



PENGERANG INTEGRATED COMPLEX

# **Sustainable Development**

**S E R I E S**

**First Edition**





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**PENGERANG INTEGRATED COMPLEX (PIC)**

The HIVE Management Office, 81600 Pengerang,  
Johor Darul Ta'zim, Malaysia

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# PIC's Sustainability Journey

**Kamal Bahrin Ahmad**

*Senior Vice President & Chief Executive Officer  
PRPC Sdn. Bhd.*

Pengerang Integrated Complex (PIC) is PETRONAS' largest greenfield petrochemical complex. Managed by PETRONAS Refinery and Petrochemical Corporation (PRPC) and guided by PETRONAS Sustainability Agenda and PETRONAS Cultural Beliefs, the Vision is for PIC to become THE Regional Petrochemical Park - a distinctive one-stop solutions provider that is competitive and sustainable for all stakeholders.

From the outset, PETRONAS had approached the development of PIC from a sustainable point of view by aligning its design and engineering to the Group's Sustainability Agenda. The journey forward is signposted in the Moving Forward Together (MFT) 50:30:0 roadmap, helping us to navigate the volatile business landscape and attain Net Zero Carbon Emissions (NZCE) by 2050.

Sustainability is both a licence to operate and integral to support business resilience as well as representing new opportunities. It's a balancing act – to be an economic driver and providing jobs for Malaysians while ensuring the long-term availability of resources and protecting the environment for future generations.

PIC goes about this delicate process in a variety of ways. One of the main ways is using technology to trim carbon emissions. Innovative technologies embedded in engineering design reduces projected yearly carbon emissions by more than a quarter, or more than 3.5 million tonnes of CO<sub>2</sub>e. This comes from harnessing steam, via various processes, such as the Cogeneration Plant, the CO Boilers and the Hydrogen Producing Unit, to generate electricity. The Pengerang Cogeneration Plant is one of the largest and most efficient gas-based plants in Southeast Asia, while massive CO Boilers transforms waste heat into

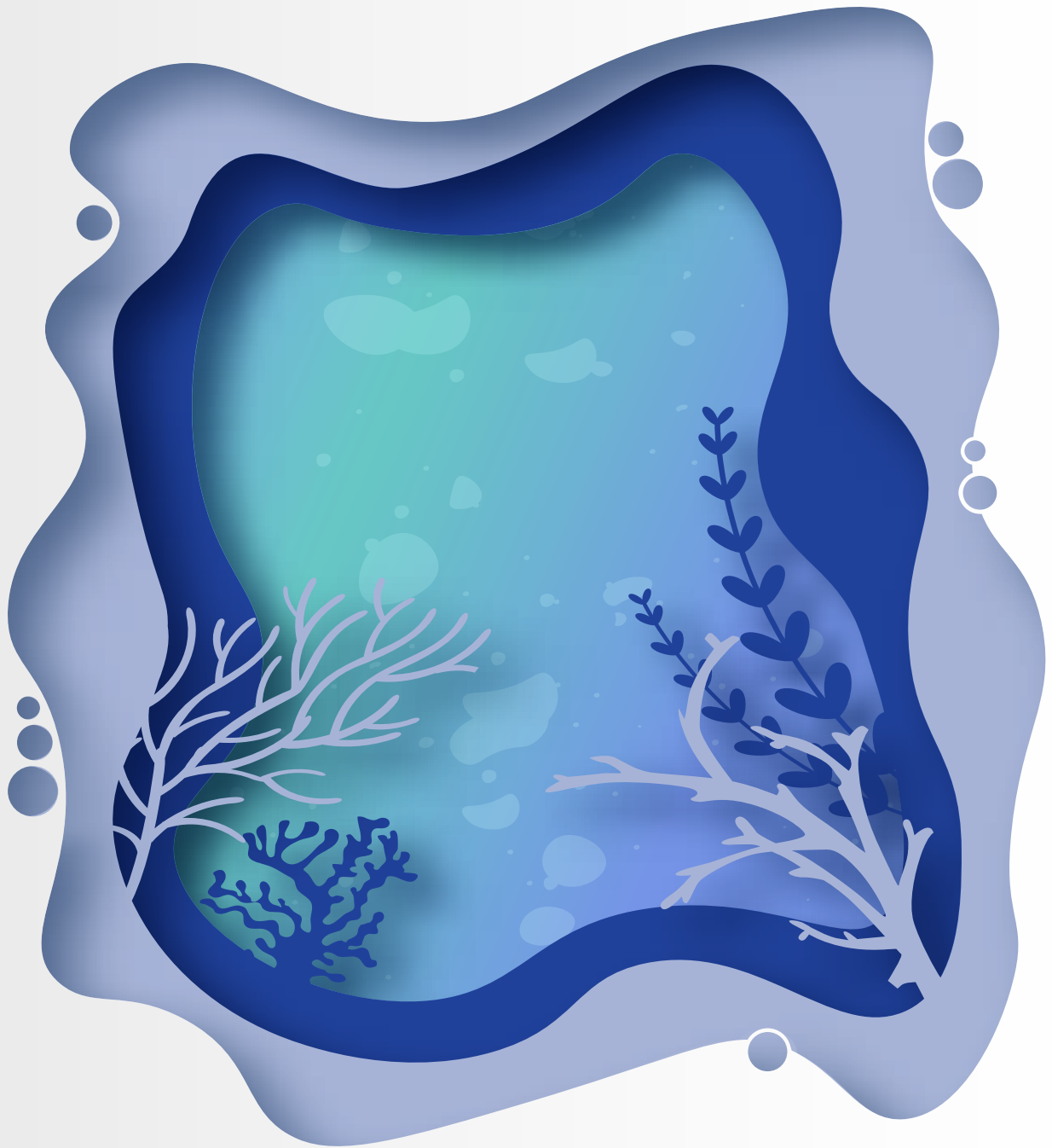
steam to power turbines and process heating.

Another green technology lighting the way towards sustainability is the use of solar power. Leveraging on the availability of land and surfaces in PIC, renewable green energy from solar sources are planned over four phases till 2028. Phase one, in collaboration with PETRONAS Gas and New Energy (GNE) Division, kicked off in December 2020. The pioneer project, involving rooftop and ground mounted solar panels, produces up to 49MWp, reducing an estimated 24,000 tonnes of CO<sub>2</sub>e emissions annually.

PIC is also to be noted for its integrated water-related infrastructure, which not only ensures safe and reliable supply but also safeguards the precious resource. Complete management throughout the chain, from the raw water Projek Air Mentah Rapid (PAMER) Dam to the Effluent Treatment Plant (ETP), enables PIC to maximise water usage efficiency while minimising environment impact. To obtain optimum 3R (Reduce, Reuse, Recycle) yields, innovative stormwater and firewater recycling processes are practised.

