

Flow



PETRONAS

Issue 1, 2019



CANADA: A NEW GAS HEARTLAND

RAY OF HOPE

/

**IN CONVERSATION WITH:
DR MAGARET SIVAPRAGASAM**

/

**YAYASAN PETRONAS:
WHERE GOOD FLOURISHES**

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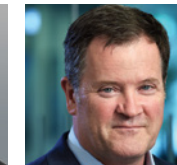
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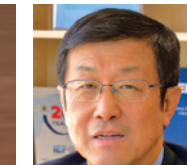
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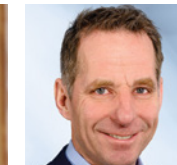
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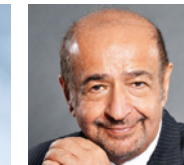
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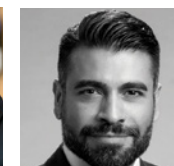
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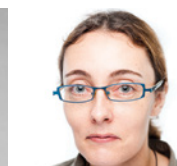
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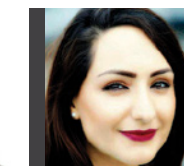
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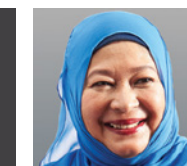
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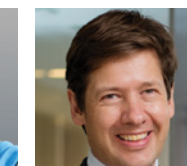
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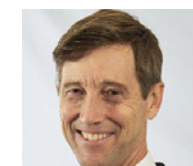
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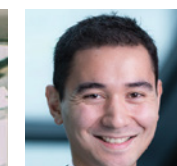
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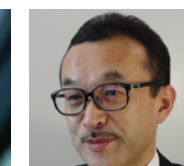
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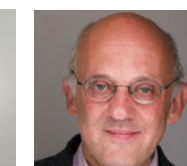
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Editor's Note

We present to you the first issue of FLOW for 2019, a new chapter with a series of stories that echoes who we are and who we aspire to be.

Kicking it off from upstream, our cover story on Canada talks about our plan to monetise the North Montney gas resource and creating an integrated business for PETRONAS' future growth as a global energy player. Both Executive Vice President and CEO of Upstream Datuk M Anuar Taib and the President and CEO of PETRONAS Energy Canada Mark Fitzgerald discuss at length on why Canada has been positioned as the cornerstone of PETRONAS' future business.

This first quarter of the year also witnessed the birth of PETRONAS' very own foundation for Corporate Social Responsibility (CSR) initiatives – Yayasan PETRONAS. Though some may raise the question of 'why now?', it is worth to note that CSR is not something new to the Company. In fact, CSR is something that is close to our heart and it has been in our 'blood' for decades. In our story on Yayasan PETRONAS, its Acting CEO Lita Osman speaks about PETRONAS' evolving sustainable strategies and the centralisation of its philanthropic projects in delivering a broader impact. Do also read the inspiring stories of beneficiaries whose lives have been significantly transformed, thanks to the assistance extended to them.

In the last issue, we introduced the entire team of the newly set up New Energy unit mandated to champion PETRONAS' move to embrace new energy sources. In this issue, we dig deeper into solar energy and



what the future holds for the renewable energy segment. To get a comprehensive view on solar energy, we reached out to Syed Malek Faisal Syed Mohamad, New Energy's Head of Business Development and Professor Dr Norani Muti Mohamed of Universiti Teknologi PETRONAS (UTP).

In this issue, we are also honoured to feature Dr Magaret Sivapragasam, a Malaysian scientist and a post doctorate student from UTP who recently made it to the International Periodic Table of Younger Chemists. We interviewed Dr Magaret on what it takes to get to the top of her field and on women's contribution in science.

We look forward to bringing more exciting stories in the coming issues. So, please stay tuned. Till then, I strongly believe that

you will find the stories in this issue both enlightening and inspiring.

We would also love to connect with our readers, so do send any feedback or suggestions to flow@petronas.com.

Happy reading!

Editor-in-Chief

Zahariah (Liza)
Abdul Rahman



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SIVAPRAGASAM:
The First Malaysian
Scientist to Receive
IUPAC Honour**



CANADA: A NEW GAS HEARTLAND

PETRONAS' venture in the LNG Canada project, a critical move in monetising its North Montney gas resource, will further strengthen its role as a major energy player.

By **Sreerema Banoo**

In October last year, PETRONAS and four global joint venture participants reached a final investment decision to build a liquefied natural gas (LNG) export facility in Kitimat, British Columbia. The multi-billion dollar LNG Canada project, initially comprising two LNG liquefaction processing units, or trains, for a total of 14 million tonnes per annum (mtpa), with the potential to expand to four trains in the future, marks a significant milestone for the energy industry in Canada.

It's been reported that the project is expected to create 10,000 jobs at the height of construction, leading to billions of dollars in direct government revenues,

including hundreds of millions of dollars in construction contracts for indigenous businesses. The project will pave the way for the export of Canadian natural gas, giving Canada the opportunity to be a global leader in the supply of cleaner energy around the world.

For PETRONAS, which has a 25 per cent participating interest through its wholly owned entity North Montney LNG Limited Partnership, the LNG Canada project represents a critical step towards monetising its considerable Canadian natural gas assets in the LNG sector, and complementing an integrated business that will ensure the company's future sustainability as a global energy player.





PETRONAS Energy Canada upstream operations in Fort St John, BC.

“

PETRONAS' ambition by 2025 is to have about 45 mtpa of LNG to be traded in the market, so we have to find the next place that will give us a long, sustainable business for the future. That's where Canada comes in.

”

- Datuk Mohd Anuar Taib
Executive Vice President
and CEO of Upstream



developed and processed due to high levels of carbon dioxide (CO₂) and hydrogen sulfide (H₂S) or sour gas. The volume of reserves that we have discovered is not as large as what we used to discover. So we know that although we easily have another 20 to 30 years to go, the production volume will start reducing," says Anuar.

The other joint venture participants of the LNG Canada project are

- Royal Dutch Shell plc, through its wholly owned subsidiary Shell Canada Energy- 40 per cent
- Mitsubishi Corporation, through its wholly owned subsidiary Diamond LNG Canada Ltd - 15 per cent
- PetroChina Canada Ltd through its wholly owned subsidiary PetroChina Kitimat LNG Partnership - 15 per cent; and
- Korea Gas Company, through its wholly owned subsidiary Kogas Canada LNG Ltd - 5 per cent.

PETRONAS' commitment to Canada also points to the group's big bet on gas, which represents 70 per cent of its portfolio. PETRONAS views gas as a fuel solution

that will stay for a long time. As the cleaner fossil fuel, it can go beyond being a mere transitional fuel to a co-solution with renewables in mitigating the impact of climate change.

How Canada fits in

To see how Canada fits into PETRONAS' future growth story, it's worth looking at where the company stands today as the third largest LNG seller in the world with positions in Australia, Egypt and Sarawak. "With the portfolio of supply in Sarawak and Australia, we are now a significant supplier of LNG to Japan, Korea, Taiwan and China, and we are also market leaders in some of these markets," says Executive Vice President and CEO of Upstream Datuk Mohd Anuar

Taib, adding that in recent years the company has also expanded its customer positions in Thailand and India.

The PETRONAS LNG Complex in Bintulu, Sarawak is one of the largest LNG production facilities in the world with nine trains, producing 29.3 million tonnes per annum (mtpa). PETRONAS is also the first Floating LNG owner-operator in the world, with the construction of a second vessel already underway and sailaway planned in first quarter of 2020.

PETRONAS is however cognisant of potential resource issues that it will need to address in the future of this depleting resource at home base. "Resources will start to get more difficult to be

In Canada, PETRONAS capitalises on the proven available resources and easy access to North Asian customers.





At the same time the LNG market will continue to grow. "By 2025, our ambition is to have about 45 mtpa of LNG to be traded in the market, so we have to find a place that will give us a long, sustainable business for the future. Here is where Canada comes in," he adds.

