

Flow



PETRONAS



SHARED RESPONSIBILITY

Building Quality Entrepreneurs

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in the Race to
Renewables**

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Issue 3, 2018



Our Winning Formula Goes Beyond Our Fluids

PETRONAS' petrochemical solutions address a myriad of industrial needs, including the automotive sector where our range of differentiated chemical products provide limitless possibilities. Specialty chemicals with unique properties such as excellent flowability for a car's interior and superior impact-resistant exterior are game changers that revolutionise the way cars are made.

Our specialty chemical portfolio is further strengthened with the establishment of Pengerang Integrated Complex (PIC). Ready for start up in 2019, PIC will increase our production to 14.6 million tonnes per annum, enabling us to cater to the growing Asia Pacific market and its multifaceted consumer segments.

We use the power of collaboration to create breakthrough solutions like our Fluid Technology Solutions™ that powered Mercedes-AMG PETRONAS Motorsport's five consecutive wins in World Constructors' Championship.

And we forge stronger partnerships worldwide because that is part of PETRONAS' winning formula.

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Editor's Note

To wrap up 2018, FLOW Magazine takes a look at PETRONAS' headways into the future, examining the concrete steps we are taking as we journey into an increasingly fast-paced and complex business environment. It's an environment which calls for stronger collaborations within and across industries as well as with multiple stakeholders.

In our cover story, we examine PETRONAS' Vendor Development Programme (VDP) and how this programme has helped build the local oil and gas industry. We also interviewed successful vendors who have grown from mere fledglings to strong corporations listed on the main board of Kuala Lumpur Stock Exchange (KLSE). In order to further strengthen the industry, PETRONAS recently launched VDP^x. The offspring of the initial programme sees six petroleum arrangement contractors (PACs) and 12 oil & gas service and equipment (OGSE) companies replicate PETRONAS' VDP to provide the same guidance and support. PETRONAS hopes that the Malaysian oil and

gas players can foster close collaboration and improve the pace of our growth as an industry. As John Donne once said, "No man is an island, entire of itself. Each is a piece of the continent, a part of the main." This rings true for organisations seeking to scale new heights as well.

The theme of collaboration is brought forth further into our next story as we look into the fruitful crowdsourcing initiatives carried out through our Innovation Gateway @ PETRONAS (IG@P). The article explores the many success stories that have sprung from the two components of IG@P; Technology Challenge and Technology Marketplace. The former sources solutions for challenges from technology providers worldwide and the latter, a platform for technology providers to propose new innovative technologies, both serving as a bank for fresh ideas and a resource management tool. Utilising this digital platform, PETRONAS hopes to spur innovation and facilitate collaboration among the global community.

As renewables shift from niche to mainstream, we take a timely look at PETRONAS' New Energy Unit in our third and final story. With a lean team of just seven, these pioneers in PETRONAS are charting our course in the realm of clean energy, determining the future direction we will take in order to strengthen our offerings in this exciting energy space. While clean energy is no new venture for PETRONAS as evidenced by its initiative in the solar power project – SINARAN, this story underlines what prompted us to create a unit dedicated to new energy and why now.

In getting ready to bid 2018 goodbye, we also take a look at some of the more momentous occasions we have recorded this year, as a group. From recognitions to new milestones, these events are a testament to our continuous pursuit of excellence.

It has indeed been an exhilarating year for us at PETRONAS. I would like to take this opportunity to wish you a Happy New Year and may 2019 bring forth many fruitful returns to all our readers. Do email us at flow@petronas.com if you have any feedback or queries.

Thank you and happy reading.

Editor-in-Chief
Zahariah (Liza) Abdul Rahman



END INSIDE



Shared Responsibility

Building Quality Entrepreneurs

The oil and gas sector is an important pillar of Malaysia's economy – with growing recognition of the country as a prominent OGSE hub in Asia. From below the ground, Malaysia produces some 6.4 Bscf of natural gas and nearly 665,000 barrels of oil and condensates per day. Above ground, even more precious resources are constantly being developed – the local entrepreneurs who are ready to take on a shared responsibility of building a robust Malaysian oil and gas industry.

By **Azura Hashim Kamal & Jacqueline Pereira**



It was on an oil platform that Ir Azhar Zainal Abidin was first intrigued by mechanical seals. He could not help but notice that despite its critical function in oil and gas, these devices were mostly imported from Europe.

He took the path less travelled by Malaysian companies at the time, to venture into high-value manufacturing technology. His conviction was so strong that even before approaching the Vendor Development Programme (VDP) team, he invested in costly Computer Numerical Control (CNC) machines and funded his own R&D

team. He believes that one has to prove what one says and ProEight came in with ready and tested prototypes. In time, the company building on its catalyst of innovation to produce more cost effective high quality products, changed the game by showing different ways of providing solutions to customers.

Today, ProEight fulfilled its aspirations as an expert in mechanical seals - designing, producing and refurbishment services. Through his vision, ProEight is able to contribute to making the country more self-reliant with its internationally recognised capabilities.

Ir Azhar saw what it took to be at the forefront, "If I want to compete with the giants in the industry, it cannot only be on pricing. It has to be on technology, research and development, and innovation."



Rough seas do not seem to get in the way of Nur Ashikin Awang, managing director of Nuri Cerah in paving her way into the oil and gas sector. The company that provides engineering services focusing on insulation maintenance, invests heavily on capability building. This is to ensure that it is able to continuously upgrade the quality of its products and services. Yet for a young entrepreneur and a new player, getting a foot in the door to prove her company's worth is a daunting task. She pairs two capable supervisors instead of one, a price that new players are paying to gain customers' confidence.

She swims against the tide of fierce competitions, while laying her foundations to build capabilities of young Sabahan talents to be at par with industry veterans. She hires an instructor, an expert for insulation in fabrication works to give structured trainings and mentoring to keep building the skillsets required. Her efforts are paying off today with over 30 in-house trained experts who have gone far and wide with her even beyond the shores of Borneo. Nur Ashikin is sharpening Nuri Cerah's competitive edge for the future with plans to develop a cutting-edge insulation technology.

Her voyage is far from over. Nur Ashikin says that "When a company survives working with PETRONAS Carigali and PACs in Malaysia, there are no barriers in the future to venture globally."



In a small town in Beaufort, southwest of Sabah, three brothers were venturing on a great dream. They wanted to run their own oil and gas engineering service company. After being a part of the VDP programme for a year, managing director Muhammad Rafiuddin Gulistan found their company Unsur Hebat being steered towards becoming a specialist provider.

With astute advice and monitoring, the company's capability grew in tandem with each project it undertook – adding to its portfolio its own premises, yard and transport facilities. Yet some things are in-built even before VDP comes into the picture: technical readiness, healthy financial performance and deep rooted values of integrity and professionalism to keep earning customers' confidence. He has clinched his company's accreditation with The American Petroleum Institute (API). He is reaping benefits with ventures in Thailand and Myanmar, and orders from Saudi Arabia.

To Muhammad Rafiuddin, it's a privilege to be part of the programme and it must be accorded due respect. "Attitude is as important as capability. I appreciate that and work with it."



According to Datin Faizah
“Trust is extremely valuable for businesses. I do not take trust for granted. I invest my time and energy to continuously build trust with both my customers and staff.”

FM Plastic Industries, a family-run business became a VDP vendor to produce and supply Form Filled Sealed Bags. Yet the company was facing financial and operational difficulties. The factory was struggling to recover from the floods that hit Terengganu a few years back, customers weren't pleased with the product quality, and when 3 lorries of the bags were rejected due to unsatisfactory quality, Datin Nor Faizah Aripshah knew she needed to take charge to rebuild the company, fast. She rose to the occasion as its new General Manager and made drastic changes on cost, culture and quality. She hired the right technical expertise to advise her on optimising the production line. Technical standards were mapped and matched with the customers' to a tee.

She engaged with staff, including them in cost saving ideas and being with them to decide on the expected quality together. Throughout the turnaround time, she spent months living in the factory itself so that she was always accessible to the team. A culture of shared accountability and success was instilled in everybody. In only a year's time, she managed to turn around the company from a rating of C to A, reduced wastage from 20% to 3%, and for the first time beginning in 2016, FM Plastic Industries started making profits. The company is now known as DD Plastic with Datin Faizah at the helm.



Despite challenges, Datuk Dr Richard is ever optimistic, “We need to work together to demonstrate that local capabilities can do it – with patience, mutual understanding and collaboration, nothing is impossible.”

Dato' Dr Richard Wil Anak Uban is no stranger to the Sarawak waters. An oil man at heart, he started Kinsajasa in 1999 with a group of friends who shared his vision of being actively involved in the local oil and gas scene. They were one of the pioneers who had

a total of 58 years' experience in offshore engineering maintenance with Sarawak Shell Berhad. Kinsajasa's staff-strength grew from only 10 to over 60 today, with strong credentials, mainly in rotating and vibration equipment.

Even with a solid foundation, the company was still exposed to an array of risks and subjected to the mercy of bigger players. This is when Dato' Dr Richard made another bold step in year 2012

to embark on a new area of specialisation of Condition Based Monitoring through VDP. The VDP team was like a partner in this new path that Kinsajasa was taking. Before long, Dato' Dr Richard established a training programme to build local capabilities on predictive maintenance. Kinsajasa stood the test of time by constantly reinventing itself to keep up with the evolving demands.

PETRONAS' Deliberate Move to Empower Local Entrepreneurs to Seize Opportunities and be Part of Nation Building

The success stories might seem to allude to the Vendor Development Programme (VDP) as the common denominator. However, there is something even more powerful at play and Norliza Nawi, PETRONAS' Head of Corporate Projects and Licensing & Local Capability Department (LLCD), Project Delivery and Technology breaks it down for us:

"It is the immense passion they possess that makes VDP work"

"Every year," she marvels "Azhar strives to innovate, repeatedly generating new technology or products and his company has already clinched 10 awards for them. If you talk to him, you can hear the energy."

The Malaysian oil and gas sector made a triumphant comeback after the oil price freefall and gaining its momentum against improved outlook and prospects of recent months. This is a sign of an agile ecosystem that wasn't built overnight but rather through some decades of purposeful and well defined collective efforts by diverse parties to promote the country's OGSE's capabilities.