PIC takes its positive social impact seriously and a key sustainable feature is the #ForPengerang programme. Among others, the many and varied initiatives under this programme have developed skills, entrepreneurship, and restored livelihoods of the local people, while carrying out environmental protection and conservation activities, both in PIC as well as the community.

As we move past our start-up in May 2022, PIC's Sustainability Journey continues – to become a diversified, integrated business that is at the forefront of PETRONAS Group's transformation into a progressive energy and solutions company, along the way enriching lives for a sustainable future.



# Green Water Technologies

# Preserving PIC Waters

We depend on water for life itself. Managing water resources efficiently and preserving ecosystems that capture and regenerate these waters are critical for a secure and sustainable supply. In the Pengerang Integrated Complex (PIC), water is key in everything we do, from refining petroleum products to manufacturing of petrochemical products. It is used extensively for cooling and is an essential component for production of power, steam and other critical utilities required to sustain operations

In alignment with the PETRONAS Sustainability Agenda, the visionary planners of PIC put in place sustainable water management practices, ensuring continuous supply to meet current and future needs. A multidisciplinary and holistic approach was employed in which technical, environmental, economic and societal needs were thoroughly evaluated.

Green technologies and 3R (Reduce, Reuse, Recycle) water strategies optimise water usage efficiency, reduce the overall freshwater withdrawal rate and minimise environmental impact. Innovative storm and fire water recycling usage maximises reuse, while effluent management strategies see to safe disposal of effluents and run-off water into receiving water bodies.

PIC's integrated water-related infrastructure – Projek Air Mentah RAPID (PAMER), Raw Water Treatment Plant (RWTP), Effluent Treatment Plant (ETP) and Storm Water Outfall (SWO) – form the backbone for sustainable water management that safeguards water resources and ecosystems.



## Safeguard the Environment

Ensuring minimal impact on biodiversity and ecosystems through sound water management and safe disposal of effluents using innovative technologies.



## Positive Social Impact

Contributing to the wellbeing of the community through delivery of projects that offer long-term economic benefits.



## Responsible Governance

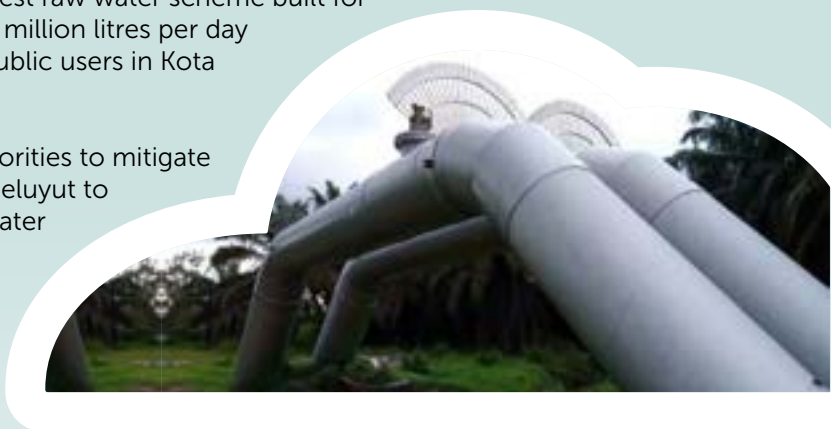
Responsible governance with robust mechanisms and strong emphasis on stringent compliance and transparent reporting.

# PAMER Ensuring Reliable Supply

Projek Air Mentah RAPID (PAMER) is Malaysia's largest raw water scheme built for the Oil & Gas industry. From the Seluyut Dam, 230 million litres per day (MLD) of water is supplied to PIC and 30 MLD to public users in Kota Tinggi district, Johor.

PAMER collaborates closely with government authorities to mitigate water supply issues, diverting raw water from the Seluyut to Lebam and Layang Dams in dry seasons to avert water shortage in the state.

The facilities were designed with provisions to be able to scale up to 500 MLD capacity in the future.

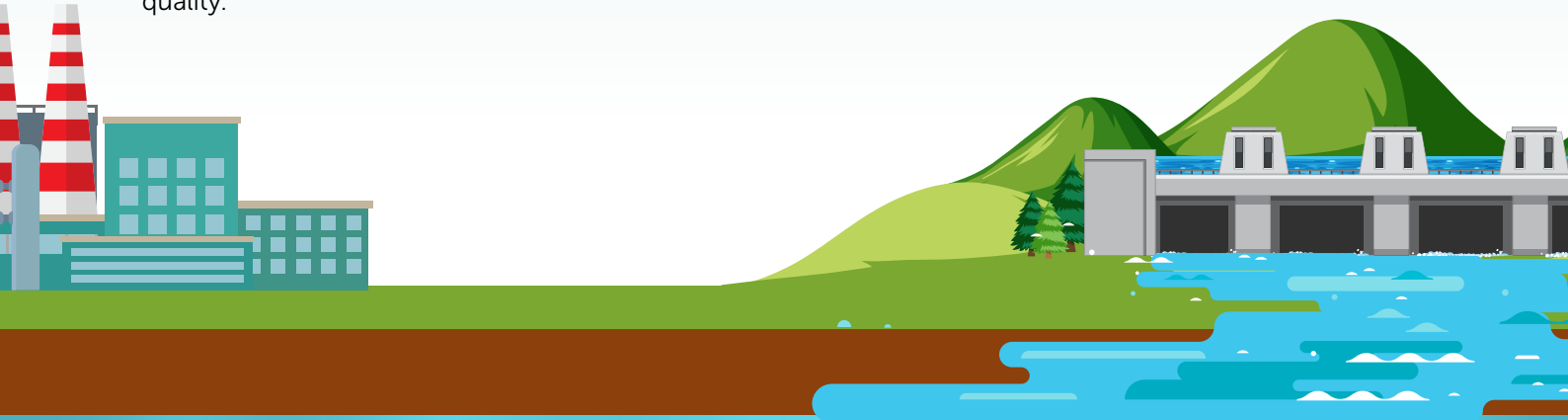


Water from Seluyut Dam is channeled to the RWTP by unique twin pipelines with interconnections that safeguard water supply

Water from the Seluyut Dam is pumped via twin pipelines to a Terminal Reservoir at Bukit Panjang, from where it flows to the Raw Water Treatment Plant in PIC and onwards to plants in the Refinery, Steam Cracker and Petrochemical Complex.

The unique twin-pipeline configuration incorporates 'interconnections' that allow water flow to be diverted from one pipeline to the other in the event repairs need to be carried out. This feature prevents wastage and ensures security of supply for plant operations.

Environmental conservation was prioritised during PAMER's construction right through to its operations. During the project stage in 2015, the team worked with Perhilitan in developing a Wildlife Management Plan to preserve the ecology in the forests, at one point relocating an entire herd of elephants. To protect the environment during operations, compensation flows released from Seluyut Dam preserve downstream aquatic ecosystems, while sound catchment and river basin management ensures sustainability of water quality.



