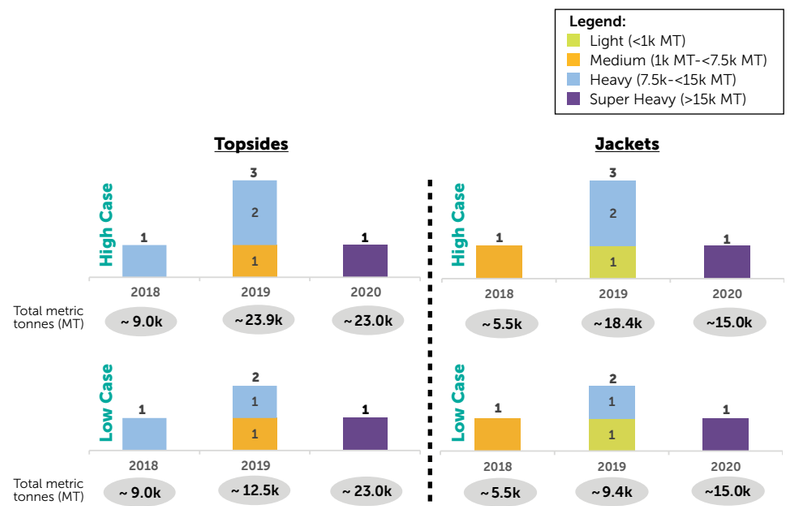
Medium Term Outlook – Post 2020

- Positive outlook can be expected for WHPs, with stable movement of oil prices, cost optimisation and new technology applications.
- Supply side consolidation can be expected.

Central Processing Platforms (CPPs)

Activity Phase: Development
Application: : CPP processes oil, gas and water from WHPs and transports to point of export. CPPs normally act as the centralized platform for the entire field complex.
Associated Services: Engineering, structural steel, bulk materials (e.g. piping, cables, etc.), equipment supplies (e.g. mechanical, electrical, instruments, etc.)

No of Structures : 3-Year Outlook



In addition, one (1) activity expected in 2019 involving a ~20k MT Mobile Offshore Production Unit (MOPU).

Notes:
- Outlook includes activities which may have been contracted out at the time of reporting
- Weight provided excludes piles and conductors.

Medium Term Outlook – Post 2020

- Modest outlook can be expected for CPPs, as cost competitiveness drives Development projects to opt for WHP tie-ins to existing nearby facilities, instead of building new CPPs.

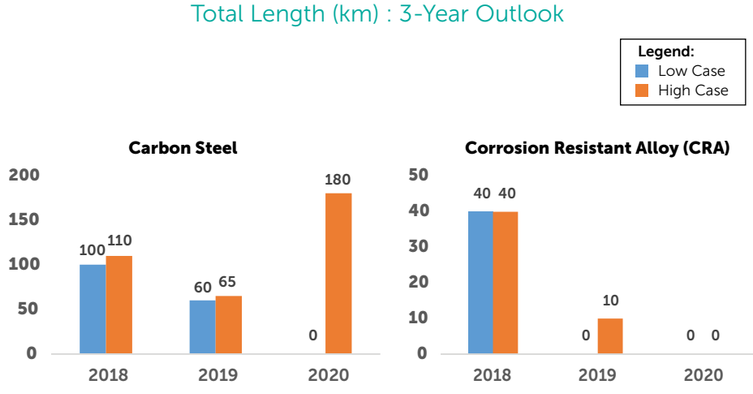
C Linepipes

For the purpose of this Report, **Linepipe** refers to the supply of Linepipes (Rigid) used to transport oil or gas between facilities.

Linepipes (Rigid)

Activity Phase: Development
Application: Generally used for longer distance.
Associated Services: Engineering, coating services, pre-commissioning services, logistics.

Total Length (km) : 3-Year Outlook



In addition, a surge in activity for Flexible Pipes is projected in the next 2-3 years (30-50km) for Development projects and WHPs tie-ins to existing Production facilities.

Notes:

- Outlook includes demand for new development projects, **excluding pipeline replacement projects, water and process pipes.**
- Outlook includes activities which may have been contracted out at the time of reporting.

Medium Term Outlook – Post 2020

- Steady outlook for Linepipes (Rigid) mainly for intra and inter-field Pipelines. No new trunk-line in the Development plan for the near future.
- Increasing number of projects with sour crude/gas, will lead to increase in demand for higher-specification materials for Linepipes.