VDP for one began as early as 1993 and has since bred 99 vendors with operations across some 30 countries. "VDP is the cornerstone in developing the Malaysian O&G vendors, who were then generally agents" Norliza explains. "We needed to build capabilities and began to push agents to become business owner-operators, manufacturers and service providers. Initially, the focus was on import substitution products such as steel gratings, but over the years VDP has grown exponentially in scope and complexity."

High achieving local companies are given the right environment, that spurs them to build capabilities, generate value, multiply acumen and develop sustainably. VDP provides aspiring entrepreneurs with rigorous guidance for developing expertise, testing new technologies and investigating in innovations.

"Women entrepreneurs like Nor Ashikin and Datin Faizah are examples of those who are breaking the glass ceiling, having managed to build and turn around companies in an industry dominated by men."

The relentless spirit of entrepreneurship is the key criterion of VDP. Norliza says, "Vendors must be visionaries. It is always about the person, their entrepreneurial spirit. That's why their companies never fail and, if they do, they fail fast and bounce back stronger" Vigilant ones are looking to expand their wings to explore opportunities outside the Malaysian shores. This will in turn help to enrich the industry's growth in the region. The possibilities are endless – either through direct participation with local subsidiaries or establishing joint ventures.

For PETRONAS' ventures to remain viable, vendors must remain competitive within a strong, supportive ecosystem. VDP provides the competitive advantage that is much needed. Norliza says, "It is about practising meritocracy and nurturing vendors to be competitive within the distraction-free incubation period."

The vendor's scope of work is also critical. To survive and thrive after the programme, the work scope must be sustainable and not be in direct competition with monopolies. Vendors must also be willing to diversify their products and clients without being heavily reliant on PETRONAS. They must explore other industries while VDP's special teams monitor, validate and audit each vendor's progress. During the incubation period, companies experience the real environment, but they must be discerning enough to survive on their own after graduating from the programme.

She adds, "Our aim is to develop entrepreneurs, the builders of companies."



Serba Dinamik is a company as old as VDP itself. Steered by one man's vision, they have risen so much from their humble beginnings, providing MRO services for rotating equipment for ASEAN Bintulu Fertilizer Plant in Bintulu, Sarawak. Today, Serba Dinamik is listed on Bursa Malaysia with over 60 per cent of its revenue stream from its overseas businesses in the US, Africa and Middle East.

"Serba Dinamik is in Forbes Asia's list of Best 200 Under A Billion. In my observation, its founder Dr Ir Abdul Karim Abdullah's vision for future growth is always grounded in retrospection and self-reflection. That's how the company can achieve so much while investing time in helping others. As an immensely successful entrepreneur, he keeps his passion not only to develop himself but others around him."



"Rudy Lawrence is a young entrepreneur from Sabah. In his 30's, his company, Firm Synergy is already standing with a niche expertise in oil and gas. They are the "doctors" of maintenance, dealing with conditioned-based monitoring (CBM) services for PETRONAS and its petroleum arrangement contractors (PACs) in Sabah and Labuan." Pn Liza recalls.

Under the VDP, Firm Synergy got the rating A in their first year and has kept on the momentum ever since.

Numbers to Note

25 years

PETRONAS Vendor Development Programme (VDP)

85%

Vendor Success Rate

99 vendors developed

4

Public-Listed Vendors

RM 8.5b

Worth of Contracts Awarded

The Next Chapter



Generally PETRONAS appoints about 3 to 4 new VDP vendors per year. In July 2018, to commemorate the silver anniversary of VDP, the next generation of VDP called VDPx was conceived. The "x" denotes the intent to further accelerate and amplify VDP's success. Core reforms were implemented from the lessons learnt over the years. Unlike VDP that was a PETRONAS exclusive, VDPx involves other major industry players – for a start, six petroleum arrangement contractors (PACs) and 12 major O&G service and equipment (OGSE) companies appointed to be the programme's anchors.

Collaboration was also intensified amongst industry enablers to create a more inclusive and sustainable ecosystem. There are seven agencies appointed as enablers to provide assistance for business development, financial management, technical and ICT, not just for VDP vendors but all OGSE vendors.

The low oil price in recent years posed a challenge to companies especially those who are just starting up, to get access to financing.

"To ease the access to financing arrangements for example, we have engaged with almost all banks in Malaysia. For Phase 1, Bank Islam Malaysia Berhad (BIMB) collaborated with PETRONAS to provide financing to companies with direct contracts by PETRONAS."

VDP has grown under the custodianship of the Ministry of International Trade and Industry (MITI) and today, it is to be further developed under the stewardship of the Minister of Entrepreneur Development, Yang Berhormat Datuk Seri Mohd Redzuan Yusof.

"Our goal is to encourage VDP vendors to diversify. Soon, VDP will evolve to emphasise innovation and technology ownership that is aligned to PETRONAS'

technology agenda and future direction," enthused Norliza.

"With speed comes innovation and technology," Ir Azhar said recalling the time his company pushed the envelope by supplying mechanical seal in 24 hours to compete with Original Equipment Manufacturers (OEMs) which took 12 weeks.

Whilst innovation and technology may seem like major components to vendors' success stories, the key basic ingredients for their recipe of success are hard work, dedication and the value for time.

Serba Dinamik's CEO Mohd Abdul Karim once said, "Time is precious and should not be wasted, especially when you are running a business".



Learn more about VDP!



Vendor Development Programme (VDP)

Stay updated on the latest development in Malaysia's oil and gas industry



PETRONAS Activity Outlook 2019-2021



Malaysia Tax Incentives Compilation and Guide for Oil and Gas Services and Equipment (OGSE) Sector

21 Currently in the Vendor Development Programme



Mohd Azizi Bin Hamzah

Petroclamp Sdn Bhd
Protector (All Cast Steel)
for Control
Lines and Cables
for PETRONAS and PACs



Nik Mustapha Bin Fathil

Omni Oil Technologies
(M) Sdn Bhd
Centralizers (Carbon
Steel Solid and
Bow Spring Type)
for PETRONAS



Abdillah Bin Yassin

North Java Sea Group (M)
Sdn Bhd
Rope Based Equipment
(Emergency
Escape Rope Ladder,
Knotted/Swing Rope and
Personnel Transfer Basket)
for PETRONAS and PACs



Datin Nur Faizah Binti Aripshah

DD Plastik Sdn Bhd
Form-Fill Seal (FFS) Bag
for PETRONAS



Enturan Luta

Jayvestar Sdn Bhd
Heat Ventilation &
Air-Conditioning (HVAC)
Maintenance Services
(Upstream & Downstream)
for PETRONAS
Sarawak



Peter Dingun

Mamanis Sdn Bhd
Heat Ventilation &
Air-Conditioning (HVAC)
Maintenance Services
(Upstream & Downstream)
for PETRONAS
Sarawak



Datuk Abdul Talib Bin Bachek

Elite Ventures Sdn Bhd
Scaffolding Services
for PETRONAS
Peninsular Malaysia



Mohd Safian Bin Saludin

Begas Energy Sdn Bhd
Heat Ventilation &
Air-Conditioning (HVAC)
Maintenance Services
(Upstream & Downstream)
for PETRONAS
Sabah and Labuan



Hj Sahih Bin Ibrahim

Masray Plastik Sdn Bhd
Form-Fill Seal (FFS) Bag
for PETRONAS



Zulkarnain Bin Jamri

MVE Technologies
Sdn Bhd
Choke Valves for
PETRONAS Carigali



Dato' Aziz Bin Ayob

Dimension Bid (M)
Sdn Bhd
Coiled Tubing Unit
Services for
PETRONAS Carigali
Peninsular Malaysia



Dato' Nasri Bin Nasrun

Setegap Ventures
Petroleum Sdn Bhd
Coiled Tubing Unit
Services for
PETRONAS Carigali
East Malaysia



Muhammad Rafiuddin Bin Gulistan

Unsur Hebat Sdn Bhd
Heat Ventilation &
Air-Conditioning (HVAC)
Maintenance Services
(Upstream & Downstream)
for PETRONAS
Sabah and Labuan



Tn Haji Abu Bakar Bin Manap

Burnmark Industries
Sdn Bhd
New Empty Steel Frum
for PETRONAS



Nur Ashikin Binti Awang

Nuri Cerah Sdn Bhd
Insulation Services
for PETRONAS and PACs
Sabah and Labuan



Wahiruddin Bin Abdul Wahid

Protection Rigging
Access Services
Sdn Bhd
Scaffolding Services
for PETRONAS
Peninsular Malaysia



Dato' Mohamed Nor Bin Abu Bakar

Hi-Essence Cable
Sdn Bhd
Electric Wire and Cable
for Low Voltage Types
for PETRONAS and PACs



Rudy Lawrence Sipayang

Firm Synergy Sdn Bhd
Condition Based
Monitoring Services For
PETRONAS and PACs
Sabah & Labuan



Mohamad Fahiz Izzat Bin Abdullah

Winner Inspection
Sdn Bhd
Non-Destructive Testing
(NDT) Services for
PETRONAS and PACs
Sabah and Labuan



Dato' Engak @ Richard Wil Anak Uban

Kinsajasa Sdn Bhd
Condition Based
Monitoring Services
for PETRONAS and PACs
Sarawak



Mohd Hafidz Bin Mohd Ismail

Dermaga Oil & Gas
Sdn Bhd
Differential Pressure (DP)
Flow Meter &
Associated Control System
for PETRONAS and PACs

New Impetus in the Race to Renewables

PETRONAS sets sail on its clean energy journey with the recently established New Energy unit.

An avid kite surfer, Jay Mariyappan loves the exhilaration that the sport offers. It's a feeling he can identify with in his day job, too. As PETRONAS' New Energy Head, he is about to surf over one of the biggest waves in today's energy space – renewables – and he is relishing the prospect.

"This is a really unique opportunity. In the next 10 to 20 years, we'll be seeing a big transformation in the energy sector. The business that we are entering is significantly different from oil and gas, so the modus operandi will have to change. There's a start-up feel, and we're going to have to be very lean and agile," he says.