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# RWTP Green Features in Water Treatment

The Raw Water Treatment Plant (RWTP) in PIC treats a total of 255 MLD for process use, power and steam generation, cooling water systems and effluent treatment. RWTP is a 'total recycle' facility where no effluents leave the plant – everything goes back into the system for further treatment.

It also innovatively recycles storm water, with one treatment train combining recycled streams of storm water, demin water and RWTP filter backwash with raw water, while another 2 trains treat fresh raw water from PAMER.

After undergoing processes of aeration, clarification, sedimentation, filtration and disinfection, the water is channelled for further treatment to meet industrial standards for a host of requirements in the plants.

The treatment process includes chemical injections to facilitate algae control, optimisation of coagulation and flocculation, and PH adjustment.

The amount of chemicals is carefully adjusted for the storm water train, which feeds solely to the cooling water system to prevent any cross contamination.

Another green feature is the sludge generation system which sends sludge through a dryer unit to be dried and compressed to 85% of its volume, reducing the amount of scheduled waste for disposal.

Thoughtful features like these take the RWTP to the cutting edge of green water technologies.



The RWTP efficiently treats 255 MLD of water for PIC through 2 treatment trains for fresh raw water from PAMER and a third train that innovatively recycles storm water



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## Embracing 3R for Sustainability



Water is critical to the operations of PIC. Here the most material commodity is managed holistically and sustainably, with effluent wastewater given as much attention as its freshwater counterparts. Water 3R forms an integral part of PIC's drive-in sustainability and reducing freshwater withdrawal.

PIC's Effluent Treatment Plant (ETP) is the largest in PETRONAS and designed to comply with the Malaysian and International Finance Corporation (IFC) discharge quality standards. It employs a multitude of treatment methods that are energy efficient and economical. It also recycles a portion of the treated effluent for use as service water and general landscaping. Efforts are increasing the amount of treated effluent to be recycled with the aspiration for PIC as a zero liquid discharge facility, ultimately supporting the circular economy transition.

Various treatment methods are used at the ETP. Physical methods as Corrugated Plate Interceptor, Dissolved Air Floatation and Multimedia Filter are combined with thermal methods, such as Wet Air Oxidation, and biological methods that mimic nature's purification technique but hastens the natural process while increasing its efficacy by maintaining the right conditions for the working bacteria to thrive.

The two-stage Bio Filter and Activated Sludge process uses bacteria species to break down pollutants before being released to the receiving water body, thus minimising environmental impacts associated with the release of untreated industrial effluents.

The resultant biological sludge is also handled in its dedicated system. It is dewatered and dried, reducing the volume that needs to be disposed of externally. To prevent the odoriferous side effects of its operation, the ETP is also equipped with a Volatile Organic Compounds (VOC) Treatment Unit that uses activated carbon beds to absorb and capture these unpleasant and pungent compounds.

Segregation at the source where the effluents streams were sorted according to their characteristics and strength are also extensively employed. The streams, ranging from accidental oil-contaminated (AOC) to sanitary wastewater, are segregated at the generating sources and then conveyed through nine dedicated collection headers before entering its assigned treatment unit.

The initial sorting prevents cross-contamination and **reduces** the pollution loading by not allowing the co-mingling of the different effluents. This approach enables PIC to **recycle** low-strength effluents by employing cost-effective treatment methods. Also, the pure water from the blowdown of the steam boilers is directly **reused** to supplement the water requirement of the cooling towers.

PIC's water resources management embraces the 3R solutions for a secure and sustainable supply of water. The application of segregation at source future-proofs the PIC ETP for more 3R opportunities. Through these efforts, water consumption is prudently managed by ensuring that every drop counts, from responsible use of freshwater resources to reducing and recycling effluent discharge for a sustainable PIC operation.

# All Water Worth Saving



PIC is located in an area blessed with abundant rainfall, especially during the monsoon seasons. This allows stormwater harvesting to be deployed from the perspective of the 2R's (Reuse and Recycle).

Stormwater harvesting facilities at PIC consist of a 4.5 km long Main Storm Water (MSTW) drainage system that acts as the backbone, with collection arteries that gather and redirect the stormwater surface runoff non-process areas into dedicated retention ponds. The ponds, totalling three in number, act as on-line storage, acquiring stormwater directly from the MSTW.

Each pond consists of three compartments. The first compartment is designed to acquire and store stormwater runoff for direct "reuse" as backup firewater during emergencies.

The stormwater runoff then flows into the second compartment, designed to acquire and store stormwater to be "recycled" in a dedicated treatment train at the Raw Water Treatment Plant (RWTP). Here, up to 3,000 cubic metres per hour of treated stormwater can be used to supplement the water requirement of the cooling towers.

As an indication of the magnitude of water recycled, the stormwater volume of 3,000 cubic metres per hour or an equivalent of 72 million litres per day is almost similar to the production water supply of the federal territory of Labuan of 76 million litres a day in 2019.

The excess stormwater runoff then flows into the third compartment before its release to the sea via the Storm Water Outfall channel (SWO), located to the east of the Material Offloading Facility (MOLF) at Tanjung Setapa. This channel, measuring 145 metres long and 80 metres across, can accommodate excess stormwater runoff at a flow rate of 505 cubic metres per second.

The stormwater ponds and SWO channel work in tandem to manage the rate of discharge into the sea. By dispersing and slowing down the stormwater runoff, potential issues with coastal erosion are mitigated. This is PIC's way to ensure that its existence in the area does not adversely impact the surrounding environment.

With freshwater a premium worldwide, it is essential that PIC manages its water resources with utmost care. PIC will continue to explore other 3R opportunities as the key driver in managing its sustainable freshwater resources.



# Managing Waste Heat

# Cogeneration Puts Waste Heat to Work



Technologists in PIC are obsessed with capturing as much energy as they possibly can – and they’ve done a remarkable job with waste heat.

Recycling waste heat translates into significant gains not just on financial sheets, but more importantly, in the delicate balance of nature. Besides lowering Scope 1 GHG emissions and directly reducing carbon footprint, it also lowers consumption of electricity and turns the heat into steam for heating and process purposes – on both counts impacting sustainability positively.

PIC’s green agenda is embedded in its very blueprint. In designing the power source for the Complex, for instance, it made absolute sense to turn exhaust waste heat from power generation into steam. Hence, the state-of-the-art Pengerang Cogeneration Plant (PCP) was conceived.

One of the largest and most efficient gas-based cogeneration plants in South East Asia, PCP has installed capacities of 1,729 MW of power and 3,200 tph of steam. It uses natural gas, a relatively clean fuel, supplied by PIC’s LNG regasification terminal, RGT2.