D Offshore Installations

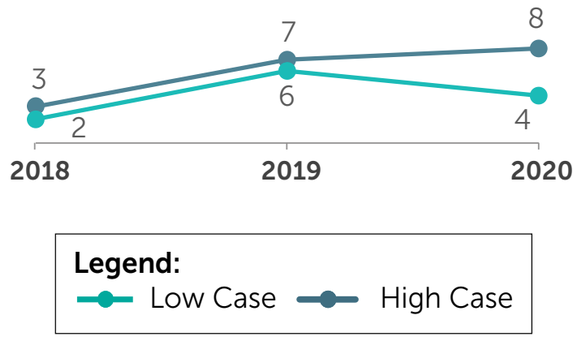
For the purpose of this Report, **Offshore Installation** refers to activities involving installation of structures (i.e. WHPs and CPPs) and pipelines; using installation barges.

Activities are measured in terms of number of projects for each type of barge. Number of offshore days for each activity may vary.

Structural Installation – Heavylift

Activity Phase: Development
Application: Used for installation of jackets (for WHPs and CPPs) and topsides (for WHPs.)
Associated Services: Supporting vessels, diving and ROVs, welding and NDTs.

No of Projects: 3-Year Outlook



Notes:

- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook number is measured in terms of number of projects and durations may vary.

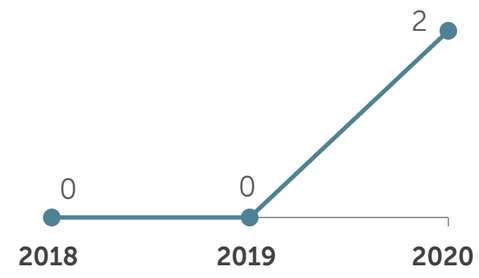
Medium Term Outlook – Post 2020

- Positive outlook for Heavylift barges can be expected as more projects are having smaller sized WHPs. Nonetheless cost competitiveness is key, as operators are actively exploring new technologies for cheaper Installation method.
- Ageing platforms may increase prospects of Decommissioning projects and usage of Heavylift barges.

Structural Installation – Floatover

Activity Phase: Development
Application: Used for installation of heavier or integrated topsides (for CPPs)
Associated Services: Supporting vessels, diving & ROVs, welding & NDTs

No of Projects: 3-Year Outlook

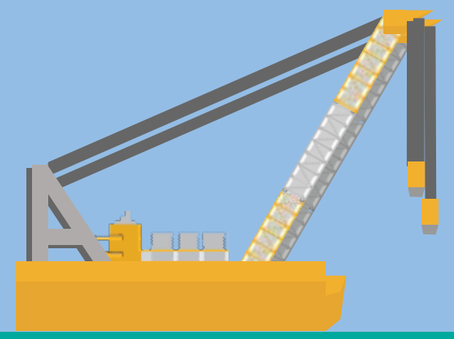


Notes:

- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook number is measured in terms of number of projects and durations may vary.

Medium Term Outlook – Post 2020

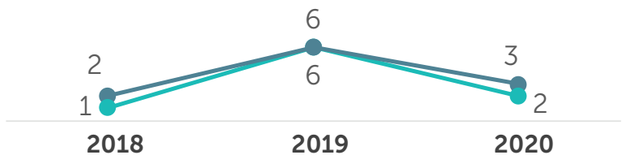
- Modest outlook can be expected for Floatover barges with lower number of CPP projects being awarded.



Pipeline Installation – Pipelay

Activity Phase: Development
Application: Used to install Linepipes (Rigid) for offshore Development projects and pipeline replacements during Operations.
Associated Services: : Supporting vessels, diving & ROVs, fill joint coating services, welding & NDT.

No of Projects: 3-Year Outlook



Legend:
Low Case — High Case

Notes:

- Outlook includes demand for new development projects, **excluding pipeline replacements projects.**
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook number is measured in terms of number of projects and durations may vary.

Medium Term Outlook – Post 2020

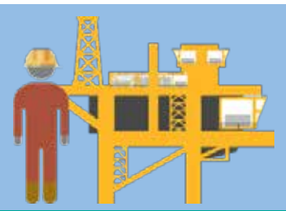
- Stable outlook can be expected for Pipelay Barges as it directly correlates with activity for Linepipes (Rigid) in new Development projects.
- Being one of the biggest cost elements, Installation cost is typically the main driver for selection of Linepipes (Rigid) against its alternative pipes technology.

E Hook-Up & Commissioning (HUC) and Maintenance, Construction & Modification (MCM)

Hook-Up & Commissioning (HUC) ties in all components of the facilities including all functioning tests and start-up of facilities.

Maintenance, Construction & Modification (MCM) covers activities related to the repair and maintenance of existing topside facilities. Typically, an MCM campaign will be executed every 5-8 years to ensure production sustainability.