PETRONAS' foray into Canada began in 2011 when it entered into a partnership with Progress Energy Canada Ltd. to form the North Montney Joint Venture. In the following year, it acquired Progress Energy as a wholly owned subsidiary of PETRONAS, later renamed PETRONAS Energy Canada Ltd. As a result, PETRONAS became the owner of about 3,600 square km of mineral rights, approximately twice the size of Melaka and initially hit the appraisal goal of 15 trillion cubic feet (tcf) of gas reserves. The condition at that time presented an ideal scenario for the company to embark on the Pacific Northwest LNG project – capitalising not only on the proven available resources but also the LNG project's location on the western side of Canada that afforded easy access to its North Asian customers.

But shifting market conditions – with LNG prices falling by half and challenging costs and



Considering the scale and quality of the natural gas resources in Canada held by PETRONAS and its partners, finding different avenues to monetise this resource is critical.

environmental conditions - precluded the development of the Pacific Northwest LNG project. In July, 2017 PETRONAS and its partners announced they were not continuing with the project but would continue to be invested in Canada and be on the lookout for more efficient ways to monetise the resource in Canada into LNG.

Towards a low carbon future

"We produce a gross of 700 million standard cubic feet per day (mmscfd) for the local (Canadian) market. It's a good size production that generates half a billion Canadian dollars of revenue per year. Given the size of the resource, however, we have to continue to explore ways to bring this substantial supply of natural gas to multiple markets in order to meet growing global consumption and expectations. So that's where LNG Canada and the continuing pursuit of LNG opportunities in alignment

with PETRONAS' worldwide LNG strategy came in," says Mark. "We believe natural gas will play an important part in the planet's transition to a low-carbon economy, and we're thrilled to have the opportunity to get the cleaner burning energy to countries currently burning coal."

Anuar expects that by 2024, the Canada LNG project will add 3.5 mtpa or about 60 cargoes a year, on top of the 420 LNG cargoes PETRONAS produces a year. "Now that people know we have that resource, other parties in LNG and petrochemicals are also approaching us to collaborate," he says, reiterating the importance of leveraging opportunities and monetising the resource.

Strategically, the LNG plant on the western side of Canada also allows for unrestricted LNG cargoes to markets in China, Japan, Korea, Taiwan and South East Asia. Having the resource, people and

Canada has the potential to become a cornerstone of PETRONAS' LNG business.



“
It’s got the scale
that will allow us
to grow and be at
the centre of the
LNG business in
Canada.”

- Mark Fitzgerald
President and CEO, PETRONAS Canada



For major projects to be carried out in Canada, they have to be done in a manner that builds trust and ensures the concerns of regulators, policymakers, communities, First Nations, and the public are addressed.

capacity to develop these resources, we are setting up the foundation for growth.

Mark agrees, adding that, “We have a significant competitive advantage because of the proximity of the British Columbia coast to Asian markets. And, considering the scale and quality of our natural gas holdings in Canada, it is important to explore different avenues to monetise the resource, with LNG being the cornerstone of that effort.”

Cornerstone of the business

Mark believes that in Canada, PETRONAS has a “fantastic opportunity” to build a core component of its long-term portfolio. “The resource has the size and is of the quality that will allow us to grow and create value. It’s unconventional which gives

us the flexibility to scale production according to our marketing commitments and it’s at the centre of an LNG business in Canada that will export cleaner burning Canadian natural gas to our markets with very short shipping times,” he adds. Anuar agrees, saying that it’s important to look at Canada from the lens of the resource that PETRONAS has in the country and what the scenario would be like 40 years ahead. “What could we achieve? If we replicate the entire development of (the LNG Complex) in Bintulu, Sarawak with the resource that we have in Canada, what we will have is a multigenerational development that will allow us to be sustainable way beyond our borders.

Canada has the potential to become a cornerstone of

PETRONAS’ LNG business and as a portfolio it would be one of those foundation countries that we have to be strong in, especially taking into account Malaysia’s finite resources. We have to look at ways of ensuring the future sustainability of the business,” he adds.

So it’s no understatement that much is riding on PETRONAS’ foray in Canada. “We are operating in a very dynamic market. We have to first understand the nature of the market...we have to be nimble and be faster at decision making, there will have to be new trading, hedging capabilities that we need to build. These are the things we need to do, and in the speed that is fast enough to allow us to capture opportunities as well as minimise risk.

“We have to be cognisant about the push towards a cleaner way of doing business, so we have to be very cautious and good at managing issues such as fugitive methane emissions. We must be able to maintain our licence to operate from the environment perspective as well as manage relationships with First Nations and the community as a whole,” says Anuar.

As for the LNG Canada project, he stresses the need to ensure that it is being managed properly so that it can deliver the project, together with its partners right on schedule and right on cost. “This is the first LNG project in Canada, so a lot is riding on it,” he says.

Community-centred development

Although the PETRONAS decision to venture into the LNG Canada project came just a year after it cancelled the Pacific Northwest LNG project, Mark believes that much has changed. “The LNG markets are better, the project has fewer hurdles as they relate to capital and social risk. It’s got a strong partnership among the joint venture participants as well, similar to what we had at Pacific Northwest and a critical aspect of a successful project,” he says.

There are also crucial lessons that can be drawn from the cancelled project, particularly the importance of stakeholder engagement. “Major projects in Canada, have to be done in a manner that builds trust

and ensures the concerns of regulators, policymakers, communities, First Nations, and the public are addressed.”

PETRONAS’ experience in helping to grow, develop and enrich communities in areas of its operations like the once largely rural Bintulu in Sarawak, which is now a bustling town, also gives him the optimism that the same success can be replicated in Kitimat, the site of the LNG Canada project.

Anuar is similarly optimistic. “Bintulu began as a small fishing community of about 3,000 people when we started the LNG Complex in 1978. Today it is a thriving 200,000-person town.

The towns of Kitimat and neighbouring Terrace have a population of about 5,000 to

6,000 and are mainly fishing communities, so imagine the potential and what it’ll be like 30 to 40 years from now,” he says.

The development of the indigenous community is also an aspect in PETRONAS’ operations in Sarawak that it plans to replicate in Canada. “From the experience in Bintulu, we have learnt that indigenous communities place importance on sustainable employment, development of skills, the preservation of social fabric and social systems in their communities, and with that really comes long-term sustainable partnership with indigenous and community leaders. And those partnerships and relationships are going to be critical to our success in the long term,” says Mark.

Where Good Flourishes

Community work has long been part of the PETRONAS culture for the last 45 years. With the recent launch of Yayasan PETRONAS, we look at the company's evolving sustainable strategies and the centralisation of their philanthropic efforts in delivering a broader impact.

Che Noorfaezah Mat Nasir shifted nervously in her seat, unsure of what she was doing in a class with 99 other Teluk Ketapang women. Earlier when she had been asked to sign up, Faezah didn't even know what to write for her telephone number.

As the instructor asked her what her talent was, Faezah just shook her head and sighed. A housewife and mother of six, she felt small and out of place. Other women in class had, at least, experience in selling food or sewing clothes.

They were all participants of PETRONAS' Planting Tomorrow programme which sought to upgrade the lives of single mothers and wives of fishermen who live below the poverty line.

"I didn't have the confidence. At that time, most of the others in class had some small business. They all had something they were good at," explains Faezah, 36.

It was only after much encouragement from the trainer that she remembered friends and relatives' remarks about how good she was at giving massages. From that point, Faezah flourished in class. She met the targets set by the trainer, did her homework and even printed business cards.

Within a month, her income increased from RM100 to RM700, and is currently at RM2,700. In a room full of people, she no longer sits awkwardly in a corner. Faezah reveals that she has many clients now and has even started selling massage oil – a product she makes with her father.

"I used to be very negative and didn't believe I could do much. But this programme taught me to think out of the box to achieve different results," says Faezah.