The move into renewables and new energy is seen as crucial to securing PETRONAS' business sustainability, and is part of its Step Out strategy that includes specialty chemicals.

Currently incubated within Corporate Strategy, the New Energy unit was set up in April 2018 and is expected to be fully operational in the first quarter of 2019. Including Jay, who joined the team in October, it is a seven-member team made up largely of internal staffers, and will be supplemented with experienced industry personnel.



Jay and his New Energy team.

Though he is a newbie to PETRONAS, Jay has some two decades' experience in clean energy under his belt.

Prior to joining PETRONAS, Jay was with Sindicatum Renewable Energy Company Pte Ltd, a Singapore-based firm that develops, owns and operates clean energy projects in South and Southeast Asia. There, he was the managing director responsible for delivery, sales and trading of environmental products in Asia, and delivery and business development in Southeast Asia.

He has also earned energy sector credentials with stints at a major power company in the utility planning department, and at an engineering

consultancy where he advised a number of energy companies and financial institutions in power sector planning, investments and emissions trading.

He was also seconded part-time to the UK government for 18 months, advising on the emissions markets, policy and projects.

With such an impressive resume, it is no surprise that PETRONAS came calling. Ikmal Hisham Maharon, who joined the New Energy unit in August, explains why it was important to recruit someone externally to lead the team.

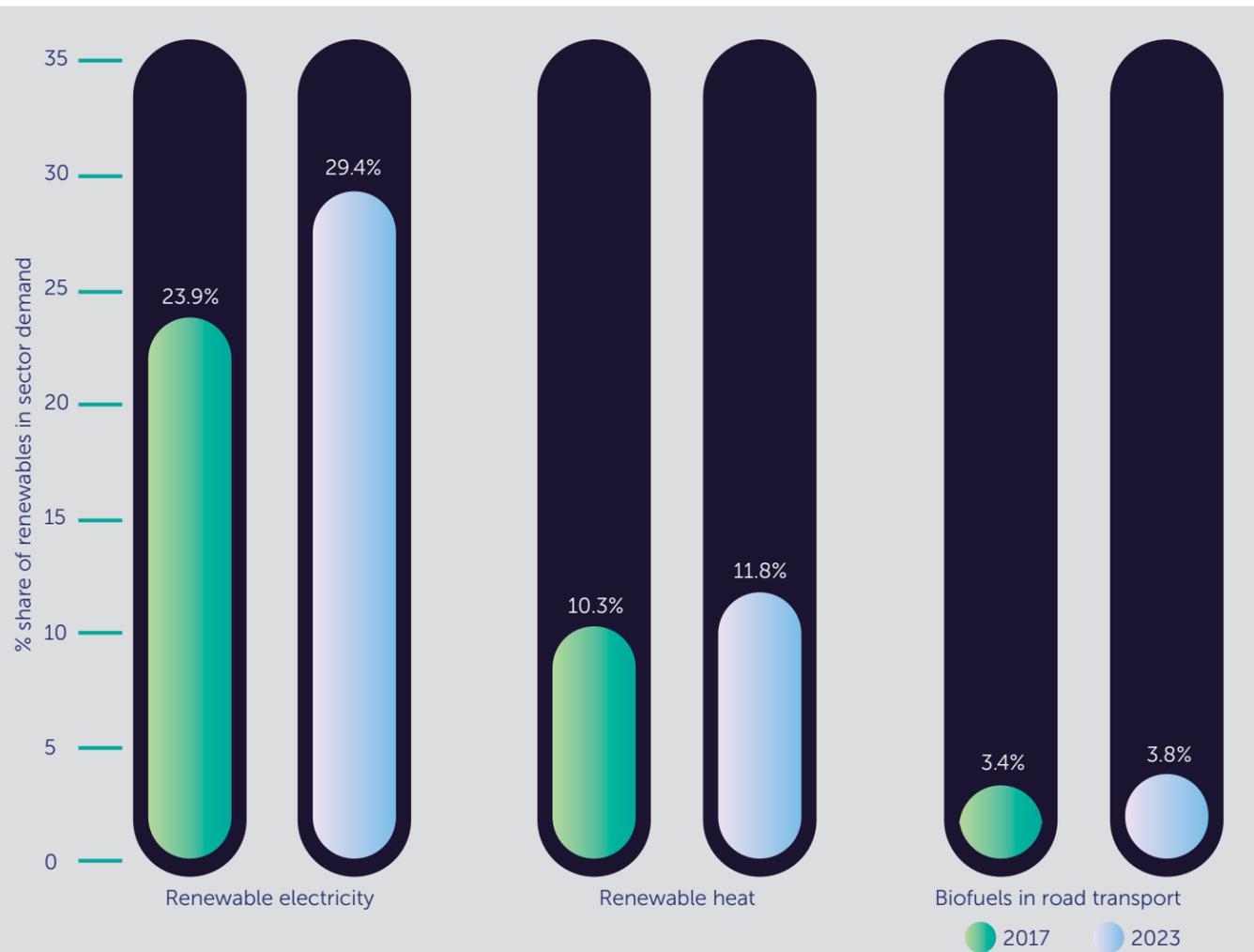
"If we didn't do that, we would be operating out of the same mould, very

much that of oil and gas. But here, we are going into a very different kind of business and even though it is still energy, the way we work and do things in this business is very different from oil and gas," he says.

Aware of the expectations, Jay is nonetheless taking it in his stride. "There is a lot of expectations and I do feel them, but that's in a positive way because, right from the top, everyone wants this to be a success... so yeah, it's good pressure," he says.

The team, too, is reveling the chance to forge its way in this new business segment. "We're getting ourselves plugged into the network, from industry players' research, analysis and the venture capital side."

By **Sreerema Banoo**



Source : Renewables 2018
 In the *Renewables 2018* forecasts, the share of renewables in meeting global energy demand is expected to grow by one-fifth in the next five years to reach 12.4% in 2023.

From niche to mainstream

So why clean energy? And why now? Ikmal points to a Group Positioning Study in 2017 that identified, among others, clean energy as a new business for PETRONAS.

“Technology changes and disruptors come in and if we don’t change, then many of our businesses will be disrupted. So there is a need for us to have a revenue stream decoupled from oil and gas.”

“What we want to do is grow new energy and make it a substantial business so that it can help the company weather the changes in the oil and gas industry,” adds Jay, not discounting that in the future, new energy may well be one of PETRONAS’ core revenue earners alongside the upstream and downstream businesses.

Although the move into renewables seems evolutionary for oil and gas players, especially if you want to brand yourself as an energy company, there have not been many success stories, even among the oil majors.

“Oil and gas companies have been in and out of renewables for a long time, even from back in the 1970s and again in the 1990s. But as soon as a financial crisis hits, these companies start looking at maximising cash flows and cutting a lot of non-core businesses, including renewables,” says Jay, adding this is one pitfall to avoid.

He also feels that given the stop-start stance of oil and gas companies in renewables, PETRONAS isn’t a late entrant. More to the point, the timing, he reckons, is right on the money.

Levelised Cost of Energy Comparison - Unsubsidised Analysis

Certain Alternative Energy generation technologies are cost-competitive with conventional generation technologies under certain circumstances

Category	Technology	2017 LCOE (\$/MWh)	2023 LCOE (\$/MWh)
Alternative Energy	Solar PV - Rooftop Residential	\$160	\$260
	Solar PV - Rooftop C & I	\$81	\$170
	Solar PV - Community	\$73	\$145
	Solar PV - Crystalline Utility Scale	\$40	\$46
	Solar PV - Thin Film Utility Scale	\$36	\$44
	Solar Thermal Tower with Storage	\$98	\$181
	Fuel Cell	\$103	\$152
Conventional	Geothermal	\$71	\$111
	Wind	\$29	\$56
	Gas Peaking	\$152	\$206
	Nuclear ⁽⁴⁾	\$36 ⁽⁵⁾	\$112
	Coal ⁽³⁾	\$36 ⁽⁵⁾	\$60
Gas Combined Cycle	\$41	\$74	

Levelised Cost (\$/MWh) \$0 \$50 \$100 \$150 \$200 \$250 \$300 \$350
 Note: Levelised Cost of Energy (LCOE) is the Net Present Value of energy over the lifetime of the generating asset.

“Renewable energy today has got the level of maturity, where it’s moved from niche to mainstream. And if you look at renewables in power generation, it’s seeing the fastest capacity growth rates of any generation types,” he says.

A recent report from the International Renewable Energy Agency (IRENA) confirms this. It found that after years of steady cost decline for solar and wind technologies, renewable power is becoming an increasingly competitive way to meet new generation needs.

It is also predicted that electricity from renewables will soon be consistently cheaper than most fossil fuels, and in some countries are already cheaper than coal power.

A latest report from Lazard compares the Levelised Cost of Energy (LCOE) of different power generation technology and shows that wind and solar are already below or within the range of coal and gas.

The vehicles and transport sectors are also undergoing transition. “These are likely to see major transformation and technology evolution including the use of new types of clean fuels.”

The push factors for renewables and clean energy are just as apparent. Climate change concerns coupled with air quality issues are increasingly part of the everyday conversation.

“When we talk about what consumers want these days, they include high levels

of service but also they want energy that’s cleaner, especially with some companies pledging to go 100 per cent renewable.”

“In the past, people didn’t think about where energy came from or how much they consumed but now, with smart metering and labelling or certificates, you know what’s your carbon footprint and so people are looking at how they can use resources more efficiently and contribute to a better environment. Additionally, with the Internet of Things (IoT) the lines between someone who consumes energy and someone who is producing energy becomes blurred, leading to what may be a very different energy market place than we have seen before,” he says.

The Malaysian government also has aggressive climate-change targets – 20 per cent of the country’s electricity to be generated by renewable sources by 2025, from two per cent currently – where it will need all key players in the country to play a role in meeting that target.

“And having PETRONAS on board is key to that,” he says.

Although fossil fuels are getting a bad rap, Jay however, stresses the importance of natural gas, especially as a complementing fuel. “It has an important role in the whole transformation of the energy sector because it’s the most flexible, and in electricity generation it will help with the intermittencies of renewables.”