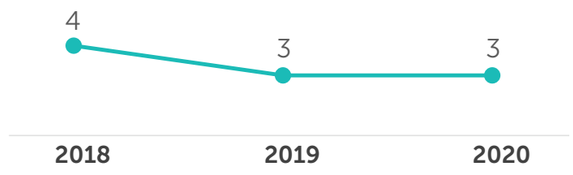
Both HUC and MCM are grouped together, as they generally have similar manpower and equipment requirements. Given that both activities are labour intensive, activity outlook is stated in man-hour units.



Hook-Up & Commissioning (HUC)

Activity Phase: Development, Production
Application: Greenfield HUC involves works on newly installed platforms during Development stage. Typically bundled as part of EPCC/EPCIC contracts. Brownfield HUC involves works on existing offshore facilities and equipment; including rejuvenation/ redevelopment, general topside modification, infill drilling activities, etc.
Associated Services: Work and accommodation vessels, logistics services, precommissioning services, inspection services, blasting and painting services.

No of Man-hours (Millions) : 3-Year Outlook

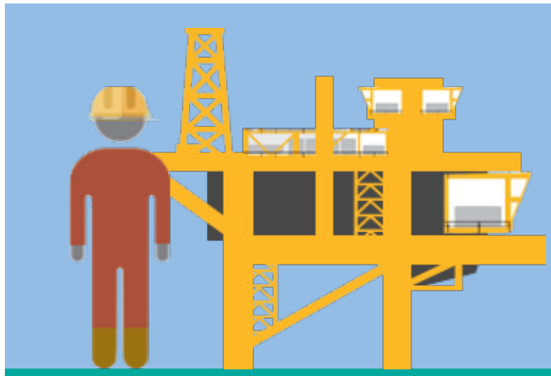


Most activities accounted are for Brownfield HUC. HUC activities are expected to remain stable over the next 3 years, thus no High Case is provided.

Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- In comparison, activities in 2018-2020 are ~50% lower than peak activity level in 2013/14.

Medium Term Outlook – Post 2020

- Steady outlook can be expected as Brownfield HUC will persist due to increasing number of projects and ageing facilities despite continuous efforts to reduce cost via scope optimisation.

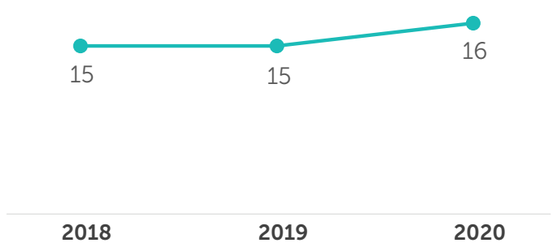


Maintenance, Construction & Modification (MCM)

Activity Phase: Production
Application: Formerly known as Topside Major Maintenance (TMM), MCM involves two types of activities for Offshore facilities:
1. Scheduled Maintenance: Planned activities.
2. Corrective Maintenance: Unplanned activities arising from unforeseen circumstances.

Associated Services: Work and accommodation vessels, logistics services, inspection services, blasting and painting services.

No of Man-hours (Millions) : 3-Year Outlook



Activity is expected to remain stable over the next 3 years, thus no High Case is provided.

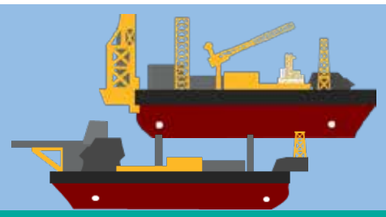
Notes:
- Outlook includes activities which may have been contracted out at the time of reporting; e.g.: PCSB MCM & Pan Malaysia MCM contracts.
- In comparison, activities in 2018-2020 are similar to peak activity level in 2013/14 to support operational requirements.

Medium Term Outlook – Post 2020

- Steady outlook can be expected with the increasing number of projects and ageing facilities. However, higher cost pressure will drive further scope optimisation/prioritisation.

F Floating Offshore Facilities (Floaters)

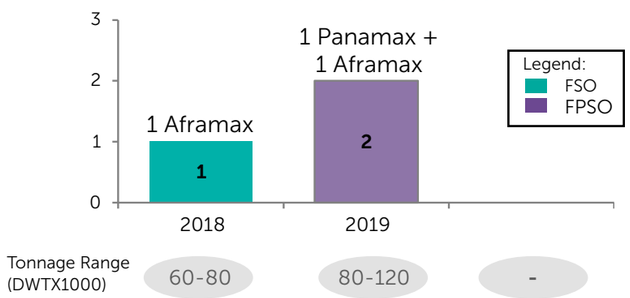
For the purpose of this Report, **Floating Offshore Facilities (Floaters)** refers to Floating Production Storage and Offloading (FPSO) and Floating Storage and Offloading (FSO) units; non-fixed structures involved in processing and/or storage of hydrocarbons.