The Yayasan PETRONAS launch was officiated by Deputy Prime Minister Datuk Seri Dr Wan Azizah Wan Ismail in March. Also present were President and Group CEO of PETRONAS Tan Sri Wan Zulkiflee Wan Ariffin (left) and Chairman of PETRONAS Datuk Ahmad Nizam Salleh (right).

Planting the Future



Although volunteerism and CSR have always been part of the company's culture, it is only this year that Yayasan PETRONAS, the CSR arm of PETRONAS, was launched.

Lita Osman, Acting Chief Executive Officer, explains that now as the central body, Yayasan PETRONAS manages all of the CSR activities for better governance. It's all about doing better philanthropy, delivering programmes that are designed on our four guiding principles - creating value, sustainable impact, innovative solutions, and effective partnerships or shared success."

Ensuring that all programmes remain sustainable, Yayasan PETRONAS will continue to make broader impact through three focus areas: Sentuhan Ilmu (Education), Sentuhan Harapan (Community Well-being and Development), and Sentuhan Alam (Environment).

By **BRIGITTE ROZARIO**



Lita (extreme left) with the ginger farmers of Kampung Pulutan, Sabah. Ginger cultivated here is now pulverised and marketed in many other parts of Malaysia.

Yayasan PETRONAS believes that social progress is inclusive and everyone can enjoy a better life. Reaching out to underprivileged communities and youth, the foundation's Community Well-being and Development focus area creates avenues for these groups to be exposed to social entrepreneurship programmes, promoting a more sustainable livelihood and better health. Flood relief and food aid programmes are also implemented during periods of natural disaster to allow affected communities to resume their daily activities sooner.

Planting Tomorrow, for instance, allows Yayasan PETRONAS to work with Yayasan Sejahtera to help villagers in rural and remote areas of Sabah.

"In Sabah, there are many villages with no water supply. So, we provided water through our gravity-fed system. Villagers no longer need to go to the river, as this would have taken them four or five hours on foot. The time they save can be used to work on the good soil.

"We even teach them about entrepreneurship, financial understanding, design, marketing and branding, so they know how to market their products. We talk to them about new ways of planting and give them the necessary equipment," explains Lita.

With the help of PETRONAS, we finally have water flowing into the village through the gravity-fed system. Before that, we had to walk to the river, fill up our bottles and buckets and carry them back, three times a day.

- Ginger farmer Justah



(From left) Ritah and Justah now earn three times higher income by harvesting Bentong ginger.

The new programme introduced ginger cultivation to the villagers and it was a collaboration with Yayasan Sejahtera that lasted for about nine months.

The experts PETRONAS brought in, identified ginger as the most suitable plant for their soil. The local farmers were given seeds to sow on a large scale and were taught the right techniques for planting, including how to shorten the harvesting period. They were also advised to keep some seeds to plant in a nursery – a somewhat novel idea for the villagers.

With encouragement and some targets set for them, the farmers have changed the face of farming in their village and now grow ginger abundantly.

"With the help of PETRONAS, we finally have water flowing into the village through the gravity-fed system. Before that, we had to walk to the river, fill up our bottles and buckets and carry them back, three times a day – in the morning, afternoon and evening," relates Justah.

Ritah further says that Planting Tomorrow opened her eyes to the benefits of working together. "Previously, we used to work on our individual land. Now, we help each other, and reap more profit. We also work faster together."

They are now financially comfortable earning RM1,500 - RM3,300 a month from their ginger cultivation business, compared with their previous meagre earnings of RM150- RM500 – a substantial increase from before!



Crop Cultivation: Transforming Lives

Sisters Justah, 31, and Ritah Dahlan, 29, were among 19 participants of Planting Tomorrow from Kampung Pulutan in the interior of Sabah. Justah has two children and her husband works as a rubber tapper, while Ritah lives with their mother, who is also a farmer. They had been planting vegetables traditionally like the rest in their village until PETRONAS came into the picture in 2017.



“It's all about doing better philanthropy...”

- Lita Osman
Acting CEO, Yayasan PETRONAS

NO “parachute initiatives”

According to Lita, farming on their ancestral land is what these women do best. Although they knew the soil was good, they had not been doing so well because they didn't know which crops were best to plant, nor how to maximise their harvest.

“They were surprised that we were willing to go the extra mile to help and give them gainful work where they could derive more value for their effort. As we put in a lot of effort, they too felt compelled to work with us and make the programme a success,” says Lita.

She stressed that Yayasan PETRONAS does not believe in “parachute initiatives” where you drop in, do a one-off charitable work and leave. The foundation aims to have sustainable programmes that provide the necessary tools for the communities to grow so that in the long run, these communities can improve their lives and enjoy a steady income stream.

With many senior PETRONAS staff coming from similar backgrounds and communities, some being beneficiaries of the company's scholarships, the motivation to help is stronger.

“Naturally, they have that passion to give back to their own communities. It's part of our DNA at PETRONAS,” Lita adds.

“We now dive three to four times a year at the Patricia Reef in Bintulu to monitor the area. Within two years, I have seen the difference. There is more marine life now.”

- Jong Churh Fang



Yayasan PETRONAS is cognisant of its responsibilities, not just to communities, but also the environment.

Through Sentuhan Alam, Yayasan PETRONAS seeks to better the environment through biodiversity conservation and carbon neutral programmes. The foundation's initiatives include rehabilitation and conservation of coral reefs and mangrove swamps. In Kerteh, Terengganu, PETRONAS Chemicals Group works with the Malaysian Nature Society on the ecoCare mangrove learning centre, which has been in operation for the past 14 years.

PETRONAS' involvement in regenerating marine biodiversity in Bintulu, Sarawak, started in 2013

with the Biodiversity, Environment & Conservation (BEACON) project where thousands of reef balls were embedded in the seabed for corals to amalgamate. In addition, BEACON also conducts diving lessons, and beach and coral cleaning.

MLNG operations technician Jong Churh Fang is one of the many PETRONAS employees who volunteers his time for this project. In fact, Jong learned to dive just so he could participate in BEACON. The programme's agenda to conserve reefs and prevent illegal trawling resonates deep with the 33 year-old from Kuching, Sarawak. “I think this programme is good because we help promote coral growth,

so that more fish can live there. It helps conserve our marine and raises awareness of the importance of conservation,” says Jong.

An avid fishing enthusiast, Jong obtained a new level of appreciation for nature after going underwater. “I never really thought about learning to dive. I took it up to volunteer for the BEACON project. We now dive three to four times a year at the Patricia Reef in Bintulu to monitor the area. Within two years, I have seen the difference. There is more marine life now. I remember the second time I went underwater and saw cuttlefish breeding near our reef balls - I was elated. I felt like I had accomplished something.”



Better Care for the Ocean

Studying the Forest



Amidst lush greenery and the beautiful Imbak falls, the opening of the Imbak Canyon Studies Centre (ICSC) marked a historic milestone for the Imbak Canyon Conservation Area (ICCA), a pristine rainforest in the heart of Sabah and home to a wide variety of flora, fauna and unique landscapes.

The launch of the ICSC is an important step in the Sabah State Government's move to protect the State's rainforest heritage and the environment. This world-class biodiversity and environmental research centre, is a 27-hectare facility that sits within the 270,000-hectare core zone of the ICCA.

Since 2010, PETRONAS has committed a total of RM83 million towards the conservation of Imbak Canyon – making it the first and largest ever local partnership by Yayasan Sabah Group in

conserving a gazetted forest area in the State.

Datuk Seri Panglima Haji Mohd Shafie bin Haji Apdal, Chief Minister of Sabah says, "The ICCA has the potential to become the destination of choice for rainforest research, attracting both local and international researchers."

The Chairman of Yayasan PETRONAS, Datuk Ahmad Nizam Salleh concurs: "In order to promote research activities here, we plan to introduce an environment research grant to spur research related to carbon sequestration, new energy as well as in biodiversity."

Director of Yayasan Sabah, Datuk Haji Jamalul Kiram bin Datuk Haji Mohd Zakaria continues, "The construction of ICSC will create more jobs for communities living nearby in the Imbak area, especially young people, in hospitality and tourism related activities. Through these we hope they can better their standard of living in a sustainable way."