The Cogen Plant powers the entire PIC complex and provides a reliable and continuous supply of steam to the process plants, with an additional power capacity of about 600 MW being sold to the national grid.

Other innovative strategies further boost the Cogen Plant’s efficiency and reliability such as supplementary firing that provides flexible operations by allowing steam generation at low gas turbine load. There are also features that control and balance real-time supply-demand, enabling accurate delivery of power within specified limits to the national grid.

PCP set a precedent when it was awarded the first-ever full-fledged Power Purchase Agreement between national power company Tenaga Nasional Berhad and a cogeneration plant, an achievement certified by Malaysia Book of Records. This paves the way for a more significant application of highly efficient cogeneration technology in the nation.

Steam generated from exhaust waste gas is used to power the steam turbines, boosting energy efficiency to well over 80% when in full operation.

**This is among the highest levels of energy efficiency for combined cycle technologies available globally.**



En M Zulkarnain Muhamad  
PCP's Head of Plant



Saves more than USD 5 billion over 20 years compared to coal-firing



Reduces carbon dioxide emission by up to 50%



Recycles 100% of blowdown steam into cooling water



2

Steam Turbine Generators

4

- H-class Technology Gas Turbines
- Hydrogen-cooled Power Generators
- Heat Recovery Steam Generators



## Safeguard the Environment

Minimising the impact on the environment through the use of innovative technologies.

## Responsible Governance

Ensuring stringent compliance with regulatory requirements.

# CO Boilers Recycle Waste Heat

At the PIC, energy optimisation is a priority, right from the Front End Engineering Design (FEED) stage. With the aim to reduce energy consumption through efficient solutions for heat generation and recovery, advanced systems were included to optimise overall plant performance.

Major equipment like furnaces are designed to have minimum 88% fuel efficiency, with some operating at a rigorous 92%. Excellent steam management strategies ensure that any excess is converted into electricity. Besides that, waste heat is also recycled.

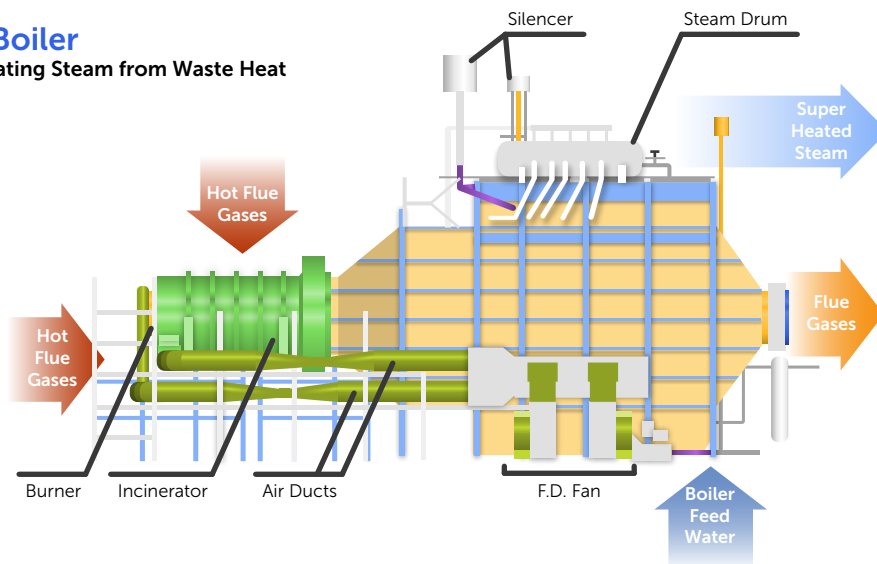
A prime example is the CO Boilers, an essential component of the Residual Fluid Catalytic Cracker (RFCC) which cracks hydro-treated atmospheric residue into feedstock for the Steam Cracker. These facilities are part of the Refinery and Petrochemical Complex which is owned by PRefChem, a joint venture between PETRONAS and Saudi Aramco.

The two CO Boilers, each weighing about 2,000 tonnes, transform waste heat into steam for process heating and to power turbines. In doing so, they cut down CO<sub>2</sub> emissions by about 1.3 million tonnes a year, one of the largest contributors to Scope 1 emission reduction in PIC.

The CO Boilers convert carbon monoxide (CO) in flue gases into carbon dioxide (CO<sub>2</sub>) and use the heat generated to transform boiler feed water into superheated steam. There are two main sections – the CO incinerator where the combustion of CO occurs, and the waste heat boiler where heat recovery takes place. Combustion effluents from the incinerator mixed with flue gases are channelled to the waste heat boiler, where heat is efficiently recovered, and superheated steam is produced for various steam systems, to meet requirements at the main fractionator of the Refinery.

## CO Boiler

Generating Steam from Waste Heat



## Cleaning Emissions

The CO Boilers work in combination with the RFCC Scrubbers to treat flue gases from the Regenerators for safe release to the atmosphere. The incinerator reduces CO to stringent emission levels of 200 mg/Nm<sup>3</sup> and below. Three low-NO<sub>x</sub> burners in the combustion chamber ensure that NO<sub>x</sub> emissions are kept at levels of 450 mg/Nm<sup>3</sup> or less during RFCC operation. The Scrubbers remove particulate content and SO<sub>x</sub> to meet regulatory requirements.

## Flexible Firing

En Nor Syamrin Wagirin, PRefChem's Area Head of Refinery Technology, elaborates on the Boilers' advanced capabilities, "The incinerator's dual firing mode optimises the consumption of fuel oil and reduces natural gas intake." Firing of a mixture of fuel oil, natural gas and combustion air in the incinerator chamber occurs at a controlled temperature of 1,050°C. Oxygen levels, gas velocity and 'residence time' are also carefully monitored to ensure a significant reduction of CO levels in the gases.

## Efficient Heat Recovery

The massive waste heat boilers, with heat duty of 207.6 MW and the total heating surface of 1,1620 m<sup>2</sup>, recover heat and cool the gases to temperatures of 205°C or lower. The recovered heat is fed to several steam systems:

▶ High-pressure superheated steam of 326.7 t/h is generated to maintain a delicate steam balance at the Refinery and Steam Cracker plants.

▶ Superheated saturated steam at medium pressure of 48.68 t/h and low pressure of 13.76 t/h is generated for RFCC internal usage.

This solution to harness waste heat is a clear demonstration of PRefChem and PIC's commitment to a greener, sustainable future for all.



## Safeguard the Environment

Minimising the impact on the environment through the use of innovative technologies.

## Responsible Governance

Ensuring stringent compliance with regulatory requirements.