FPSOs / FSOs

Activity Phase: Development
Application: Used for production, processing, storage and offloading. FSO is essentially a simplified FPSO without the capability for oil or gas processing.
Associated Services: Engineering, structural steel, equipment supplies (e.g.: mechanical, electrical, instruments, etc.), shipyards.

No of FPSOs/FSOs : 3-Year Outlook



Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- Outlook only covers supply of Floaters, including conversions and new-builds.

Medium Term Outlook – Post 2020

- Modest outlook can be expected for Floaters as fewer marginal fields and deepwater project developments are to be awarded in current market conditions.
- New technology and lower cost make this a more attractive development option.

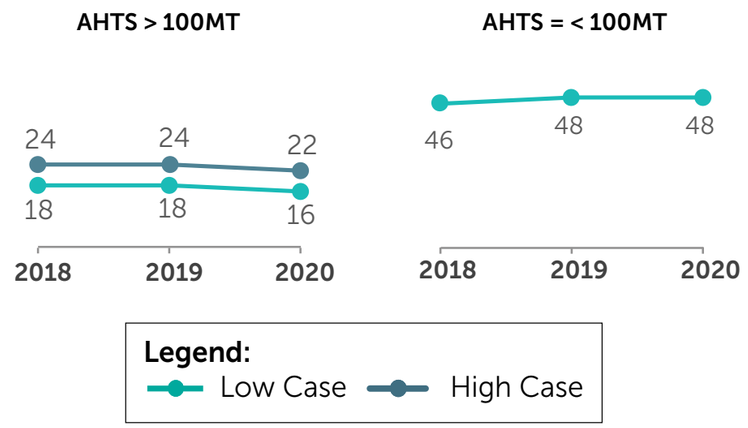
G Marine Vessels

Marine Vessels offer a wide range of support services for Exploration and Development drilling, installation, HUC and Production. This Report only covers Anchor Handling Tug Supply (AHTS), Platform Supply Vessels (PSV)/Straight Supply Vessels (SSVs) and Fast Crew Boats (FCB), as the most widely-used vessel types.

Anchor Handling Tug Supply (AHTS)

Activity Phase: Exploration, Development, Production
Application: An offshore tug/supply ship equipped with a high bollard pull and a stern roller for anchor handling. Also used to transport supplies to offshore sites.
Associated Services: Vessel inspection services, bunkering services, port services.

No of Vessels: 3-Year Outlook

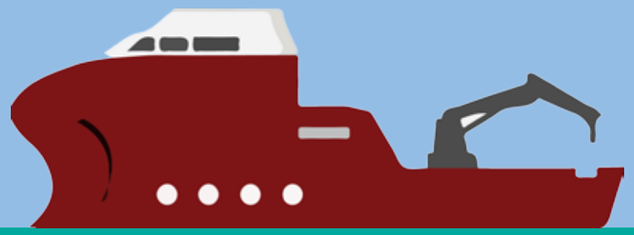


Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook numbers are based on full-year utilisation. Actual number may vary based on campaign duration or optimisation.

Medium Term Outlook – Post 2020

- Stable outlook can generally be expected for AHTS to fulfil Exploration and Production commitment. However comparatively lower activity can be expected for higher capacity AHTS, in this cost optimisation environment. Activity to support new Development projects may increase slightly, but are unlikely to approach historical high levels (~2013/14).

Platform Supply Vessels (PSVs) & Straight Supply Vessels (SSVs)



Activity Phase: Exploration, Development, Production
Application: Typically used to transport supplies to offshore sites.
Associated Services: Vessel inspection services, bunkering services, port services

No of Vessels : 3-Year Outlook

Legend:
Low Case — High Case

Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook numbers are based on full-year utilisation. Actual number may vary based on campaign duration or optimisation.

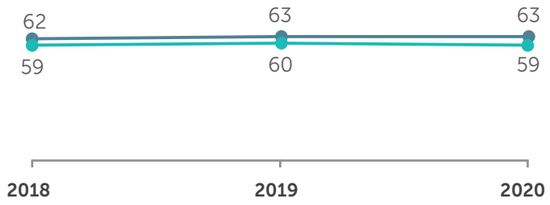
Medium Term Outlook – Post 2020

- Stable outlook can also be expected for PSVs/SSVs. Unlikely to see an uptick in activity, especially during lower rig utilisation and day rates pressure.