There are about 15 villages around Imbak. "Before ICSC was established, the people depended on the jungle to sell or use its natural resources, such as Tongkat Ali.

"When we work with Yayasan Sabah, we also have to work with the community in that area. We give them the opportunity to gain better employment and start their own business," Lita Osman explains.

Imbak Canyon has rich biodiversity with over 600 species recorded to date.

New Tree Species

- *Dipterocarpus megacarpus* (Dipterocarpaceae) (Madani, 1992).
- *Ceriscoides imbakensis* (Azmi, 2000), a rare tree from the Rubiaceae family.

Mammals: 81 species – including Orangutan, Proboscis Monkey, Banteng, Bornean Pygmy Elephant, etc.

Birds: 245 species - a mix of lowland and montane species, including six species of pitta, all eight species of Bornean hornbills and 20 species of flycatcher.

Fish: 22 freshwater species.

“The ICCA has the potential to become the destination of choice for rainforest research, attracting both local and international researchers.”

- Datuk Seri Panglima Haji Mohd Shafie bin Haji Apdal
Chief Minister of Sabah



(From left) Datuk Ahmad Nizam, Datuk Seri Panglima Haji Mohd Shafie and Dr Yap Sau Wai, Group Manager, Conservation & Environmental Management Division of Yayasan Sabah at the ICSC Science Laboratory.

Protecting Imbak Canyon

Before PETRONAS engaged the communities living near Imbak Canyon, the villagers had a tough time trying to make ends meet. The future looked bleak for their youngsters; they knew they would have to go to the city to earn a living.

Ranger David Francis, 32, lives in Kampung Imbak. "I used to work as a part-time porter in Imbak before I became a ranger in 2007. I thought I might have to work in a faraway place but, thanks to PETRONAS, I have not had to move to another state or to the city to find work. There is now the gravity-fed water system, homestays by villagers, and more job opportunities in Imbak.

"Previously, there also wasn't much jungle monitoring to protect the animals from poachers. Now there is better protection of wildlife. Initially, I felt a bit out of place working in the jungle but now I have become very comfortable and I enjoy being there. I like being a ranger because there's a lot we can learn from the new species and subspecies found. I am happy with the new discoveries. I also get to regularly see deer, roe deer, mouse deer and gibbons. It is our job to protect nature and the wildlife so the younger ones know what a jungle is," says the father of two.

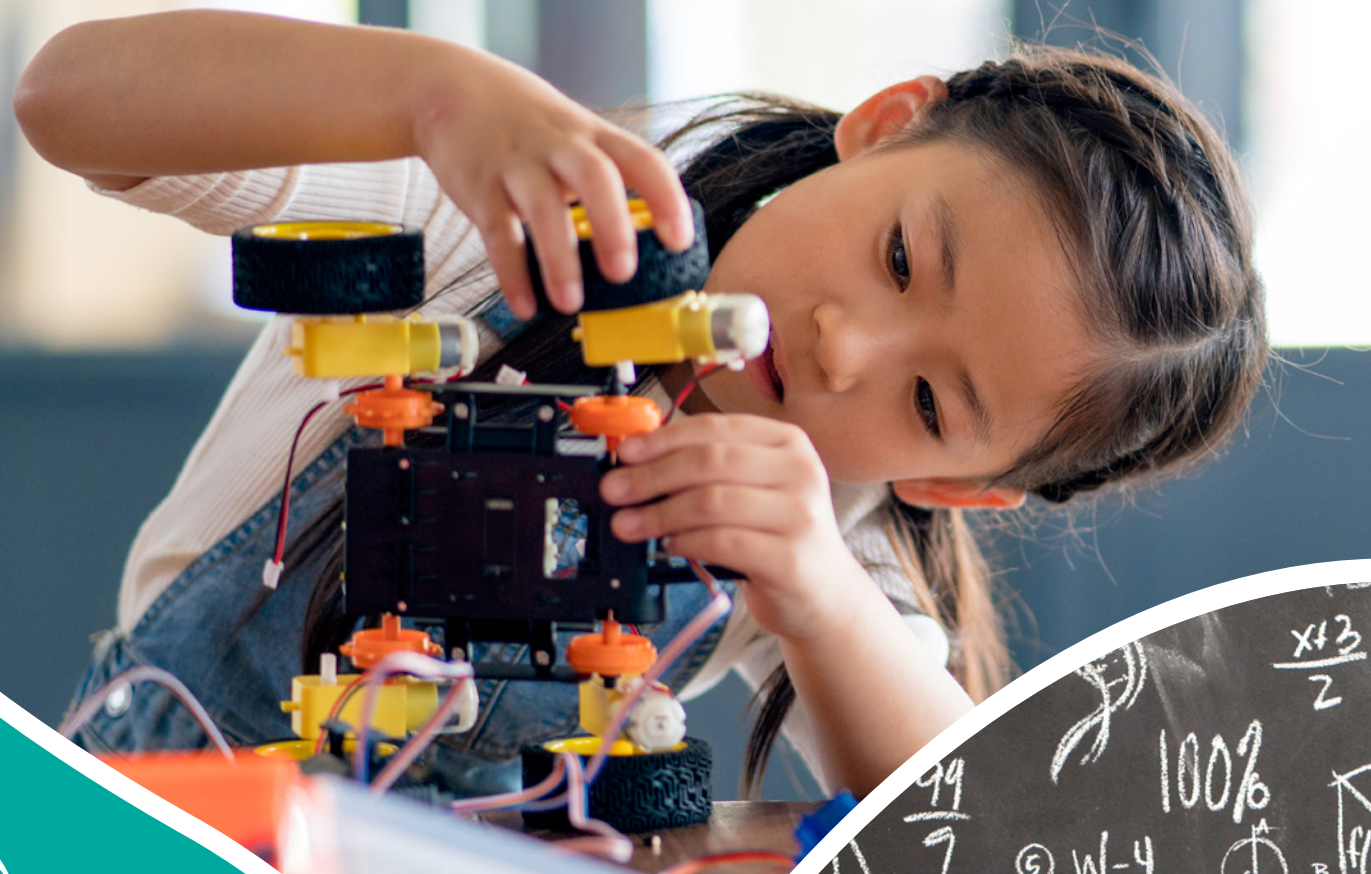
Part-time porter Ronny Mi, 25, also lives in Kampung Imbak. With a small shop and a vegetable garden, he only helps visitors when his services are required.

"After PETRONAS came in, there were many programmes to upgrade the community such as the porters association. I am a member and it informs me whenever someone needs a porter. My hope is that the people of Imbak can remain there and work in that area rather than leave their families to go to the city," he says.

David and Ronny now serve a greater purpose - protecting the jungle of Imbak.