# Harnessing Energy from Excess Steam

**In line with PETRONAS' commitment to achieve Net Zero Carbon by 2050, facilities in PIC shoot for the highest levels of energy efficiency possible, with notable results.**

Utilities provider PRPC UF operates massive steam distribution networks to supply high, medium and low-pressure steam for process purposes. The steam is channeled to various process facilities in the Refinery and Petrochemical Complex.

A fine steam balance must be maintained in the networks – any excess is condensed via an energy-intensive cooling process and recycled as boiler feed water. Seizing the opportunity to maximise energy recovery, the Complex planners added a Steam Turbine Generator (STG) in the LP steam pathway.

The newly built STG, codenamed Unit 4155, is scheduled to begin operation in Q1 2021. It features a Baker Hughes fully condensing turbine which has the capability to recycle excess steam from the LP steam header, converting it into electrical power.

The turbine extracts energy by expanding the steam to slightly below atmospheric pressure and channeling the energy to the generator via a gearbox. Condensate that is produced as a by-product is sent to a drum for recycling as boiler feed water.

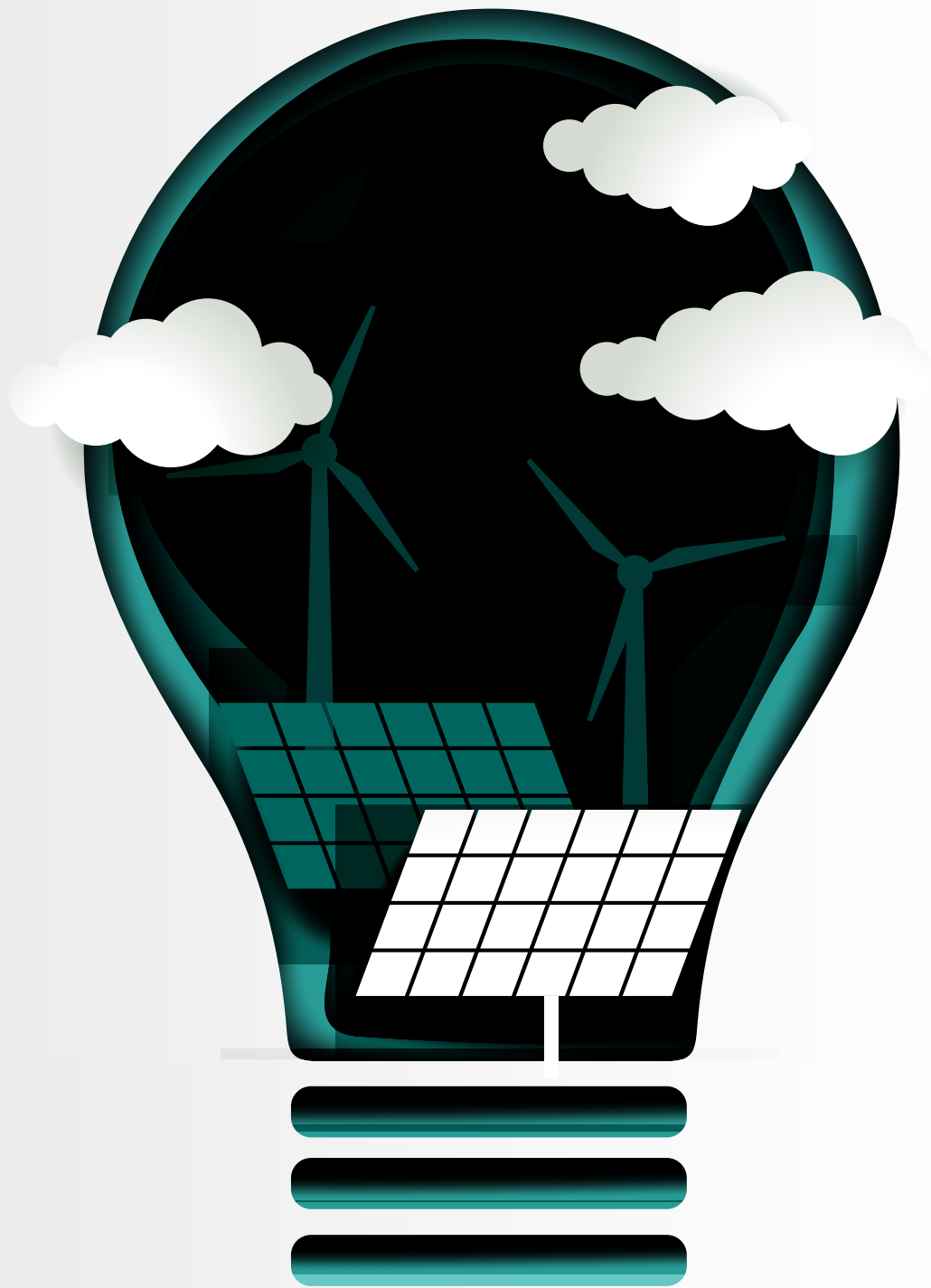
During normal operations, Unit 4155 can convert 100 tons per hour of LP steam into 14 MW of electricity. In periods of low LP steam usage, it pushes the limits to transform 140 tons per hour of steam into 19.2 MW of power. The 11 kV electricity that it generates is stepped-up to 33 kV and exported to PIC's high voltage grid, to augment power supply to the plants.

**The STG is estimated to generate 288 MWh of power in a year, equivalent to over 23,000 tonnes of CO<sub>2</sub>e emission avoidance.** The unit is one of numerous energy recovery technologies that effectively reduce Scope 1 GHG emissions and shrink PIC's carbon footprint, in full alignment with PETRONAS' Sustainability Agenda.



## Safeguard the Environment

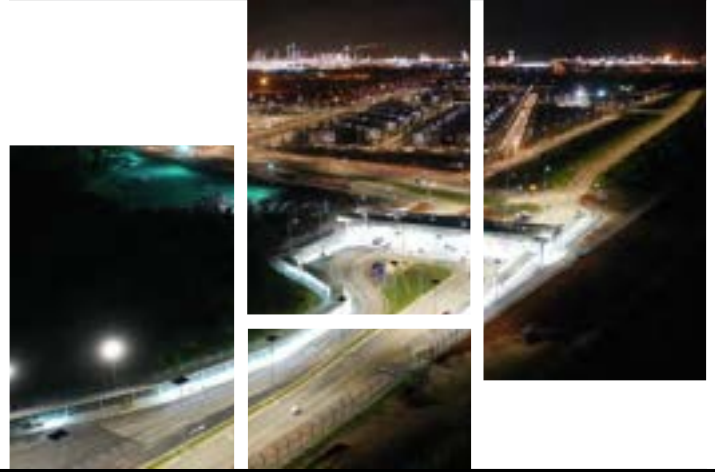
Minimising the impact on the environment through the use of innovative technologies.