“Renewable energy today has got the level of maturity, where it’s moved from niche to mainstream. And if you look at renewables in power generation, it’s seeing the fastest capacity growth rates of any generation types,” he says.





Jay Mariyappan

Capturing long-term value

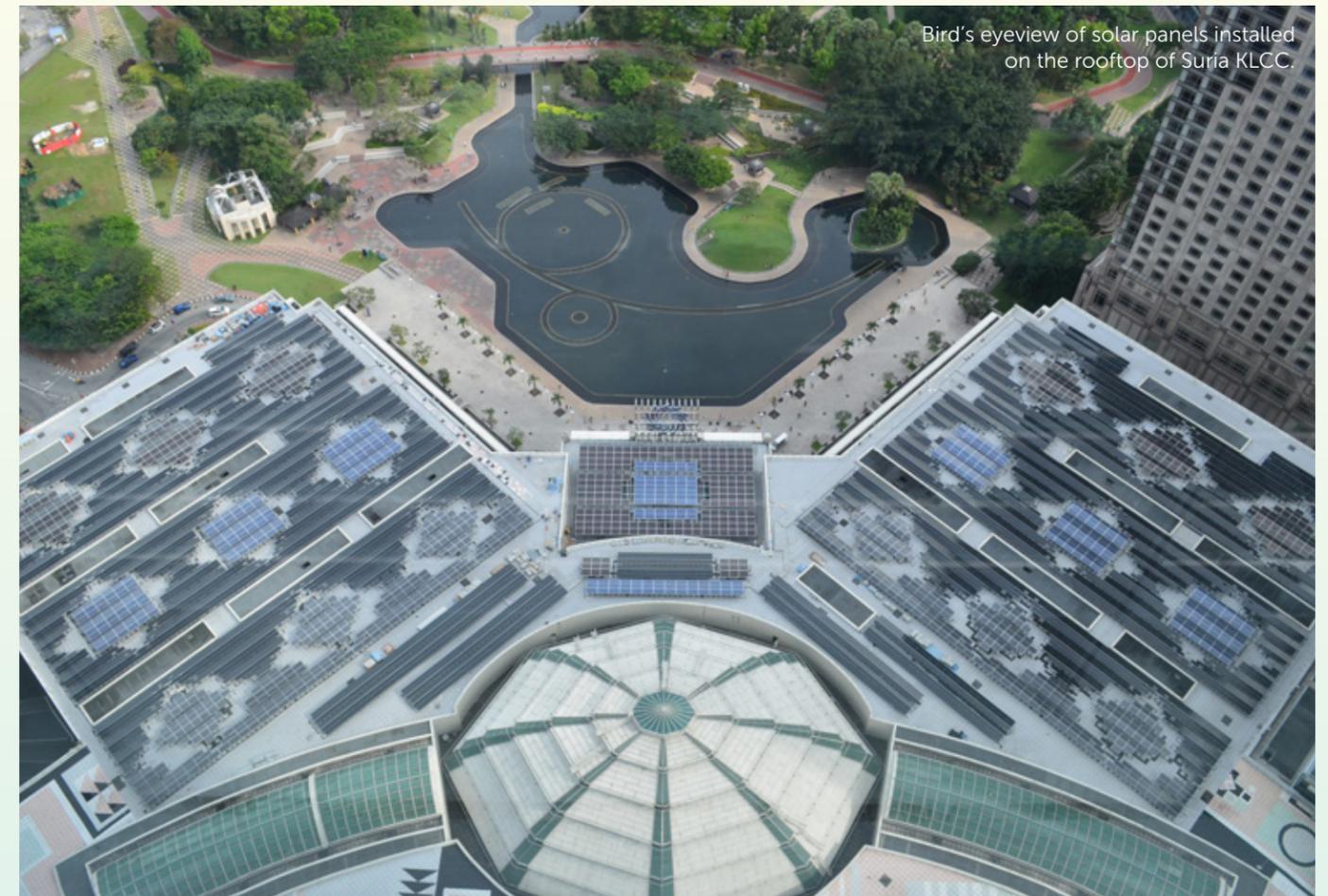
So what does the New Energy unit have up its sleeve? Jay is tight-lipped, only disclosing that wind and solar look promising.

"We're still working on the strategy. It's going to be a dynamic one. It's not really a question of how large the capital invested, but more of a question of what's an attractive business case that will enable us to capture long-term value," he says, adding that the goal is to be fully self-sufficient within a few years.

"There is still a lot of work that needs to be done to make this goal a reality," he admits.

"We want to develop a sizeable business and that would mean working with a few companies and partners as well as building the capability within PETRONAS to be able to develop and execute new energy projects."

"The key for us is to leverage on what we're already good at so that we can have that edge, including being able to provide a broad range of clean energy solution."



Bird's eyeview of solar panels installed on the rooftop of Suria KLCC.



These solutions, he adds, will be "technology neutral".

"We could be looking at any technology that has a good business case and is proven... in the shorter term, we are looking at commercial technologies. We ask: Are they commercial today? Are they proven and cost-effective today? We are aware that there is a lot of technology development going on and markets and regulations are also changing, so there will be opportunities in the future that are not here today."

"When we look at technology, we're also looking at making a link to the future in order to grow the business. So that means working with other parts of PETRONAS, especially the research and development side under Project Delivery

& Technology (PD&T) division to see how we can bring in the new energy angle into what they are doing or to develop our own technologies and know-how."

Ikmal also doesn't discount the possibility of partnering with other new energy players. "In our discussions with local developers and energy vendors, who have been around for some time, they are excited that PETRONAS is coming in."

Jay is optimistic about the future. "In Malaysia, what we are seeing now is excitement in the clean-energy space. The focus now is to build up assets and capabilities for the next five to 10 years, and if we can do that, then it will form a good base for future growth."

The sky, as they say, really is the limit.

Although fossil fuels are getting a bad rap, Jay however, stresses the importance of natural gas, especially as a complementing fuel. "It has an important role in the whole transformation of the energy sector because it's the most flexible, and in electricity generation it will help with the intermittencies of renewables."

Charting the Low-Carbon Journey of PETRONAS

The pursuit of renewables or clean energy is viewed with a different lens over at PETRONAS' Climate Change unit. While the team at the recently established New Energy unit has its sights trained on renewables from a business and business sustainability standpoint, over at the Climate Change unit, renewable energy is one of the routes in PETRONAS' low-carbon journey.

And the man to talk to about that journey is Thirupathi Rao, who heads the Climate Change unit.

"We look at energy efficiency improvement, hydrocarbon flaring and venting reduction, carbon capture utilisation and storage (CCUS), renewables, carbon pricing and carbon offset, to name a few. We also look at adapting our operations to build resilience against potential consequences of climate change," he says.

The electrical engineer, who has been with PETRONAS since 2011, leads a team responsible for bringing all the climate-related data to the corporate level – facilitating risk assessments that aid in the delivery of the organisation's climate-change strategies.

The climate-change journey at PETRONAS has been evolutionary.

"We first built our capability, tools and standards to inventorise GHG emissions, following which, we focused on operational excellence initiatives to help in reducing GHG emissions," he says. Then in 2012, we came up with a carbon commitment. Instead of focusing on just accounting emissions, we started to have an internal target to reduce GHG emissions," he says, disclosing success stories between 2012 and 2017 in annual PETRONAS Sustainability Reports, the internal goal of shaving eight million tonnes of carbon dioxide equivalent (CO₂e) was achieved.

Having ticked that box, as a responsible company, PETRONAS is now in the midst of setting the next set of targets,

leading up to 2030, aligned with Paris Agreement and the United Nations' Sustainable Development Goals (SDG). One of the SDG is climate action, and it is governed and operationalised under the UN Framework Convention on Climate Change (UNFCCC) negotiations, in particular, the Paris Agreement in 2015.

The agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 °Celsius and to pursue efforts to limit the temperature rise even lower to 1.5 °Celsius.

"Since we are operating internationally, we need to see which countries have ambitious reduction targets and if they are going to introduce laws on mandatory reporting or carbon pricing. We need to keep our radar open every year to screen for changes resulting from the annual global climate-change negotiations.

"We highlight emerging legislation in relation to climate change, and work closely with Group Risk Management and Group Corporate Strategy as well as the Business Risk fraternity to manage potential exposure arising from carbon liability.

"We partner with Group Research and Technology to ensure that the right technologies are developed at the right time," he adds.

"By early next year, we'll have a digital GHG dashboard internally so that our people can view the carbon footprint of each operating unit and business – allowing management to track and make the necessary early interventions."

The low-carbon journey of the organisation is building momentum, says Thirupathi, pointing out that new plants or facilities built after 2013 will need to comply with the PETRONAS Carbon Commitment to ensure business sustainability.



Thirupathi Rao

Going SOLAR

In 2012, PETRONAS embarked on a solar-power project, which saw the commissioning of a 685-kilowatt solar photovoltaic system on the rooftop of Suria KLCC.

The system is reported to be able to supply 30 per cent of the mall's energy needs or power 250 typical Malaysian households for a month, and saves emission of 360 tonnes of CO₂e annually.

On the heels of the Suria KLCC project was the development of a 10MW solar plant in Gebeng, Pahang. Both projects were developed under the feed-in-tariff (FiT) scheme. Through the FiT scheme, companies and homeowners can sell

energy generated to the national grid at a fixed rate for 21 years.

More recently, there has also been a push to look at the feasibility of installing solar panels at PETRONAS assets, says Thirupathi. This project is called SINARAN (Solar INstallation and Application on PETRONAS Rooftops & Assets Nationwide).

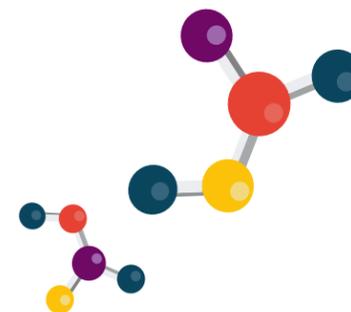
"We surveyed all our facilities, including training centres, buildings, depots and petrol stations and we found it's possible to install 30 MW peak of Solar PV on the rooftops of our facilities, as a start," he says, adding that this will increase our Solar PV capacity by three times resulting in the reduction of electricity bill as well as GHG emissions.