Fast Crew Boats (FCBs)

Activity Phase: Development, Production
Application: A high speed vessel for the transportation of crew to offshore facilities
Associated Services: Vessel inspection services, bunkering services, port services

No of Vessels : 3-Year Outlook



Legend:
Low Case — High Case

Notes:
- Outlook includes activities which may have been contracted out at the time of reporting.
- The outlook numbers are based on full-year utilisation. Actual number may vary based on campaign duration or optimisation.
- Low case reflects the level of uncertainty in rig, Installation and HUC activity.

Medium Term Outlook – Post 2020

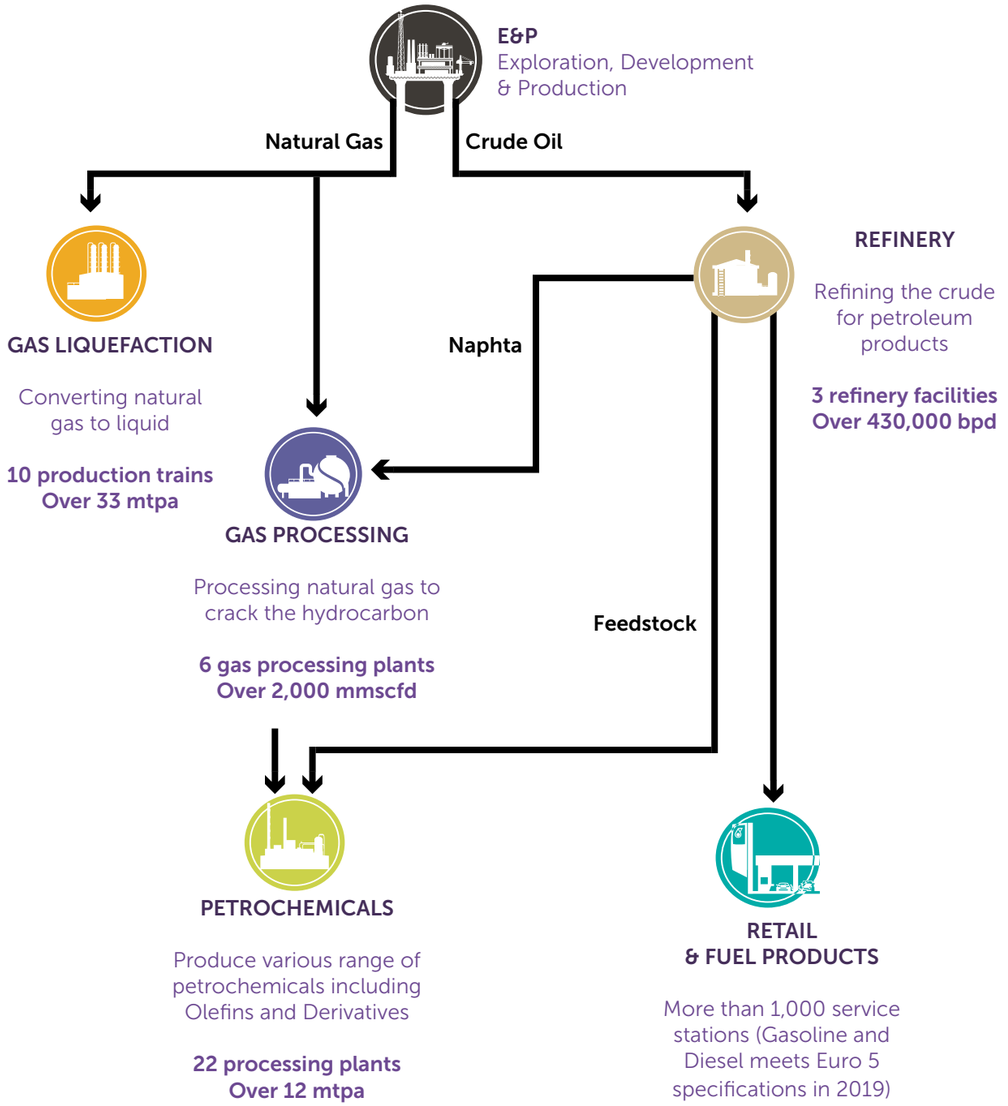
- Positive outlook can be expected for FCBs in this cost optimisation environment driving changes in operating philosophy.
- Higher speed vessel **(>40 knots)** with lower operating cost is seen as an alternative to chopper.

Did you know?

In recent years, the Marine Vessel category was faced with critical oversupply situation. Market self-correction is gradually driving towards supply-demand balance.

Downstream Malaysia

As part of PETRONAS' integrated business, Downstream plays a strategic role in enhancing the value of our petroleum resources, transforming it into high-quality, value-added products for the domestic and international market.



Downstream Malaysia Main Activities

Main Location(s): Kertih (Terengganu) and Sg.Udang (Melaka)
3 refineries facilities with total combined capacity of 430 kpbd. Designed to produce various range of petroleum products including Gasoline, Diesel and Jet A-1.