# PIC Growth Projects

## SOLAR POWER LIGHTS THE WAY

Located in a region that is blessed with abundant sunshine, PIC is harnessing solar energy in line with its sustainability agenda. Solar panels have been installed at several strategic locations to augment power supply for PIC's requirements.



## POWERING THE COGEN PLANT

The Pengerang Cogeneration Plant (PCP) took the lead in PIC's drive towards renewables with the installation of 628 Solar Photovoltaic (PV) panels and 9 inverters on its roof tops. The panels collectively provide 207 kilowatts peak (kWp) of power, sufficient to supply 80 per cent of the plant's office and control building energy needs. This translates to a reduction of 108 tonnes of greenhouse gas emissions annually. The initiative places PCP uniquely among the first solar powered Cogeneration Plants in the world.

## BRIGHT LIGHTS AT GATES AND PARK

PIC gates are another solar power generating point. Gates 1 and 3 are installed with 276 PV panels covering an area of 548 sq m, which produce about 105 kWp of electricity. In a year, the solar panels generate more than 140,540 kWh of energy, contributing to a reduction of 132 tonnes of greenhouse gas emissions annually.

Additionally, Gates 1, 2 and 3 and the jogging track along the Seaside Park are installed with 450 solar streetlights that supply well over 190,700 kWh of energy annually. The streetlights keep the area brightly lit, enhancing security.

Besides these solar solutions, there are bigger plans in store. Feasibility studies are on-going for more initiatives including plans for a floating solar project. Solar power will continue to light the way to the future for PIC, in alignment with its commitment to environmental protection and long-term value creation.



## Safeguard the Environment

Reducing carbon footprint through renewable energy solutions.

*The Pengerang Integrated Complex is fully committed to the sustainability agenda, in line with PETRONAS' purpose to be a progressive energy and solutions partner enriching lives for a sustainable future.*

# SOLAR PROJECT

## BOOSTS GREEN ENERGY IN PIC

When it starts up in 2021, PIC will not only be one of the largest integrated petrochemical hubs in the region, it will be aggressively exploring sustainable technologies and energy systems.

Park developer PETRONAS Refinery & Petrochemical Corporation (PRPC) is steering PIC's growth plans in line with PETRONAS' Sustainability Agenda. Considerations include optimal operating efficiency, alternative energy systems, innovations through research and development, as well as positive social impact.

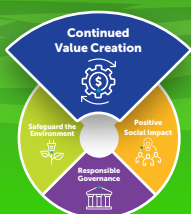
Apart from petrochemical derivative projects to maximise the value of molecules, Green Energy initiatives are being pursued with passion. The first to be rolled out is the Solar Project, with installations of up to 400 MWp capacities planned for the next 5 years in collaboration with PETRONAS Gas & New Energy (GNE) Division. This also includes Floating solar installations at PAMER which are being explored for the near future.

Phase 1 of the Solar Project received PRPC Board approval in August 2020, followed by approval from the board of PETRONAS Power Sdn (PPSB), a company in GNE Division, in December 2020. On 29 December 2020, four milestone Power Purchase Agreements (PPA) were signed between PRPC Group of Companies and PPSB.

Phase 1 involves rooftop and ground mounted solar panels totalling 49 MWp in capacity, to be installed in PIC and at the PAMER raw water supply facility. Forecast to start operations in Q4 2021, these panels will reduce greenhouse gas emissions by an estimated 30,850 tonnes annually, shrinking the Complex's carbon footprint.

Besides the Solar Project, PIC has its sights on numerous other sustainability projects. They include Zero Water Discharge through recycling of rainwater and effluent water; Algae and Biofuels by Group Research & Technology; as well as a Plastics-to-Energy project under study by PETRONAS Chemicals Group.

All of which point to long-term economic value creation and an exciting future for PIC, in full alignment with PETRONAS Group's purpose to be a progressive energy and solutions partner, enriching lives for a sustainable future for all.





# Enriching Community & Workers Life

# #ForPengerang Nurtures Cooperatives

PIC brings positive change to the surrounding communities through #ForPengerang, an initiative that has the villagers' socio-economic well-being at heart.

Among other efforts, #ForPengerang nurtures the development of cooperatives, entrepreneurs, skills and capabilities, and advances livelihood restoration programmes. It also runs various community development and education outreach programmes, as well as environmental protection and conservation initiatives.

Back in 2012, a group of representatives of seven villages in Pengerang came together to chart the economic future for members of their communities. They formed Koperasi Pengerang Jaya Johor or KOPEJA, a cooperative with a membership base of over 500, which would be a stepping stone to seize the wealth of opportunities created by PIC.

KOPEJA began with investments in small ventures, and raised the game in 2016 when it was invited by PETRONAS to run a diesel station within PIC to supply thousands of vehicles plying the complex grounds.

Sales quickly grew and KOPEJA expanded further in 2018 by setting up Pit Stop, a convenience store-cum-cafe at the station that served as a much-welcomed stopover for drivers and workers at PIC. It later opened a larger mini market to cater to the thousands of customers in one of PIC's temporary workers' camps.

KOPEJA is now the largest cooperative under the #ForPengerang umbrella with a number of subsidiaries incorporated. Successfully ventured into Supply & Services, the cooperative has also taken a bold step into technical services with the ultimate aim of becoming a Technical Vendor within the next 10 years.

The #ForPengerang cooperatives development programme was also extended to four other cooperatives in businesses that include lubricants warehousing and distribution, retail, landscaping, catering and carwash services.

All five have reported annual sales that exceeded their targets and are at various stages in adding more building blocks for future undertakings, in the interest of their members and community.

"Together We Move Forward", the motto that drives KOPEJA, is the common theme behind the formation of the five cooperatives.

**"We come together, decide where we want to go, take charge of our own destiny – not just in the interests of the current members but also for what may come in the future for our children, their children and grandchildren."**



## Positive Social Impact

Contributing to the wellbeing of the community. Cumulatively, between 2019 and 2021, profitable cooperatives earned a total of RM4.76 million.

# Mussel Farming Restores Livelihood



The indigenous Orang Seletar, once nomadic seafarers living in pau kajang or houseboats, gradually settled in villages on the southern coast of Johor. The sea continues to be an essential source of subsistence for them, with traditional fishing and mussels farming being two popular economic activities.

When the Pengerang Integrated Complex (PIC) development reduced fishing areas in Pengerang waters, a feasibility study was conducted under the #ForPengerang initiative aimed at establishing lasting socio-economic wellbeing in the surrounding communities.

The study led to the launch in April 2019 of a green mussel aquaculture project in Kampung Kuala Masai, to restore and enhance the livelihood of about 100 Orang Seletar fisherfolk.

The project is a joint effort among PETRONAS, PRefChem, the Department of Orang Asli Development, the Fisheries Development Authority of Malaysia, the Johor Department of Fisheries, the Malaysian Institute of Policy and Nutrition and Universiti Putra Malaysia. It aims to provide an enhanced and sustainable source of income for the Orang Seletar through improved aquaculture methods and technology.