Crowdsourcing & Collaboration

The Way Forward

By **BRIGITTE ROZARIO**



W

aste management has been a perennial concern for PETRONAS when it comes to crude oil processing. For years, PETRONAS has had to deal with thousands of oily sludge drums, a waste product that is the result of crude oil processing. In order to comply with environmental regulations, the current practice is to send the sludge for incineration.

Believing that a solution existed to recover hydrocarbon from the sludge and reduce the waste, PETRONAS presented the topic as PETRONAS Technology Challenge 3 to source for innovative solutions from all over the world.

In just six months, an answer was found. Cheras-based Malaysian company TiME MARINE Services beat 27 submissions from 19 countries to win the challenge.

"TiME's solution offered effective sludge treatment using nanotechnology to convert the sludge as recovered hydrocarbon for revenue generation, reduce the downtime for tank cleaning, and minimise the actual waste for disposal," enthuses Fadhlan Nik Abdul Aziz, PETRONAS' Head of Innovation Management.

Technology crowdsourcing is trending with big players who are picking the brains of technology providers to strengthen their core business and explore the future. The foundation for this is collaboration, with both parties engaged in a mutually beneficial arrangement to deploy edge, innovative solutions that can be kept as competitive edge or commercialised while complying with the needs and best practices of users, typically multinationals such as PETRONAS.



Fadhlan Nik Abdul Aziz.

"For the past 20 years, we paid a few companies to take away the sludge and dispose of it. Now, we can recover the hydrocarbon, refine it and sell it. We were left with just water, sand, and small sediments to dispose. The solution saw a sharp reduction in waste, from about 15,000 drums per crude oil tank to a few hundred drums."

Encouraged with the outcomes of the first three challenges, PETRONAS threw open three more challenges that are still ongoing. They are Technology Challenge 4: Effective Field Inspection Tool to Detect and Assess Corrosion Under

Insulation (CUI) for Piping Systems and Components; Technology Challenge 5: Total Technology Solution For Prediction, Removal, and Prevention of Chloride-Induced Corrosion; and Technology Challenge 6: Autonomous Drone Capable of Performing Ultrasonic Thickness (UT) Measurement at Height.

The Technology Challenge is part of the Innovation Gateway @ PETRONAS (IG@P) launched in July 2017. It is a crowdsourcing initiative that addresses issues faced by the Group today. In addition to Technology Challenges,



IG@P also has a Technology Marketplace where technology providers can propose new value-adding technologies.

Chosen technologies from both initiatives are adapted to suit the needs of PETRONAS. Customised solutions are registered on an online technology catalogue made accessible across the Group. The comprehensive catalogue helps avoid redundancy, time and cost for assets looking for solutions to their challenges. By referring to the technology catalogue, they are likely to find a match. No more time-consuming and costly technology searches and assessments, unless the issue at hand is unique, individualistic or still awaiting a technology breakthrough.

A trend among multinationals

At the heart of it is collaboration between big players and external parties to develop solutions. The goal of crowdsourcing varies from addressing issues of today to seizing opportunities for tomorrow in crowded, competitive and disruptive marketplaces. In the oil and gas industry, crowdsourcing has become a way to innovate and stay ahead.

PETRONAS is not the first oil and gas multinational with a crowdsourcing programme. Shell has its GameChanger programme that focuses on renewables, while Equinor (formerly Statoil) has its Innovate programme (see box). In other industries, General Electric,



Netflix, and Siemens have been crowdsourcing for ideas for some time now.

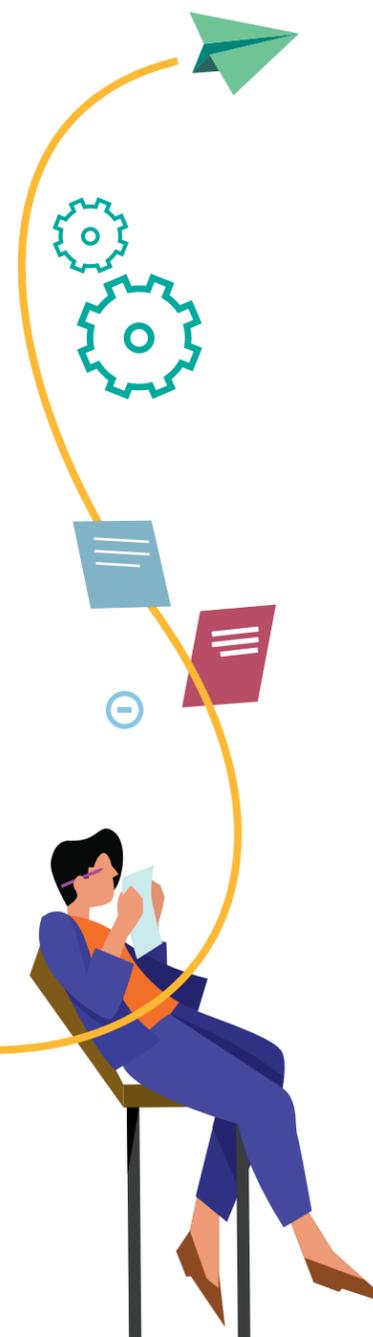
PETRONAS entered the crowdsourcing arena to stay ahead in the age of technology and disruption. Understanding that it must innovate quickly and the best way to do so is through collaboration. PETRONAS responded, and launched IG@P as its crowdsourcing platform. Comprising two components - Technology Challenge and Technology Marketplace, IG@P serves as a bank of fresh ideas and innovative solutions. It will also serve as the digital platform for technology providers to approach PETRONAS.

PETRONAS Head of Technology Management & Commercialisation, Pauziyah Abdul Hamid, believes that collaboration through crowdsourcing allows the company to move forward at a greater pace.

"If you want to go at it alone, it takes time. For example, in 'Facilities

of the Future', one of the clusters identified in the PETRONAS Technology Agenda, we want to use drones for transportation at offshore platforms. Instead of building drones from scratch ourselves, it's better to get them from the market and then improvise to suit our needs," she says."

Fadhlan explains, "When a vendor approaches a regional asset, the technical specialists there will assess the solution, and if found suitable, deploy it. The solution remains localised and unknown to the rest of the group. Then, there are pockets existing in different parts of PETRONAS, with different expectations and views to a solution. Our people in Gurun might say the solution is fantastic; Kertih might question it; Pengerang might disagree with it; Sabah might say it is good but don't know how to apply it; while KL might be clueless of the new technology!"



IG@P centralises solutions developed with external parties. Assessments are conducted by a dedicated team that is entrusted with the assessment and approval of technological solutions and provide feedback on possible modifications to ensure that the solutions meet PETRONAS' standards and are suited to our environment. Once approved, the solution is uploaded onto the online technology catalogue that is accessible to all PETRONAS staff across different geographies. At the end of the day, we will have a seamless platform for the sharing technological knowledge and solutions within the group."

Opening up exciting new doors

Technology crowdsourcing is opening up exciting new doors. For PETRONAS, the focus now is to tap into expertise in areas such as artificial intelligence (AI), machine learning, robotics, and automation. Collaboration between user and provider is becoming a fundamental, with both parties pursuing technologies that give each other a leg up and elevate their stature in their respective industries.

"Crowdsourcing is about knowledge-sharing. The technology provider can have a robot with impressive capabilities, but how applicable are these to oil and gas industry? For example, if the robot can help clean our vessels or inspect

our equipment, then we can work with the technology provider. For PETRONAS, collaboration is key," says Fadhlan, who is confident PETRONAS will work with more small companies and startups across industry in the near future.

For PETRONAS, collaboration is critical to achieve its Technology Agenda that covers:

- **Future Positioning** - Differentiated growth outside of current Upstream and Downstream business.
- **Competitive Edge** - Growth within current business areas that provide high impact competitive advantage.
- **Operational Excellence** - Improved performance and efficiency within current business areas.

Aligned to this overarching agenda, IG@P focuses on the following:

- Companies looking for technology investment
- R&D opportunities
- Technology solutions ready for deployment into the field

"Investing in R&D for Operational Excellence (OE) tends to be costly and time-consuming. Moreover, by the time a solution is developed in-house, the problem can grow into something bigger. It makes more sense to work with technology providers who already have the relevant technologies at hand, and customise them for PETRONAS," says Fadhlan.

What is IG@P?



- **Digital Platform** for PETRONAS Open Innovation
- **Created to Facilitate Collaboration** between the Global Community and Technology Providers
- **Aimed to Accelerate Pace** in Deploying Innovative Technology Solutions

“Some solutions from technology providers require additional R&D investments. If they are aligned with the PETRONAS Technology Agenda, we will take and pump them into our Competitive Edge R&D programmes.”

Technology ready for deployment solutions must comply with the PETRONAS Technology Management System only then can they be directly put to work in the field. If solutions are below the ‘Technology Readiness Level 5’, they are subject to further development. These ‘work-in-progress’ solutions are classified ‘Competitive Edge R&D’.

Catalyst to innovation

It is early days yet for the IG@P platform that is just over a year old. While there is a wide selection of R&D proposals, there are ample displacing technologies that can transform the way PETRONAS works.

A case in point is flare tip inspection. Traditionally, it was done by erecting scaffolding as high as 60 to 70 metres, with people climbing up to take photos and perform temperature-dependent sensing. Today, risking lives is no longer necessary with the introduction of drones that can do the same work and transmit the data almost instantly.

As at December 2018, IG@P’s initiatives Technology Challenge and Technology Marketplace had attracted an equal measure of submissions that stood at more than 260 from all over the world. This is an encouraging start, according to Fadhlán, who says technology companies are looking to collaborate with multinational oil companies such as PETRONAS to deploy and commercialise their solutions.

“If they don’t work with us, the opportunity to test their technologies in a real-world setting is limited. The other alternative open to them is to work with companies with a small footprint. However, feedback obtained from the latter may not be as conclusive when their technologies are deployed across larger geographies, in multiple assets. With PETRONAS’ diverse operating landscapes and variables, these technologies stand a better chance of growing from good to great.”

IG@P also allows PETRONAS to have its ear to the ground. This is a good way to find out what’s being developed globally. Fadhlán believes it also motivates staff to find better ways to work and innovate.