Learn more about Imbak at www.youtube.com/user/PETRONASOfficial





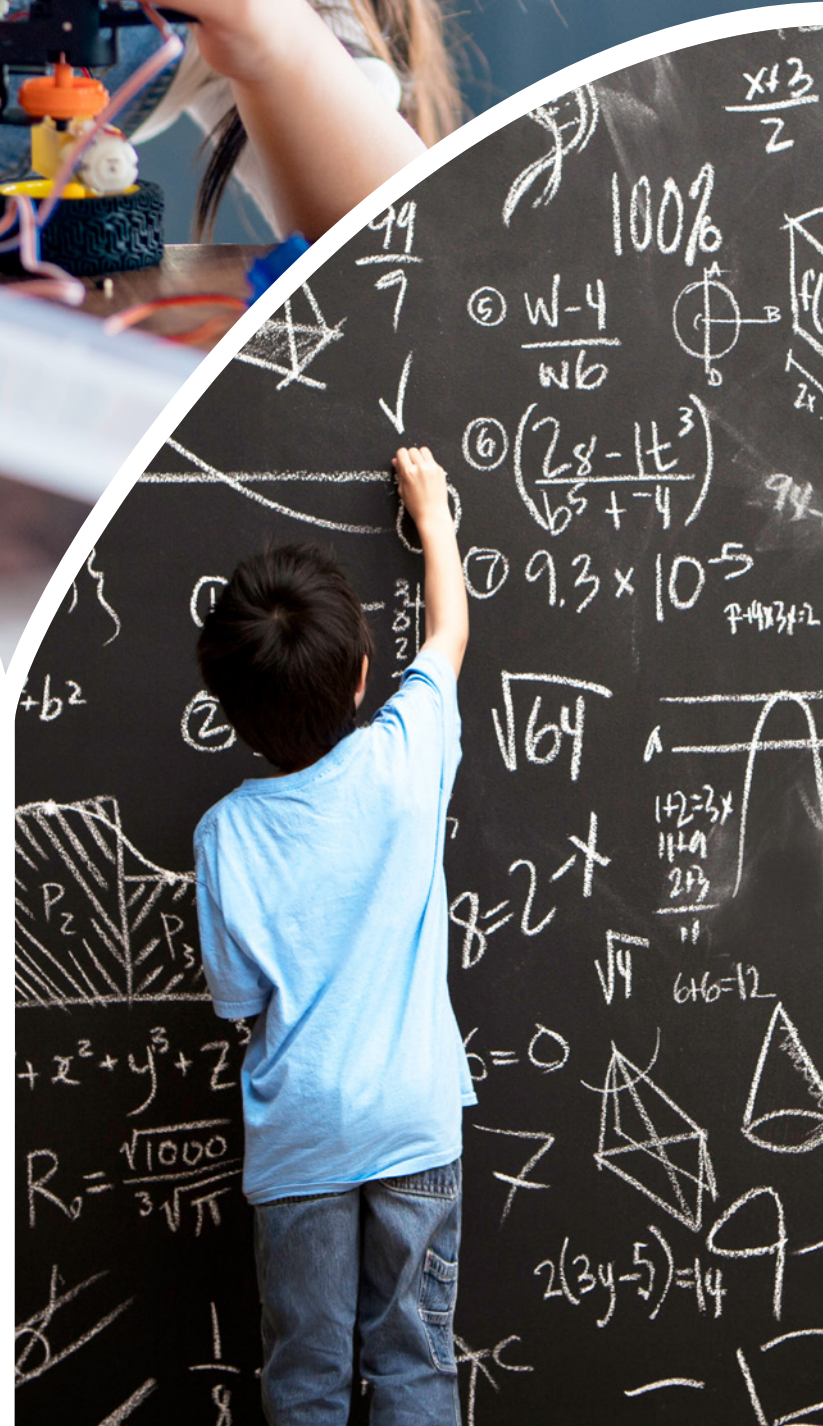
Sharpening Young Minds

Yayasan PETRONAS' Sentuhan Ilmu supports underprivileged students to better their STEM (science, technology, engineering and mathematics) education. Aligned with the government's 60:40 target ratio of STEM-ARTS enrolment, Yayasan PETRONAS hopes that Sentuhan Ilmu will provide students with the right exposure needed for the 21st century workforce.

Yayasan PETRONAS also runs All About Youth (AAY) competition which began in 2014. In the past five years, about 3,000 students and 150 schools have benefited from its programmes, empowering the students to create impactful ideas for communities.

Muhd Anis Firdausi Hazmi and Phesagan Ravi, both 18, were part of the winning team in AAY 2017 from SMK Tinggi Melaka. They were 16 at that time. With a PETRONAS mentor to guide their group of 20 students for three months, they came up with the HistoMap, a history lesson app in the form of mind maps.

"We tried to build the app from scratch but it was challenging. So, we had to ask the well-known publisher Appy Pie to help provide us with the base on which to build our content. Next, Phesagan had to email Google and Apple to get their permission to publish the app. It was really tough convincing them," informs Muhd Anis.



// **Even though PETRONAS is a very large company, it still takes time to give back to society. It taught us that no matter how successful you are, you have to give back to the country.** //

- Muhd Anis
a member of the HistoMap team

In fact, their mobile app submission was rejected twice by Apple, which has very strict policies. It took many calls from Phesagan to convince Apple that HistoMap was a real app and not a hacking tool. Through the experience, he learned the importance of good communication skills.

The group then visited selected schools to promote HistoMap by handing out flyers and talking to students about their app. According to Muhd Anis, one of their goals was to help students in rural schools.

"They don't have libraries to do their research in, but they can use their phones. So, we thought we would let them know there is this app to help them study better," he says.

HistoMap, which is available on Google Play Store and Apple App Store, now has more than 1,500 downloads.

Collaboration and teamwork were key for Muhd Anis. "Distributing the workload was a challenge because everyone had to study for exams at the same time. But we also really wanted to win for our school. That was our motivation - to do our best.

It was mind-blowing to find out that even though PETRONAS is a very large company, it still takes time to give back to society. It taught us that no matter how successful you are, you have to give back to the country," says Muhd Anis of his experience.

The winning team from SMK Tinggi Melaka who created the HistoMap for the All About Youth (AAY) competition.



HistoMap now has more than 1,500 downloads.



A Lasting Legacy

Yayasan PETRONAS will carry on doing all this good work – to better it, sustain it, and scale it. We want to take it further for the Malaysian society and the environment. We aim to take the good that PETRONAS has done and allow it to flourish.



- Lita Osman



Yayasan PETRONAS is determined to run programmes that are sustainable, scalable and with shared success.

This year, the foundation will be launching two new programmes – the Teacher Ambassador Programme and the Environment Grants.

Five other ongoing programmes will be revisited, refocused and repackaged for greater impact. The enhanced programmes are Planting Tomorrow, Program Sentuhan Ilmu PETRONAS (PSIP), Cancer Research, Disaster Relief Efforts, and the Youth Programme.

"We can only do so much as a company, hence we look

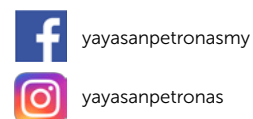
forward to partnerships. Each partner can bring their own strength to the table, and together, if we are united as one *kampung*, we definitely can make a difference," says Lita.

PETRONAS has done amazing CSR work in the past 45 years, rolling out more than 500 programmes. Yayasan PETRONAS will ensure this legacy is continued.

Yayasan PETRONAS will carry on doing all this good work – to better it, sustain it, and scale it. We want to take it further for the Malaysian society and the environment. We aim to take the good that PETRONAS has done and allow it to flourish," says Lita.

(From left) Datuk Haji Jamalul Kiram, Tan Sri Wan Zulkiflee, Datuk Seri Panglima Haji Mohd Shafie and Datuk Ahmad Nizam having a chat at the Imbak Waterfall.

Follow Yayasan PETRONAS:



IT ONLY TAKES A LITTLE BIT OF GOOD TO BRING OUT THE BEST IN US ALL



Goodness, in large amounts or small, can really turn a life around. We see it in our classrooms, as children explore the wonders of science and technology. We see it in our communities, as helping hands ensure the welfare of all. We see it too in our forests, as the search for new species and potential cures continues. Each and every day, we do all we can to bring good to life. Each and every day, we're rewarded.

#WhereGoodFlourishes



yayasanpetronas.com.my



RAY OF HOPE

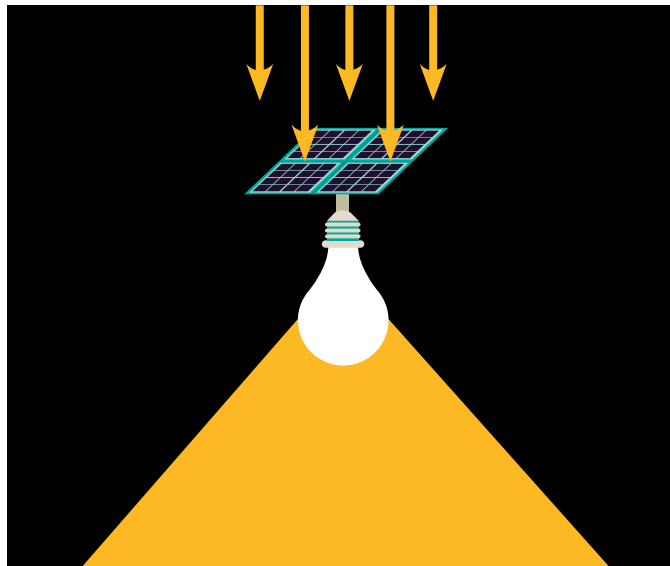
By **JACQUELINE PEREIRA**

Advanced technology and reduced costs place solar energy at the top of renewable energy resources.