The livelihood restoration programme involves five villages: Kampung Pasir Salam in Ulu Tiram, Kampung Pasir Putih, Kampung Kuala Masai, Kampung Teluk Jawa and Kampung Teluk Kabong in the Pasir Gudang vicinity.

To date, 30,000 collector trawl lines have been installed in Kampung Kuala Masai for mussel breeding.

The fisherfolk are looking forward to a good harvest of mussels that will supplement their income. Just as importantly, the project brings the once seafaring people closer to familiar territories, to preserve some of their age-old ways and traditions.



The project aims to restore and enhance the livelihood of about 100 Orang Seletar.



## Positive Social Impact

Contributing to the wellbeing of the community. Harvest is forecasted to add RM200 income per month for every farmer.

# Breaths of Clean Air

Clean air is an undeniable human right. To ensure that its operations do not impact air quality in the surrounding areas, Pengerang Integrated Complex (PIC) has rolled out its Continuous Ambient Air Quality Monitoring (CAQM) station in January 2021 to monitor air quality in the surrounding areas.

The station is the first and only one of its kind in PETRONAS operations, and the set-up is similar to other air monitoring stations installed by the authorities in Malaysia.

The inconspicuous shed, with the 10m tall meteorology tower, is situated within the grounds of Sekolah Kebangsaan Pengerang. Approximately 1km from PIC western boundary, the site is approved by the Malaysian Department of the Environment (DOE).

The station consists of a meteorology sensor, gas analysers and data acquisition system. The US-made equipment continuously monitors the ambient air quality for Nitrogen Dioxide (NO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>), Hydrogen Sulfide (H<sub>2</sub>S), Benzene, and meteorological parameters such as wind speed and direction, relative humidity, ambient temperature and rain data.

The station runs on a 24-hour basis and provides verified and quality controlled hourly data to the users. The information is relayed to the dedicated HSE teams in PIC via an online share point including a warning system to inform the users on limits based on Malaysia and IFC standards.



# Steward of Workers' Well-Being

The Code of Conduct and Business Ethics (CoBE) guides PETRONAS Refinery and Petrochemical Corporation (PRPC) in how we conduct business, run operations and upholds our commitment to sustainable development.

It is intrinsically linked to PETRONAS' Human Rights Commitment, which encompasses labour and working conditions, third party security, supply chain management and community well-being.

Human Rights is embedded across the five key areas of the PETRONAS Social Performance Framework that could potentially affect operations, namely Environment, Health, Safety, Security and Socio-economic and Cultural.

At Pengerang Integrated Complex (PIC), PRPC, as Park Manager, is fully committed to improving the quality of lives of workers and contributing to societal well-being and progress by treating everyone with equality and respect, and providing a high standard of housing, facilities, services and amenities.

The HIVE Residency, SPC Camp and P14 Camp in PIC is capable of housing more than 17,000 people in quality housing, supported by various dining, indoor and outdoor recreation, religious and medical facilities.

The COVID-19 pandemic highlighted the importance of proper housing and living facilities for workers as a key measure to contain the disease. In 2020, an audit conducted by the authorities gave all of PIC's residential facilities a clean bill of health under the Workers' Minimum Standards of Housing and Amenities Act 1990 (Act 446).

Strong camp and workers' grievance management coupled with a stringent Health, Safety, Security and Environment Framework also guarantees worker welfare and well-being and productivity while safeguarding resources and maintains trust and license to operate.

By doing so, PIC is sustaining PETRONAS' aims to uphold strong governance mechanisms and create a positive social impact at the same time.





# CO<sub>2</sub> Emissions

# Technologies Trim Carbon Emissions at PIC

At PIC strategies to minimise carbon footprint were built into the very design of this mega-project.

Carbon dioxide equivalent (CO<sub>2</sub>e) emissions are estimated at 10.2 million tonnes a year during operations, resulting from hydrocarbon combustion in process furnaces, heaters and gas turbines.



**Mohamad Nasir**  
Head of PIC Operations & Complex Management  
*(former Head of Process during project stage)*

“By including a suite of innovative technologies, the mega-complex can avoid **3.9 million tonnes of CO<sub>2</sub>e emissions annually** – a substantial one-quarter of the 14.1 million tonnes that might otherwise have been released.”

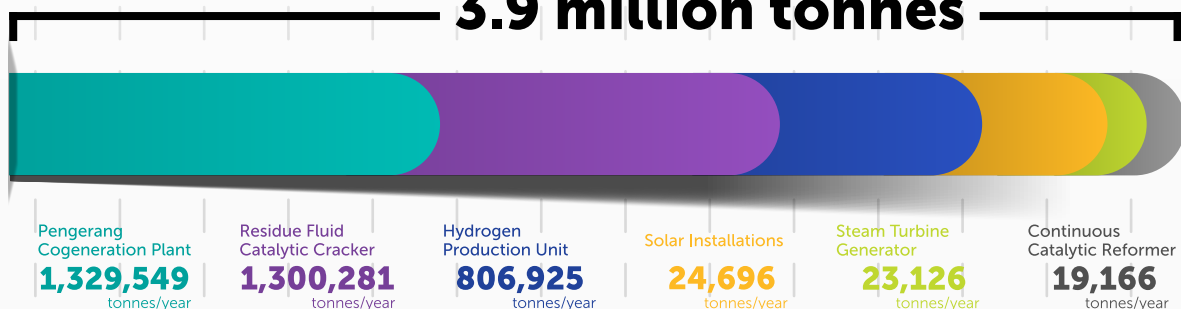
Carbon emission-reducing features were incorporated in the engineering design, such as recycling of waste heat for steam generation by the Cogeneration Plant, CO Boilers, Sulfur Recovery Unit, and Hydrogen Producing Unit.

The Continuous Catalytic Reformer generates steam via reaction convection. Besides, a steam turbine generator and solar installations harness energy to produce power.