“If we find out somebody is already three years ahead of us on a certain technology, it will spur us to improve.

IG@P’s Technology Challenge: 7 Steps

1. Refer to PETRONAS Technology Challenge webpage for the topic, deadline and requirements.
2. Send proposals to **techcomm@petronas.com**
3. Review and assessment of proposals by a multi-disciplinary team of experts.
4. Announcement of winner.
5. Initiate collaboration with winner.
6. Signing of a technology collaboration agreement with winner; it stipulates exclusive collaboration with PETRONAS.
7. Technology to be adapted to suit PETRONAS at the deployment stage. It will become more compact, cost-effective, and customised to PETRONAS needs. The background IP belongs to the winner, while the foreground IP, as an enhancement to the current technology, is to be shared with PETRONAS.



Scan here

If all it took was a couple of enthusiasts and RM50,000 in the bank, we, as a multinational, should be doing three or four times better than them. It should serve as a catalyst for innovation within PETRONAS. Then again, we might make more business sense to collaborate with this small company. Still, the company may have one approach while we have a different one. Together, we can build a better product to serve both of our needs well,” says Fadhlán.

IG@P has created a buzz within PETRONAS, with employees excited about finding solutions for longstanding problems. Besides looking outside for answers, there are plenty of opportunities for in-house brainwork. For example, there is a dire need to develop an algorithm to store and retrieve data from voluminous documents, photos, PDFs, PowerPoint slides and Excel sheets. If only there was an AI or virtual robot that can retrieve such information in a

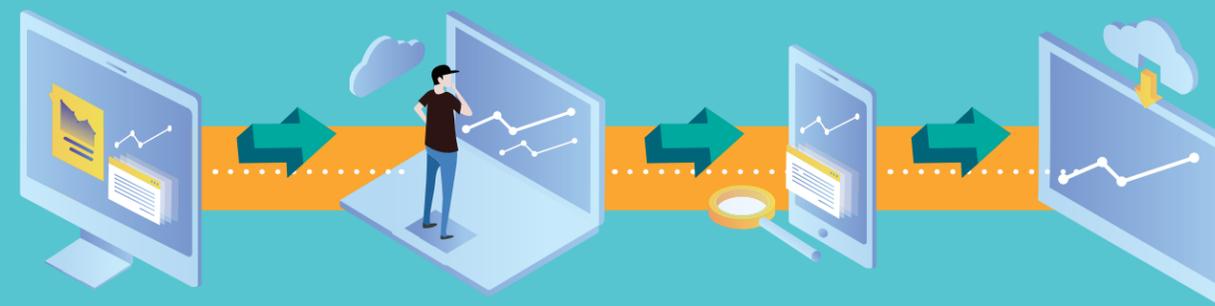
matter of seconds based on questions fielded. Questions such as when was the last time a particular equipment was checked, what was inspected and so on. This means no more poring over volumes of dated documents and files. Sounds good? Fadhlán is hoping that someone in PETRONAS will discover that algorithm in the near future.

Growing IG@P

He has many plans for the IG@P platform. First, he would like each new technology to be star-rated based on technological performance. He is looking at a structured feedback process that takes account of where and how the technology was deployed and the outcome, and, if it is possible for PETRONAS staff to purchase the technology directly from the technology provider via the platform.

What is Technology Marketplace?

How Does It Work?



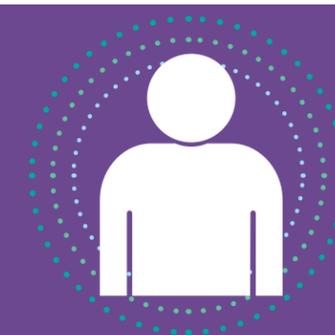
The process begins with company registration and submission of technology

Upon submission of the Technology offering(s), proposal(s) will be made accessible to PETRONAS for evaluation and validation

Technology deployment to PETRONAS upon suitability

Technology Challenge

Sharing of PETRONAS’ operation pain points with external parties to inspire technology solutions to be deployed in PETRONAS



Technology Marketplace

External parties to submit their technology offerings aimed at adding value to PETRONAS



Alone, we can do so little

Together, we can do so much

Innovation Gateway @ PETRONAS (IG@P)

PETRONAS' single-digital platform for value adding technologies

<https://innovation.petronas.com>



Fadhlan speaking on crowdsourcing at an event.

Fadhlan would also like to have celebrity spokespersons such as Mercedes-AMG PETRONAS Formula One drivers Lewis Hamilton and Valtteri Bottas to promote IG@P. Additionally, he would like to develop an Internal Innovation Challenge to encourage staff to create new solutions.

"Finally, I want to support the local universities and tap into their pool of experts. There is still a gap in our research capabilities. Premier universities such as Imperial College London, Queen's University Belfast, Massachusetts Institute of Technology (MIT), and Harvard University are a class act as centres of learning and research. I envision IG@P playing a part in this, to help bridge the gap by creating a technology challenge specifically for local universities. This would create opportunities for academic institutions to collaborate with industry players on

specific R&D programmes that are needed by us," he adds.

Collaboration is not just a buzzword. It is very real and the best way to grow fast. In fact, Fadhlan expects the future to see seamless collaboration between organisations and people for the greater good of mankind and the environment.

For now, his priority is to turn IG@P into a world class technology crowdsourcing platform for PETRONAS. He welcomes ideas from the industry as well as from colleagues. After all, the primary goal of technology crowdsourcing is coming up with ideas and solutions together.

The Global Scene

Large enterprises are leveraging on technology crowdsourcing to address their business challenges. While crowdsourcing platforms and applications continue to be launched, its use remains fragmented. Its future lies in user organisations unifying their practices and management methods to realise the full potential of crowdsourcing. The oil and gas industry has made some headway with structured crowdsourcing programmes.

Shell

In 1996, Shell GameChanger was launched to pursue technology ideas or business plans that could impact the future of energy. Calls for proposals include ideas for solar fuel, grids of the future, novel wells, machine learning and integrated geoscience. To date, Shell has engaged with more than 5,000 innovators from around the world and converted more than 150 ideas into reality. Among them are disruptive ideas such as Kite Power Systems, Brent Sonar Sphere and Swellflex.

Equinor

Equinor leverages on its Innovate programme to explore opportunities, radical ideas and solutions in three focus areas: competitive edge, transforming the O&G industry, and low carbon energy for the future. Innovate launched its first challenge in 2015. Among the winning solutions are heavy maintenance of offshore wind turbines, Corrosion Under Insulation (CUI) risk reduction, and reduction of fresh water in shale oil and gas production.

Drapner Energy

Swedish upstream energy company Drapner Energy uses crowdsourcing and networked innovation to identify and deliver ideas and solutions to market. It is the first upstream O&G company to integrate networked innovation, crowdsourcing, and crowd acceleration via online community in its business and operations model. In 2016, it launched its first crowdsourcing project that invited individuals and groups to submit proposals for prospectivity, the basis for the application for a production licence in the Mid North Sea High area.

Technology Challenges and Winners

Since its inception, the Technology Challenge has unearthed innovative and effective solutions that have resulted in a significant increase in efficiency. The following are the three winners whose solutions have made a great difference in our operations. The winners hail from locations as close as Cheras, and as far as Scotland, a testament to the effectiveness of Technology Challenge in fostering worldwide collaboration.



facilities, flowmeters on other facilities to gauge the actual flowrate of the gas (to authenticate figures) and off-the-shelf technology to monetise AG.

"The solution proposed was proven onshore but there was no offshore record. What worked in the winners' favour was the compatibility of Transwater and MTCE expertise, with each bringing to the table its own specialist skills. They made a good combo team that was driven to make this project successful. They were open to different techno-commercial models we

suggested and were willing to undertake the project capital expenditure with some rental arrangements. These factors made them our preferred choice.

"We are still at the techno-commercial feasibility study stage to patch some gaps observed in their initial proposal submission last year. By the end of this year we will be able to decide whether it's worth investing in the pilot. We need to ensure this project captures all best practices and lessons learned from all previous projects to minimise risk and the possibility of failure," he adds.

Technology Challenge 1: Monetisation of Associated Gas from Offshore Flares

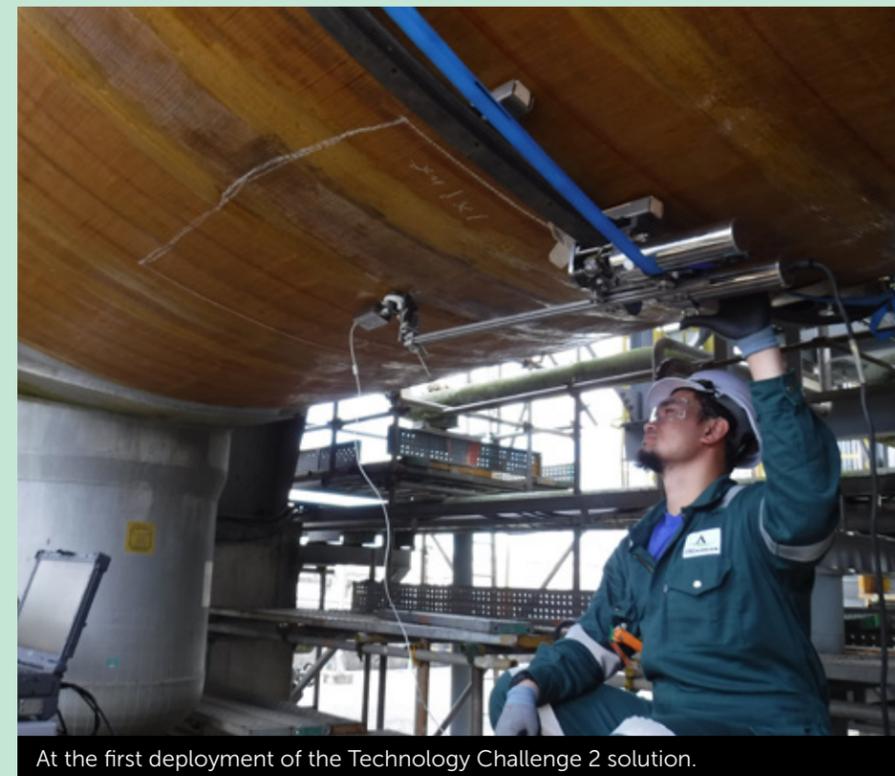
The challenge was to look for economic ways to monetise Associated Gas (AG) from offshore flaring facilities that have no gas utilisation or evacuation infrastructure. The solution would result in the beneficial utilisation of hydrocarbons while reducing PETRONAS' carbon footprint and intensity. PETRONAS received 34 proposals from 10 countries that covered Gas Processing, Gas to Liquids, Gas to Power, Gas to Solids, and even Gas to Food.