In the renewable arena, Malaysia is rapidly gaining momentum in harnessing the potential of solar energy.

The Malaysian Government's target of achieving 20 per cent clean energy generation in the national power mix (excluding hydro) by 2025 may be ambitious, with the current mix hovering around 2 per cent. However, this ambitious aim - part of the Renewable Energy Transition Roadmap (RETR) 2035 - is driving the energy industry to explore alternative energies, minimise costs and innovate technology solutions.

In March 2019, Yeo Bee Yin, Minister of Energy, Science, Technology, Environment, and Climate Change (MESTECC) reiterated the Government's commitment to increase energy efficiency in reducing electricity bills and decarbonising administration. To boost renewable energy (RE) growth, MESTECC has implemented the net metering (NEM) programme. Under this solar photovoltaic (PV) initiative, all energy produced from the installed solar PV system will first be consumed, and any surplus power will be exported to all Tenaga Nasional Bhd (TNB) customers.



ENERGY TRANSITION

An August 2018 Financial Times report stated that solar and wind power could soon compete with coal and oil on scale and cost. As a result, companies that now competitively bid for RE projects are growing as fast as technology evolves and costs decline, instead of relying on previous generous government subsidies, said the report.

The increased viability of the businesses has led to more corporates making a fundamental shift towards clean energy. According to RE Forbes 2019, the evolving landscape of sustainable energy will see big oil companies transitioning into power generation, selling renewable electricity and natural gas directly to homes and businesses.

"This move from molecules to electrons is inevitable. The energy transition is happening regardless of whether the industry players are ready," stressed PETRONAS

New Energy's Head of Business Development, Syed Malek Faisal Syed Mohamad. This significant trend is further boosted by government's commitment to eventually deregulate the market to satisfy the increasing consumer demand for affordable, clean energy. He expects movement all along the RE value chain, with feverish activity in areas such as energy trading and electric mobility.

Even before the New Energy Division was set up in April 2018, PETRONAS had already invested in a 10MW solar farm in Gebeng, Pahang. In 2013, a pilot project with solar rooftops was developed in Suria KLCC and several petrol stations. SINARAN (Solar Installation and Application on PETRONAS Rooftops & Assets Nationwide) was also launched to study the feasibility of installing solar panels at PETRONAS assets, as well as other clean energy initiatives across its businesses.



"This move from molecules to electrons is inevitable. The energy transition is happening regardless of whether the industry players are ready."

Syed Malek
PETRONAS New Energy's Head of Business Development

CREATING A BRIGHTER FUTURE



"Many people are eager to be green and the prices have come down by 70 to 80 per cent in the last decade."

Looi Kok Sun
Managing Director of Renosuntellus magna

Since the introduction of MESTECC's net metering programme in October 2018, various sectors have taken up 38 megawatts (MW) out of the 500 MW allocated for the programme. In a Sustainable Energy Development Authority (SEDA) statement, the Minister said, Malaysia has huge potential to harness solar power via rooftop PV systems with 3.2 million landed properties, 450,000 shophouses, 90,000 terraced factories, 21,000 stand-alone factories and 1,000 shopping complexes.

The Government's aggressive policies have generated new solar PV behind-the-meter (BTM) business opportunities, including solar leasing, purchase of solar electricity via power purchase agreement (PPA) or a hybrid of both. By mid-March, SEDA had approved 17 solar investor applications since the implementation of the solar PV investor directory in January this year.

"The solar power business can be very viable, with a more than respectable profit margin," said Looi Kok Sun, Managing Director of Renosun, a solar-related systems management consultant, provider and distributor. The recent purchase of Large-Scale-Solar 3 (LSS3) tender documents by 700 companies is further proof. With bids from local companies to undertake RM2 billion of solar projects this year, the tendered capacity will be between

one megawatt (MW) and 100 MW, with a target aggregate capacity of 500 MW in Peninsular Malaysia.

"A solar plant, once set up and harnessing, runs by itself," Looi added. For solar, the initial capital expenditure is always higher than the operating cost, which can plunge to near-zero after it has been set up.

But herein lies the catch - the return-on-investment period, especially for homeowners, could be up to 10 years. But for large companies generating enormous amounts of electricity for their own consumption, savings can be impressive. Moreover, most get their returns, in the form of savings on their energy bills, in about 5 years.

"Many people are eager to be green and the prices have come down by 70 to 80 per cent in the last decade, so the time is ripe," declared Looi, whose company delivers engineering, procurement and construction (EPC) solutions and was recently selected as a contractor on PETRONAS' panel. But it boils down to ringgit and sen in the end, even with the inescapable determining climate change factor. Still, solar energy demand is expected to rise as electricity prices continue to increase and more people are informed about the concept of generating clean electricity themselves.

NEW ENERGY, NEW COLLABORATION

In April 2019, PETRONAS acquired a 100% interest in Amplus Energy Solutions Pte Ltd, also known as M+, a leading Singapore-based company with a portfolio of distributed, renewable energy assets in Asia.

Established in 2013, M+ caters to commercial and industrial customers, specialising in end-to-end solutions for rooftop and ground-mounted solar power projects. With a cumulative capacity of over 500 megawatt (MW) under operation and development, M+ serves more than 150 commercial and industrial customers at over 200 locations across India, the Middle East and South East Asia.

"The acquisition is our first international solar venture. We are also working on a number of solar energy initiatives in Malaysia," Syed Malek explained further.

The month before, PETRONAS' New Energy Unit signed a Letter of Intent with UiTM Energy & Facilities Sdn Bhd (UEFSB), a subsidiary of UiTM Holdings Sdn Bhd to jointly develop Large Scale Solar (LSS) Photovoltaic Power Plants and On-Campus Energy Optimisation, and Solar Rooftop projects.

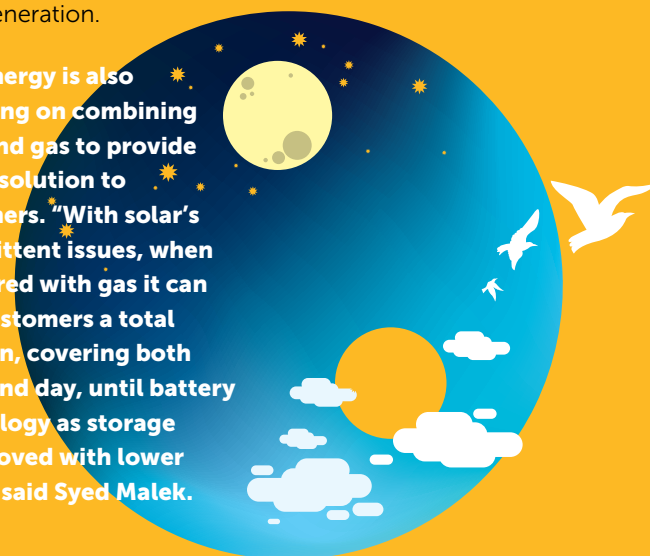
New opportunities here will include installation of solar generators on rooftops and the implementation of energy efficiency initiatives for selected buildings on Universiti Teknologi Mara (UiTM) campuses nationwide. With over 30 campuses,

UiTM can potentially save up to 30 per cent on its annual energy expenditure. UEFSB currently owns a 50 MW large-scale solar PV power plant in Gambang, Pahang, and has also commenced development of its second 25 MW large-scale solar PV power plant in Pasir Gudang, Johor.