Activity Highlights
- Additional capacity of 220,000 bpd of petroleum products from PIC in 2019.

REFINERIES

Main Location(s): Kertih (Terengganu), Gebeng (Pahang), Bintulu and Sipitang (Sabah)
18 Manufacturing plants with 2 sites fully integrated complex. Total combined capacity of more than 12 mil mtpa. Manufacture product group of olefins, derivatives, fertilizers and methanol.

Activity Highlights
- Additional capacity of 3.3 mil mtpa in 2019 from PIC, including production of differentiated and specialty chemicals.
- New capacity of 1.9 mil mtpa from PETRONAS Chemical Fertilizer Sabah (SAMUR), commissioned in May 2017.
- Commissioning and start-up process of the Integrated Aroma Ingredients Complex in phases by 2017, located in Gebeng.

PETROCHEMICALS

Main Location(s): Kertih (Terengganu), Segamat (Johor), Lumut (Perak) and Gurun (Kedah)
6 gas processing plants with more than 2,000 mmscfd. 2,500 km gas transmition pipeline across Malaysia. 530 mmscfd Regastification Terminal Sg. Udang, Melaka. Cover feedgas from East Peninsular Malaysia into sales gas, ethane, propane & butane through Peninsular Gas Utilisation (PGU) network

Activity Highlights
- Air Seperation Unit (ASU) is under construction to support PIC.

GAS PROCESSING

Main Location(s): Sarawak (Bintulu)
One of the world's largest LNG production facilities at a single onshore location.

Activity Highlights
- Additional capacity of 3.6 mil mtpa from MLNG Train 9. Operationalised in May 2016.
- New capacity of 1.2 mil mtpa from PFLNG SATU. Operationalised in December 2016.

GAS LIQUEFACTIONS

H PLANT TURNAROUND

Plant Turnaround is defined as a major engineering event during which an onshore facility is shut down for equipment inspection and overhaul, debottlenecking, revamps and catalyst regeneration projects.

Turnaround comprises of main mechanical work, which constitutes the bulk of total activities (~60%). Turnaround is labour intensive, hence activity outlook is stated in man-hours.

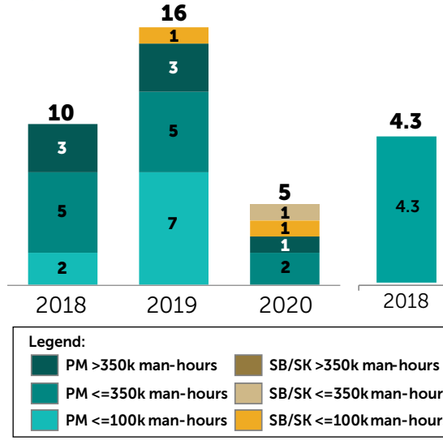
Did you know?

The average age of existing plants are between 20-30 years. They continuously undergo rejuvenation, upgrading or modification by taking opportunity of downtime window during Turnaround.

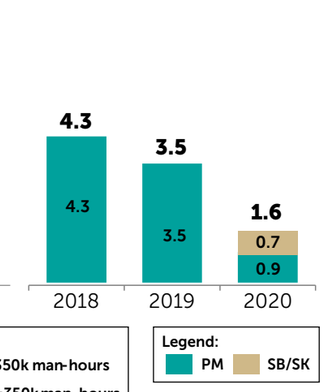
Plant Turnaround

Activity Phase: Operations
Application: : Turnarounds are scheduled periodically, important to ensure timely renewal of Certificate of Fitness (CF) by authority and maximise plant efficiency & capacity.
Associated Services: Equipment services (e.g.: mechanical, electrical, instruments, etc.), inspection services, manpower.

No of Turnaround :3-Year Outlook



No of Man-hours (Millions): 3-Year Outlook



Notes:
- Outlook includes activities driven by PETRONAS Group of Companies only, which may have been contracted out at the time of reporting.
- While Turnaround schedule is part of legislation compliance, activity deferment/ rescheduling may happen depending on operational requirements.

Medium Term Outlook – Post 2020

- Positive outlook. Market should anticipate substantial increase in Turnaround activity to cater for PIC, due to the large size of its operations.
- PIC project is scheduled to come online by 2019, and Turnaround activities will kick-start around 2022 onwards.
- Good opportunity for collaboration between industry players and foreign participation in building local capability.

FREQUENTLY ASKED QUESTION (FAQs)

1 **How does this Report benefit the OGSE industry?**
This Report will improve visibility on PETRONAS' domestic activities, hoping to allow better planning of resources and investments by vendors.