The Winner: Transwater / MTC Engineering Consortium from Malaysia
The Solution: A floating compressed natural gas system (FCNG) with innovative CNG transfer systems

PETRONAS' Head of Sustainable Development, M Isham Isnin explains that there are many pain points in this challenge. First, was mindset change that needed one to view AG beyond the pollution paradigm. Second, AG needed to be viewed as having value. Third, was the absence of infrastructure such as gas evacuation structures for some



Introducing the winners of Technology Challenge 3.



At the first deployment of the Technology Challenge 2 solution.



Technology Challenge 3 in action.

Technology Challenge 2: Field Inspection Tool for Composite Overwrap Repairs over Carbon Steel Pipelines and Piping

The challenge was to find an effective inspection tool to examine and monitor the integrity of the composite overwrap repairs used on top of carbon steel pipelines and piping for oil and gas. This includes all repairs performed using different types of composites.

Proposals came from seven countries with ideas for multiple inspection techniques such as Ultrasonic Testing, Electromagnetic, Laser Testing Methods, Guided Wave Testing, Microwave and X-Ray technology.

The Winner: Sonomatic Ltd from Scotland
The Solution: An integrated solution consisting of Dynamic Response Spectroscopy (DRS) and Microwave Field Inspection Tools. DRS is primarily utilised for the inspection of the carbon steel pipe remaining wall thickness. It also offers a high level assessment of the wrap integrity while the microwave method is primarily utilised for the assessment of the repair integrity and the external surface of piping substrate.

Technology Challenge 3: Onshore Hydrocarbon Recovery from Sludge

This challenge was to look for innovative and economic solutions in sludge treatment to recover hydrocarbon from onshore facilities.

The Winner: TIME MARINE Services Sdn Bhd from Malaysia
The Solution: It consisted of biodegradable chemical and mechanical technologies that can effectively recover hydrocarbon from the oily sludge. The proposed solution also offered savings in waste disposal costs.

Explaining the impact of this solution, Abigail Lian De Cruz, Production Chemistry, Sabah, says, "When I first found out about this technology challenge initiative, I was eager to see how it will work and ultimately benefit the company. When you have a large amount of sludge that needs to be collected and transported as scheduled waste and it includes an unknown amount of oil in the sludge, you would want to know how much of the oil can be recovered to reduce the overall tank cleaning cost. The technology has not been applied yet, but we look forward to a positive outcome of the pilot."

2018 in Reminiscence

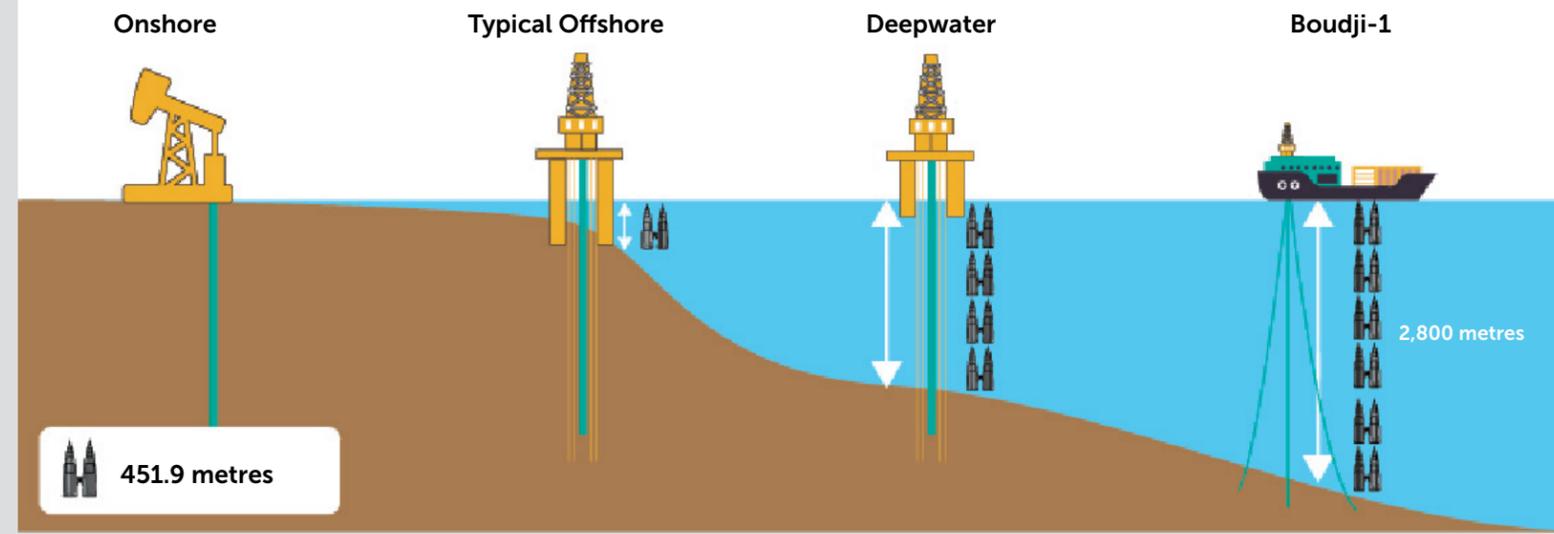
24
**JAN
2018**



TWICE IS NICE

PETRONAS was named National Oil Company (NOC) of the Year for the second time running at the Energy Council's APAC Energy Assembly & Awards Dinner in Singapore. This is a recognition of PETRONAS' contribution to the global industry.

BOUDJI-1 Well is in Ultra-Deepwater Territory



PRESERVE & CONSERVE

PETRONAS contributed RM8 million for the development and preservation of Setiu Wetlands, the largest natural wetland in east coast Peninsular Malaysia. The contribution will be used for infrastructure and community development to ensure that the wetlands continue to play its role in supporting the diverse ecosystems and the surrounding population.



NEW DEPTH, NEW DISCOVERY

PETRONAS' new oil and gas discovery in South Gabon from the Boudji-1 exploration well in Block 14 (Likuale), marks a significant milestone as we expand our upstream growth in West Africa. This discovery also demonstrates our strengths in frontier exploration and deepwater operations.

5
**MAR
2018**



12
**FEB
2018**

15
MAR
2018

STATE-OF-THE-ART



PETRONAS Lubricants International Sdn Bhd (PLI) invested US\$60 million (RM234.8 million) to build a state-of-the-art global research and technology (R&T) centre in Turin, Italy. The facility will be the global hub for R&T activities as PLI diversifies its product portfolio to strengthen our global position in the fluids industry.

25
MAY
2018

GOING DIGITAL

PETRONAS LNG Ltd (PLL) began selling LNG cargo through GLX, a global online marketplace. GLX members comprise more than 40 of the world's largest LNG buyers and sellers from Asia, Europe, North America, Middle East and Australia.



BROTHERS IN ARMS

PETRONAS launched an updated Vendor Development Programme or the VDP^x scheme. This sees six Petroleum Arrangement Contractors (PAC) and 12 Oil & Gas Service & Equipment (OGSE) companies, replicating PETRONAS' VDP programme, to reach out to more local vendors. These participating organisations receive support from SIRIM Berhad, Centre for Entrepreneur Development & Research Sdn Bhd (CEDAR), Malaysia Digital Economy Corporation Sdn Bhd (MDEC), MIMOS Berhad, National Institute of Occupational Safety & Health (NIOSH), Talent Corporation Malaysia Berhad (TalentCorp), and Association of Chartered Certified Accountants Malaysia (ACCA) in the areas of business development, financial management, technical and ICT.



13
JUN
2018

BREAKING NEW GROUNDS

PETRONAS LNG Ltd (PLL) delivered LNG cargo through its maiden break bulking ship-to-ship (STS) transfer in Brunei Bay, as part of its latest offering as a global LNG portfolio solutions provider. The cargo from Malaysia LNG Sdn Bhd in Bintulu, Sarawak was transferred from the Seri Bijaksana to the SS Lucia Ambition vessels.

31
JUL
2018

13 AUG 2018

NEW VENTURE

PETRONAS' PC Senegal Ltd acquired 30 per cent equity in Senegal's Rufisque Offshore Profond Exploration Block, marking our entry into the country. The block is located in the vicinity of recent significant oil and gas discoveries namely the St Louis Profond, Cayar Profond and Rufisque Sangomar OffShore Deep (RSSD).



3 SEP 2018

PURSUIT OF EXCELLENCE

The Merdeka Award 2018 honoured seven distinguished individuals for their inspiring achievements and outstanding contribution to the people of Malaysia. First established in 2007 by PETRONAS, ExxonMobil and Shell, the Merdeka Award is Malaysia's most prestigious award for excellence, conferred to outstanding individuals and organisations that embody the "Spirit of Merdeka" in their pursuit of excellence.

2 OCT 2018

SIGNED AND SEALED

PETRONAS reached a final investment decision (FID) on LNG Canada, a major LNG project in Kitimat, British Columbia, Canada. PETRONAS' wholly-owned entity, the North Montney LNG Limited Partnership, holds a 25 per cent participating interest in the project together with Shell Canada Energy (40 per cent), PetroChina Canada Ltd (15 per cent), Diamond LNG Canada Ltd (15 per cent), and Kogas Canada LNG Ltd (5 per cent). The project is operated through LNG Canada Development Inc. The LNG export facility will see the design, construction and operation of a natural gas liquefaction plant and facilities for the storage and export of LNG, including marine facilities.