PETRONAS New Energy business aims to contribute at least 1.5 GW to the Malaysian Government's renewable energy target of 6 GW by 2025, and collaboration among industry and educational partners like UiTM is crucial.

"We are now ready to deploy our solar rooftop solution to commercial and industrial customers and develop large scale solar projects," stressed Syed Malek. New Energy will be offering a zero CAPEX solar rooftop solution for the commercial and industrial sector. Customers would have to sign a Power Purchase Agreement (PPA) typically for 20-25 years and they enjoy savings through cheaper tariff offered via solar generation.

New Energy is also exploring on combining solar and gas to provide a total solution to customers. "With solar's intermittent issues, when partnered with gas it can give customers a total solution, covering both night and day, until battery technology as storage is improved with lower costs," said Syed Malek.



DEREGULATING THE MARKET



 Solar energy investment is predicted to grow in an open market.

In September 2018, MESTECC reactivated a special-purpose agency, MyPower Corp, for three years as part of the Malaysia Energy Supply Industry (MESI) 2.0 initiative. MyPower, or the Malaysia Programme Office for Power Electricity Reform is an independent company to implement a reform programme that will include increasing industry efficiency; future-proofing the industry structure, regulations and key processes, as well as empowering consumers, democratising and decentralising the

electricity supply industry. According to Syed Malek, New Energy is looking at developed countries to learn from their deregulated markets' innovative energy solutions, for example the US and Europe. Once the electricity supply industry is deregulated in emerging market like Malaysia, we would then be ready to offer our innovative energy solutions.

"This encourages an open market where competition thrives," asserted Syed Malek, stating that a deregulated market would

open up opportunities to enable a myriad of innovations such as peer-to-peer energy trading, which is supported by blockchain technology. The global trend towards electric mobility, too, has the potential to enable vehicle-to-grid energy trading in the future, he reckons. Demand for electric vehicles is expected to rise significantly in the coming decades with a quarter of the world's car fleet to be electric by 2040. And this is driving oil and gas corporations to adapt rapidly.

SOLAR RESEARCH BREAKTHROUGHS



As the solar industry expands, so does R&D. Let's get a glimpse of new research developments with Professor Dr Norani Muti Mohamed from Universiti Teknologi PETRONAS (UTP). She's also the Director of the Centre of Innovative Nanostructures & Nanodevices (COINN), who has been leading a team in developing thin-film photovoltaic devices that can be used to create electricity-generating windows.

The process is a kind of artificial photosynthesis, using dye to capture the sun's energy. Through nanotechnology, the team developed the nano-structured catalyst and other components to improve the dye solar cell (DSC) performance from laboratory scale to user scale for practical application.

Q & A

What constitutes an artificial photosynthesis process?

Artificial photosynthesis is a chemical process that bio-mimics the natural process of photosynthesis to convert sunlight, water, and carbon dioxide into carbohydrates and oxygen. This process could potentially create an endless, relatively inexpensive supply of gas and electricity, and in storable form.

Why did it take us so long to return to nature for inspiration?

For years, scientists have been trying to come up with a way to use the same energy system the plants. With the invention of the photo electrochemical cell (PEC), the system is 'almost there,' but the performance is poor as the natural dye (plant extract) used degrades easily. The breakthrough came with the creation of a highly efficient and stable synthetic dye, responsible for absorbing solar radiation. This is then incorporated into PEC for longer-hour operation in lower solar radiation intensity.

What has been the response to this invention?

Based on the survey results, there's an overall high interest and positive support on the potential market for power-generated solar windows. Since the dye solar cell (DSC)-based building integrated photovoltaic (BIPV) is a new development in Malaysia, there is no competition or close comparison with other forms of BIPV products. Although Silicon (Si)-based BIPV still remains a major contender for high power generation, it is worthwhile for SME investors to look into



Professor Dr Norani Muti Mohamed

Director of the Centre of Innovative Nanostructure & Nanodevices (COINN)

less competitive BIPV products that can evolve into a good niche market with sizeable profit margin. Government policies and incentives on BIPV development should be fully utilised.

When will it be ready for commercialisation and what do you expect the demand to be in the future?

In Malaysia, established Si-based BIPV companies and manufacturers are involved mainly in BIPV deployment and modular development. However, glass-based BIPV with DSCs has not been commercially established in Malaysia. COINN in UTP hopes to become a market catalyst in setting the stage for start-ups to produce power-generating windows based on DSCs. This year, we'll be collaborating with industries to develop the manufacturing processes for large-scale production with the aim to produce commercial-ready solar panels by the end of 2019 or early 2020. >>



Professor Dr Norani (on the right) and her colleague in the lab, developing thin-film photovoltaics using dye.



Electricity-generating windows are the way of the future.

Why the window to harvest energy rather than roof or walls?

In the silicon PV traditionally used in roof or walls, the silicon acts as both, the source of photoelectrons and electric field to separate the charges. In low light conditions, the charges tend to recombine, making silicon PV a poor conductor of current.

Conversely, DSC is made up of photo electrochemical cells and has the light-absorbing dye to replace the chlorophyll in the leaf. The energy is collected by a structure of electrolytes and catalysts, much like the surrounding structure of a leaf. In this way, DSC mimics photosynthesis with very effective charge separation that results in better performance, even at low light levels.

The major breakthrough with the product is also the low manufacturing cost and use of readily available non-toxic raw materials. Solar windows can make 'green' energy a more economically viable option.

What is next in terms of technology to tap fully into solar energy?

There are new technologies that can be further developed. For example, Perovskite cell, the new photovoltaic technology using hybrid organic-inorganic lead, or tin halide-based material as the light-harvesting active layer. It's the first new technology to come along in years, offering the promise of better efficiency in the conversion of light to electric power at a lower cost than existing technologies. Currently, it is still at research level.

And then, there are Photovoltaic (PV) panels. New developments include new aesthetics, such as clear solar panels, bi-facial (double-sided) panels, efficiency improvements and solar inverter integration, frameless solar panels with specialised mounting apparatus, glass solar panels, Tesla solar roof tiles and many more designs to attract users.

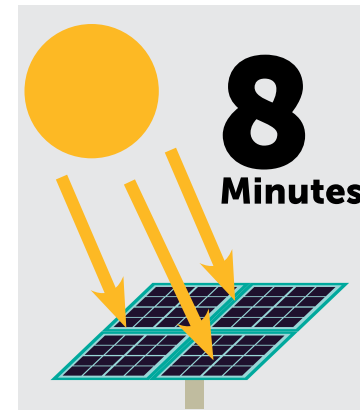
THE POWER OF DYE SOLAR WINDOW

- Performs well in low light, even at 0.1 degree sun at 7.30 am and 7.00 pm, such that it works longer hours in a day; power output comparable to or better than conventional roofing Si PV
- Stable to environment as solar panel has higher tolerance for elevated temperature and minimal performance degradation because active components are not exposed to direct sunlight, unlike roofing deployment
- Robust and requires minimal maintenance, as active components are encapsulated and protected by glass panels
- Bi-facial (two faces) so that indoor light or sunlight coming from other openings can be captured by solar window PV, thus increasing electricity output
- Both outdoor and indoor light can be captured by solar panel
- Less infrastructure required, as window PV configuration produces clean energy right at the point of consumption on building walls.

* DID YOU KNOW?

Evolution of solar could have started as early as the 18th century, when Swiss scientist Horace-Benedict de Saussure created the world's first known solar collector. Featuring three layers of glass, the solar oven reached a temperature of 110°C by harnessing the power of the sun.