2 **Is this a one-off exercise or a regular effort?**
This is part of PETRONAS' effort to increase engagement with the OGSE industry. Moving forward, we will endeavor to provide this Report on annual basis.

3 **What is the accuracy and reliability of the outlook data? Would this be in line with what has been previously disclosed in the public?**
This data is based on projection of activities with high/low scenarios evincing the project milestones, per time of release. Changes are to be expected in response to market dynamics and operational requirements.

4 **Is this outlook referring to tender to be issued or contracts to be awarded?**
The outlook provided is based on activity per year, not by tender issuance nor contract award. Therefore, it includes activity which may have been contracted at the time of reporting.

5 **Should I make my investment decisions/business planning based on this Report?**
The intent of this outlook is to provide a general direction for the industry and sufficient for players to make their high level planning. We recommend players to also make reference to other sources of data/information to complement your decision making.

6 **What is USD50s to USD60s per barrel expectation based on? Does this figure represent PETRONAS' view on the crude price?**
Most industry analysts e.g. research houses and banks, publicly share this expectation. Companies may take a conservative approach in their assumption. PETRONAS remains prudent and will continue to adopt lower for longer approach until we are confident that the current uptrend is sustainable.

7 How will the OGSE industry be affected if oil price recovers?

If oil price recovers for a sustainable period, we expect a higher number of greenfield and brownfield projects to become commercially viable; provided that we keep the cost at a competitive level. Thus activities for OGSE services may increase accordingly.

8 WHP, CPP and Rigs infomation are primarily for larger players—are there any information targeted for smaller players?

The outlook in this Report prioritises leading indicators for a broad spectrum of activities in the Oil and Gas industry, as indicated in the list of Associated Services. This Report also provides profiles of operating assets, giving a complete spectrum of the value chain.

Contact Us

We want to hear from you. Please share your feedback/enquiries with our team via **pdtcorporateprojects@petronas.com**

Thank you for showing your interest to PETRONAS Activity Outlook 2018-2020

List of Abbreviation

Abbreviation used in the Report

	TERM	DEFINITIONS
A	AHTS	Anchor Handling Tug Supply
C	CPP	Central Processing Platform
	CRA	Corrosion Resistant Alloy
D	DCS	Distributed Control System
	DD/MWD/LWD	Directional Drilling/Measurement-While-Drilling/ Logging-While-Drilling
E	EIA	Energy Information Administration
	EOS	Economies of Scale
	EPCC	Engineering, Procurement, Construction & Commissioning
	EPCIC	Engineering, Procurement, Construction, Installation & Commissioning
	ETP	Economic Transformation Programme
F	FCB	Fast Crew Boat
	FPS	Floating Production Storage
	FPSO	Floating Production Storage and Offloading
	FSO	Floating Storage and Offloading
	FSU	Floating Storage Unit
H	HSE	Health, Safety and Environment
	HUC	Hook-Up & Commissioning
L	LTIs	Loss Time Injuries

List of Abbreviation

Abbreviation used in the Report (con't)

	TERM	DEFINITIONS
M	MCM	Maintenance, Construction & Modification (MCM)
	MTJDA	Malaysia-Thailand Joint Development Area
N	NDT	Non-destructive testing
O	O&M	Operations & Maintenance
	OCTG	Oil Country Tubular Goods
	OGSE	Oil and Gas Services and Equipment
	OPEC	Organization of the Petroleum Exporting Countries
P	PFLNG	PETRONAS Floating LNG
	PM	Peninsular Malaysia
	PSV	Platform Supply Vessel
R	RMK-11	Rancangan Malaysia Kesebelas (Eleventh Malaysia Plan)
	ROV	Remotely Operated (underwater) Vehicle
S	SB	Sabah
	SK	Sarawak
	SME	Small and Medium-sized Enterprise
	SSV	Straight Supply Vessel
	STEO	Short-Term Energy Outlook

List of Abbreviation

Abbreviation used in the Report (con't)

TERM		DEFINITIONS
T	TADR	Tender Assisted Drilling Rig
V	VMI	Vendor Managed Inventory
W	WHP	Wellhead Platform