1 NOV 2018

ANOTHER FIRST

PETRONAS LNG Ltd (PLL) successfully completed its first LNG supply operation at the Regasification Terminal Pengerang (RGTP). The reload into Kairos, the world's largest LNG Bunker Vessel with a capacity of 7,500 m³, took place at the RGTP jetty. Departing from Hyundai Mipo Dockyard, South Korea, Kairos received LNG supply from PLL, enroute to Europe. The flexibility of the RGTP in reload operations and in receiving small scale LNG ships, positions PETRONAS among the front runners in the LNG bunkering segment to meet the changing landscape of the marine fuel market.

5

TEAM EFFORT

The Pengerang Integrated Complex created history by achieving the highest safe man-hours of 120 million, entering the Malaysian Book of Records under the "Human Achievements" category. The incident-free man-hours were clocked from 18 March 2018 to 5 November 2018. A comprehensive Health, Safety & Environment (HSE) Management Plan has been rolled out to continue maintaining a safe work environment.

NOV 2018



11 NOV 2018

HI-FIVE

PETRONAS' Winning Formula successfully fuelled the Mercedes-AMG PETRONAS Motorsport team to its fifth consecutive FIA Formula One™ World Constructors Championship. This is a testament to our significant technological contribution to the team and the strong collaboration with our partners to attain shared success.

PETRONAS AT A GLANCE

Petroleum Nasional Berhad (PETRONAS) is Malaysia's national oil company that is on track towards becoming a leading oil and gas multinational of choice, ranked amongst the largest corporations in the world.

We deliver energy efficiently and reliably, having built capabilities across every stage of the oil and gas value chain. We maximise the value of every molecule through our fully integrated business model. We continue to strengthen our portfolio of conventional and unconventional resources, broaden our offering of diverse petrochemical products and maintain our track record of successful project delivery.

As we progress towards a low-carbon energy future, we continue to leverage technology, technical capabilities and our diverse, resilient and competent workforce to sustainably deliver energy to the world.

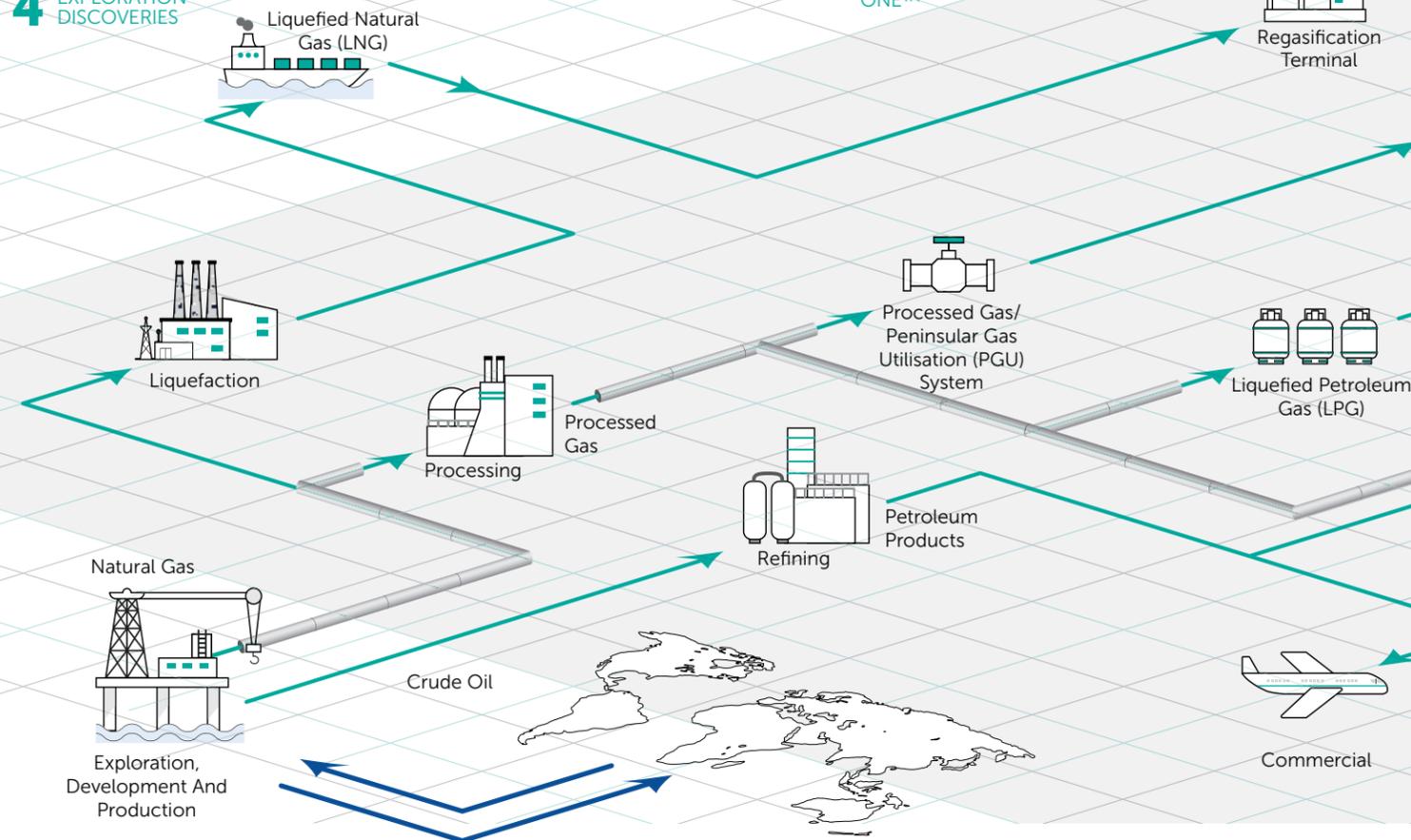
UPSTREAM

TOTAL LNG SALES VOLUME OF
30.72
MILLION METRIC TONNES

443 BCE LNG LOADABLE
DELIVERED FROM PETRONAS LNG COMPLEX IN BINTULU

AVERAGE PRODUCTION
2,320 kboe/d

4 EXPLORATION DISCOVERIES



DOWNSTREAM

91% Downstream Plant Utilisation

94.9% Overall Equipment Effectiveness (OEE)

97.9% Downstream Reliability

87% Pengerang Integrated Complex Completion

DOWNSTREAM RECORDED 227 MILLION MANHOURS, 60% HIGHER COMPARED TO LAST YEAR.

PETRONAS' RETAIL BUSINESS RECORDED THE HIGHEST UNIT MARGIN IN 5 YEARS, CONTRIBUTED BY HIGHER FUEL VOLUME AND CONVENIENCE INCOME.

EXPANDED AVAILABILITY OF THE NEW PETRONAS DYNAMIC DIESEL EURO 5 ACROSS PENINSULAR MALAYSIA AND SARAWAK.

PETRONAS CHEMICALS FERTILISER SABAH SDN BHD (SAMUR) BEGAN COMMERCIAL OPERATIONS IN MAY 2017.

5-TIME CONSECUTIVE WORLD CONSTRUCTORS' CHAMPION IN FORMULA ONE™

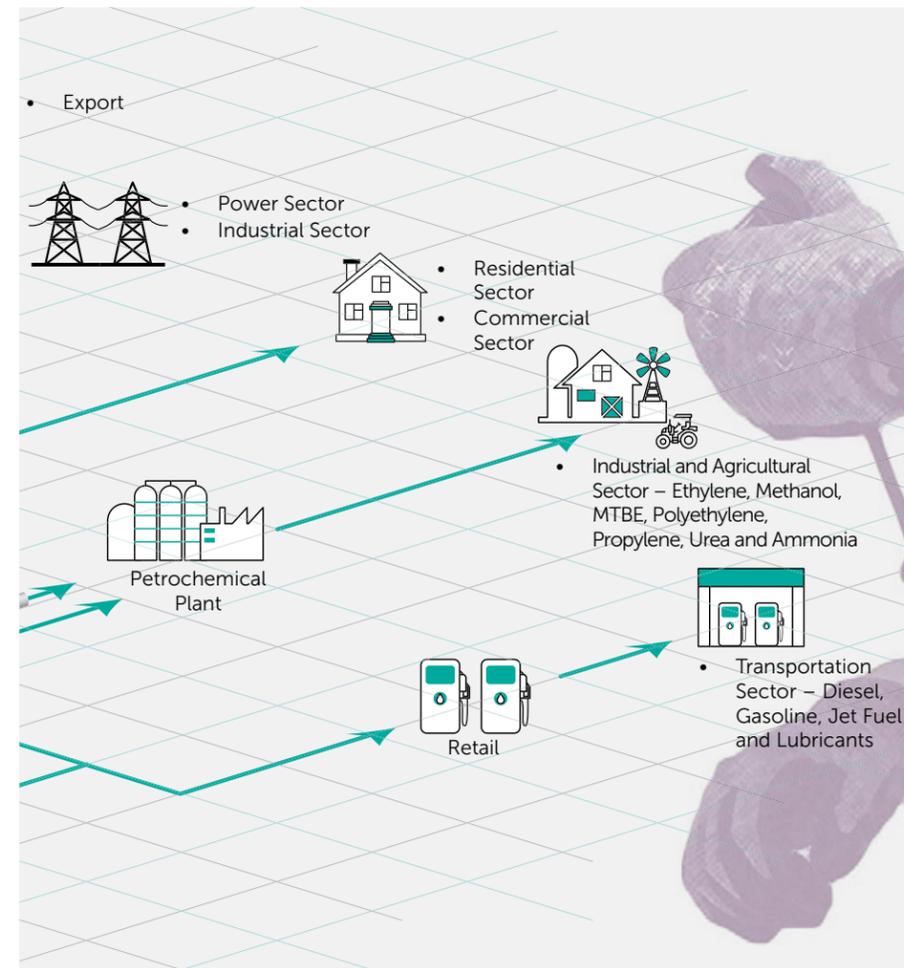
OUR VISION A Leading Oil and Gas Multinational of Choice

OUR MISSION

We are a business entity
Oil and Gas is our core business
We add value to this resource
We contribute to the wellbeing of society

SHARED VALUES

LOYALTY - Loyal to corporation
INTEGRITY - Honest and upright
PROFESSIONALISM - Strive for excellence
COHESIVENESS - United, trust and respect for each other



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