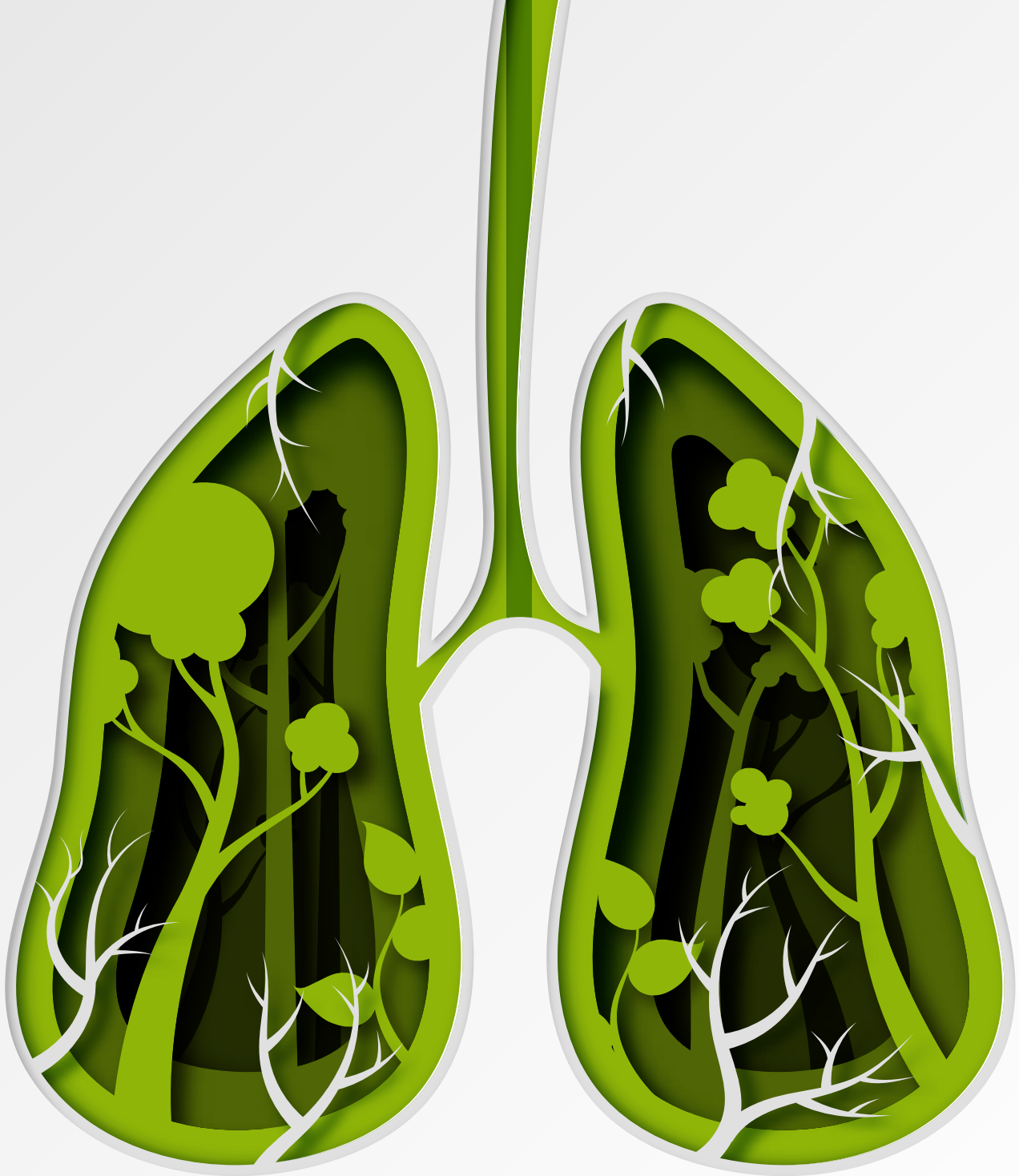
Right from its blueprint, PIC is fully committed to employing cutting-edge technologies to ensure sustainable operations and growth, in line with its purpose to be a progressive energy and solutions partner, enriching lives for a sustainable future for all.



## PIC CO<sub>2</sub>e Emissions Avoidance **3.9 million tonnes**



**Safeguard the Environment**



# **Biodiversity & Natural Resources**



# Beach Clean Up at PIC

Keeping the surrounding beaches tidy is a priority for the PIC, and it is a key activity in its programme to keep the environment clean and maintain the aesthetic value of the area.

A dedicated team from PIC's Complex Facilities and Services (CFS) diligently scours the Pengerang shoreline on every weekday to pick up litter and waste that is washed up on the beaches. Armed with gloves, pick up tools and garbage bags, the 'beachcombers' begin their task early in the morning and finish at about 5pm each day.

Says CFS Supervisor En Wan Naazreen Idham Yaakub, "It is hard work for the team members going over the long shoreline including some rocky outfalls, but it's satisfying to know that we are contributing to preserving the environment around PIC." The team collects about 6 tons of rubbish each month, which is disposed of properly at a landfill.



On top of the daily activity, Beach Clean Up events are organised periodically with participation from a large number of PIC staff. On those occasions, the volunteers fan out over a wide expanse of the shoreline beside the Storm Water Outfall, picking up bagsful of waste including discarded pieces of plastics, wood, tyres, tarballs and other domestic debris.

Besides cleaning up the environment, the events also raise awareness on the effects of coastal pollution on marine life.



## Safeguard the Environment

*The Pengerang Integrated Complex is fully committed to the sustainability agenda, in line with PETRONAS' purpose to be a progressive energy and solutions partner enriching lives for a sustainable future.*

# Meet Some of Our Neighbours at PIC



*Lutung*  
at the West Buffer Zone



*Musang*  
at the Northern Detention  
Corridor (NDC) and the West  
Buffer Zone



*Tupai*  
at the West Buffer Zone



*Helang Merah*  
at the South Coastal Line



*Trijup Kelabu*  
at the South Coastal Line and  
the NDC



*Pekaka Sungai*  
at the South Coastal Line and  
the NDC

## Did you know?

These wildlife species in PIC are classified as "Protected" and "Totally Protected" under the Wildlife Conservation Act, 2010. Hunting or keeping them as pets, taking or keeping parts or derivatives of any protected species is prohibited, unless a permit is granted under the Act.

The dusky leaf monkey, noted for its bright orange fur as babies, is an "Endangered" species under the International Union for Conservation of Nature (IUCN) Red List.

In July 2020, PIC Biodiversity Monitoring covering PIC and its vicinity was conducted. The aim of the bi-annual survey was to assess the composition and distribution of species in the study area and monitor potential impacts to the ecology arising from operational activities.

The study indicated that the area consists of habitats for a variety of wildlife including some Protected, Totally Protected and Endangered species. Based on terrestrial flora and fauna sightings and observation at the Northern Detention Corridor, PIC Hill, and Southern coastal line, these wildlife were identified:

### Avifauna

Total of 57 species, with 45 species of Protected & Totally Protected wildlife.

### Fauna

Total of 9 mammalian, 3 amphibian, and 6 reptilian species; with 1 Totally Protected species, 5 Protected species, and 1 Endangered species under IUCN.

### Flora

62 flora species were identified.

The study concluded that no alien invasive species were seen, and none of the species endemic to Pengerang area, being widespread across Malaysia. Biodiversity supports human and societal needs. PIC has demonstrated that biodiversity and our operations can coexist. Our responsibility is to sustain this relationship, creating an industrial symbiosis where we enhance environmental, economic and social performance.