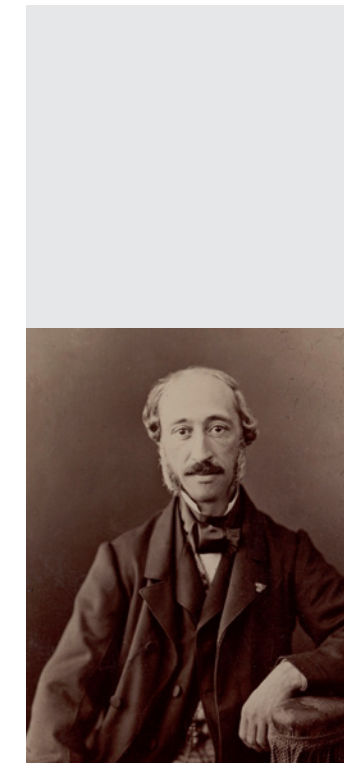
Solar power is one of the world's cleanest, most sustainable and renewable resources.



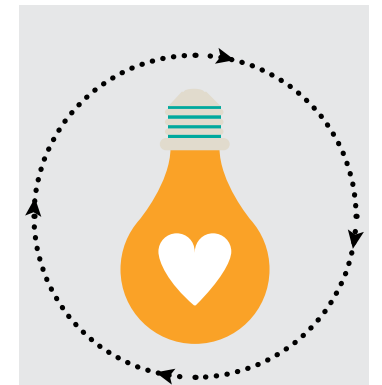
Making contact: Sunlight takes a little over eight minutes to reach Earth and a few seconds longer to make contact with your solar panels.



Las Vegas: Nevada is the biggest US city to operate on 100% renewable resources.



Harnessing solar power: The potential was first discovered by Alexandre Edmond Becquerel in 1839. He figured out the photovoltaic effect, or how to create an electrical current in a conductor that is hit by sunlight.



RE 100 : A collaborative, global initiative uniting more than 100 influential businesses committed to 100% renewable electricity.



Costa Rica: Runs almost entirely on renewable energy - 98% of the country's electricity comes from green sources in 2018.

+ DR MAGARET SIVAPRAGASAM

Recognised for her ionic liquids research on H₂O pollutant control, Dr Magaret Sivapragasam became the sole recipient from Malaysia to be honoured by the International Union of Pure and Applied Chemistry (IUPAC).

To celebrate its 100th anniversary, the highly esteemed organisation created a Periodic Table of Younger Chemist in which displays 118 outstanding young chemists from around the world. She is one of them.

Dr Magaret is no stranger to winning awards. FLOW speaks to the brilliant postdoctoral research scientist about her career aspirations at the Centre of Research Ionic Liquids in Universiti Teknologi PETRONAS (UTP).

What does it mean for you to receive the IUPAC honour?

I'm still in disbelief, but I'm happy to put Malaysia on such a prestigious global platform. Honestly, it gives me goosebumps to see the Malaysian flag on the periodic table.

The discoveries or breakthroughs that have led up to your current work?

In UTP, my team and I work on designing green liquids to absorb dye pigments from textile industrial wastewater, mostly produced by the batik industry. With this discovery, I aim to curb the issue of pollution in small villages.

The First Malaysian Scientist to Receive IUPAC Honour.

It was a long process which involved many people, from designing the chemical compound to optimising it and doing a real-life test on the ecosystem itself. For this innovation, my team and I won two prizes: one from the Shell Ideas360 Innovators, the other is an honourable mention from Yale University.

I won't take sole credit for it. I always believe that any scientific discovery is an amalgamation of team members working towards a common goal. So, I credit my hard-working team for pushing me and supporting all my endeavours.

Are there more women in science today?

I think they are more upcoming female scientists these past few years. Previously, women were bound by gender stereotypes that boxed us into traditional roles or certain types of careers only. But I see a lot of women have been stepping out of these stereotypes and proving themselves on the world stage.



What are these stereotypes, exactly?

Let me share a personal story. In 2017, I started a hashtag on Twitter called #scientistscanwearmakeup. It was after receiving some criticism on wearing makeup as a scientist. I actually had people coming up to me, saying, you don't look like you're a scientist; you look like you belong in the media world or HR. This notion is pretty common in many Asian countries where female scientists are often expected to look and act in certain ways, as in how they dress and carry themselves. And after speaking about it to a few friends, I realise it's a struggle that women face especially in a male-dominated environment.

Do you think we can break the stereotypes?

Yes, we can - if more women in the field of science have positions of power within the science community. I also feel a woman should have the liberty to wear whatever she wants without being judged. I started this hashtag to inspire young girls to always be themselves. And let their personality shine.

What inspired you to get into chemistry? And when?

Ironically, my first degree was in biotechnology, not in chemistry. Then I went on to earn my PhD in bioprocess

engineering. It was not until 2015 that I picked up chemistry in UTP at the Centre of Research Ionic Liquids.

When I first came here, I felt inferior to my colleagues because my grasp of chemistry was rudimentary. I had to force myself to burn the midnight oil and brush up my chemistry skills. Thanks to my strong interest in this line of work, it has pushed me to work hard.

Who was your 'hero' in the scientific field growing up?

My hero is the primatologist, Jane Goodall. She has always taken an unorthodox approach to research. She is well-known for her legendary research on chimpanzees in Gombe Stream National Park, Tanzania, in 1960.

What I like about her and pick up from her is that she actually puts her textbooks aside and immerses herself in learning everything and watching from nature. This particular habit resonates with me because I

feel that by sitting still and observing your surroundings, you have much more to learn than the textbooks can teach you. She showed me that.

Would you say that the IUPAC award is a turning point or defining moment in your work?

My defining moment was actually in 2017 when I won the Science Finder CAS Future Leader Award by the American Chemical Society. This award opens up a whole new world for me, giving me the platform to talk about science at international conferences. Through this award, I was also given the chance to talk to young scientists in various universities about using social media as a means to talk about your work. Science communication is something I'm passionate about. So yes, winning this previous award is a stepping stone for more recognition in my current work.

“ I feel that by sitting still and observing your surroundings, you have much more to learn than the textbooks can teach you. ”





“ I am a firm believer that scientific discoveries shouldn't remain on paper or in the lab. We should put it outside, commercialise it, and tell the world what we have achieved for the benefit of all. ”

How do you see your ionic liquids research evolving?

I don't feel science always has an ending. There is usually some sort of work that can be added on the existing ones. Right now, we are working on developing a prototype, publishing the manuscripts and getting grants and financial resources.

I am a firm believer that scientific discoveries shouldn't remain on paper or in the lab. We should put it outside, commercialise it, and tell the world what we have achieved

for the benefit of all. I mean, what's the point of research if you don't publish it, or speak about it? The study will amount to nothing.

What is the coolest thing about your work? What excites you the most?

It's the ability to inspire and aspire. People whom I don't know, even from different countries would come up to me and say that they look up to me as a role model. I'm happy to hear such positive remarks. They validate my work. Now I know that I am serving my purpose.

What do you like to do when you aren't working on research?

If I am not in the lab and wearing my scientist hat, I love reading and working out in the gym.

What are your long-term goals, in life and work?

I see myself teaching. It has always been a calling in my life. My long-term goal would be to join any university in Malaysia and teach. It's as simple as that.

#scientistscanwearmakeup

Being feminine is often stereotypically perceived as running counter to being successful in Science, Technology, Engineering and Mathematics (STEM) fields. As a woman who works in a scientific field, Dr Magaret has had the experience of being taken less seriously in a feminine attire. Now she is working towards eliminating stereotypes and has started a Twitter campaign - **#scientistscanwearmakeup**.

"I started this hashtag to inspire young girls to always be themselves, and be proud of their achievements," Dr Magaret explains. "I was happy to learn that many female scientists picked up the hashtag."

And for Dr Magaret, the ability to inspire is what keeps her going.

Feb 20
"Magaret hopes that her achievement will inspire young minds, especially young women, to believe in themselves ... as well as encourage them to show interest in, and take up, science-related courses." #malaysiabileh #scientistscanwearmakeup

Feb 20
#scientistscanwearmakeup 🧪👩🏫👩🏠

Apr 10
I am sooo proud of you @MagaretSiva .. really agree on your hashtag #scientistscanwearmakeup 🙌🙌🙌

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