GLOSSARY

Industry terms used in the Report

TERM		DEFINITION
B	Barrel	A standard unit of measurement for oil production. One barrel contains 159 litres of oil.
	Barrels of Oil Equivalent (boe)	A unit of measurement to quantify amount of crude oil, condensates and natural gas. Natural gas volumes are converted to barrels on the basis of energy content.
	Brent Price	The benchmark crude oil price in Europe, as traded on International Petroleum Exchange in London. Brent crude refers to a particular grade of crude oil, which is slightly heavier than WTI crude. See WTI price.
D	Deepwater	We define deepwater projects as those in depths exceeding 450ft. Unique methods are required to produce the oil and gas from ocean bed at such depths. See Floating Production Unit.
	Development	Drilling, construction and related activities following discovery that are necessary to begin production and transportation of crude oil and natural gas.
	Downstream	All segments of a value chain that add value to the crude oil and natural gas produced, for example, oil refining, gas processing, gas liquefaction, petrochemical manufacturing, marketing of petroleum and petrochemical products, storage and transportation.
E	Enhanced Oil Recovery (EOR)	Any method applied to productive reservoirs in order to increase production rates and to improve the overall recovery factor.
	Exploration	The search for crude oil and/or natural gas by geological and topographical studies, geophysical and seismic surveys, and drilling of wells.
F	Feedstock	Raw material used in manufacturing a product. As example, crude oil is a feedstock in a refining process which produces gasoline (petroleum).

GLOSSARY

Industry terms used in the Report (con't)

TERM		DEFINITION
F	Field	A geographical area overlying a hydrocarbon reservoir.
	Floating Production, Storage and Offloading (FPSO)	A converted or custom-built ship-like structure, with modular facilities to process oil and gas and for temporary storage of oil prior transfer to carriers/tankers.
	Floating, Storage and Offloading (FSO)	A converted or custom-built ship-like structure for temporary storage of the oil prior to transfer to tankers.
L	Liquefied Natural Gas (LNG)	Natural gas that is liquefied under extremely cold temperatures of about 260 degrees Fahrenheit to facilitate storage or transportation in specially designed vessels.
M	Mobile Offshore Production Unit (MOPU)	It is a self-installing and reusable production Jackup rigs.
N	Naphtha	Usually an intermediate product between gasoline and benzene, naphtha is colourless and volatile petroleum distillate used as a solvent or fuel.
P	Petrochemicals	Organic and inorganic compounds and mixtures derived from petroleum, used principally to manufacture chemicals, plastics and resins, synthetic fibres, detergents, adhesives and synthetic motor oils.
R	Refining	A purification process for natural resources which includes hydrocarbons, using distillation, cooling and/or compression.
	Regasification	Process of converting LNG temperature back to natural gas at atmospheric temperature.
	Resources	Resources are defined as the total estimated quantities of petroleum at a specific date to be contained in, or that have been produced from known accumulations of hydrocarbon.

GLOSSARY

Industry terms used in the Report (con't)

TERM		DEFINITION
S	Sour Crude/Gas	Sour crude oil is crude oil containing a high amount of the impurity sulfur. Sour gas is natural gas or any other gas containing significant amounts of hydrogen sulfide H2S.
	Steam Cracker	Steam cracker plant are facilities in which a feedstock is thermally cracked to produce lighter hydrocarbons.
T	Tight Oil	Also known as shale oil, tight oil is a type of oil found in impermeable shale and limestone rock deposits that are broken up by advanced drilling techniques such as horizontal drilling or hydraulic fracturing. The process is needed to produce oil in commercial quantities as shale has low matrix permeability.
U	Upstream	The segment of value chain pertaining to finding, developing and producing crude oil and natural gas. These include oil and gas exploration, development and production operations, also known as Exploration & Production (E&P).
W	WTI Price	Stands for West Texas Intermediate, the benchmark crude oil price in the US, measured in USD per barrel, which refers to a type of high quality light crude oil.

GLOSSARY

The following units are being used for this Report:

UNIT	DEFINITION	USED FOR
Kbd	Kilobarrels per day	**Production Rate**
MMscfd	Million standard cubic feet per day	**Production Rate**
MMstb	Million stock tank barrels	**Volume**
Bscf	Billion standard cubic feet	**Volume**
Tscf	Trillion standard cubic feet	**Volume**
sqkm	Square kilometers	**Distance**
Bce	Big cargo equivalent	**Capacity**
Mtpa	Metric Tonne per anum	**Capacity**
MMBtu	Million British Thermal unit	**Heating Value**
TBtu	Trillion British Thermal unit	**Heating Value**

GLOSSARY

List of Petroleum Arrangement Contractor (PAC) Operators

PETRONAS Carigali

Conoco Philips

Lundin Petroleum

JX Nippon

Mubadala

Ophir Energy

HESS

Kebabangan Petroleum Operating Company

TOTAL E&P

RHP Mukah

Enquest Petroleum**

Sapura Energy

Repsol

Exxon Mobil

Shell

PEXCO N.V.

Murphy Oil

Ophir Production

PCPP Operating Company

Petrofac

PTTEP

Coastal Energy**

Vestigo Petroleum**

22 PSC Operators, 4 RSC Operators
*RSC Operator
** Operates both PSC and RSC

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