



PPHU 2030

POLISI PEMBANGUNAN HIJAU JOHOR

**Johor Renewable
Energy Policy 2030**

Policy

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Johor Renewable Energy 2030



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Preface

Johor Renewable Energy Policy 2030



Assalamualaikum warahmatullahi wabarakatuh, and Greetings,

With a deep sense of gratitude, I extend my appreciation to all parties who have contributed to the formulation of this **Johor Renewable Energy Policy 2030**. This document reflects the commitment of the Johor State Government to pioneer the clean and sustainable energy agenda, in line with Johor's vision as a progressive green state. Dependence on fossil fuels is no longer relevant in a world that increasingly demands environmental conservation, and this policy serves as the foundation for our efforts to move towards the integrated development of renewable energy.

As an international gateway, Johor holds immense potential to become a leader in the adoption of renewable energy in Malaysia and the region. This policy is designed to strengthen the use of resources such as solar and biomass energy, while also opening avenues for innovation in green energy technology. The outlined action plan aims to ensure that this energy transition involves all stakeholders, including the public sector, private sector, and local communities, to achieve significant carbon emission reductions and enhance energy efficiency throughout the state.

Johor is also committed to ensuring that the development of renewable energy brings positive economic impacts to the people. Through investments in green technology, this policy creates new job opportunities, empowers the local workforce with high-level skills, and attracts investment in the green energy sector. The development of a sustainable renewable energy infrastructure will help Johor achieve long-term economic stability while preserving the state's ecological integrity.

Furthermore, this policy places strong emphasis on educating the public about the importance of sustainable energy use. Awareness and support from the people are key to the success of this transformation. By engaging communities through education programmes, training, and strategic partnerships, Johor aspires to cultivate a lasting green energy culture that will be passed down to future generations.

I firmly believe that with the unwavering support of all Johoreans, we can position this state as a model for sustainable renewable energy development. Through collective efforts, we not only protect our environmental heritage but also ensure lasting economic and social benefits for current and future generations. May the Johor Renewable Energy Policy 2030 serve as a clear guideline and a driving force for the green energy transformation in our state. Thank you.

Yang Amat Berhormat Dato' Onn Hafiz bin Ghazi
Chief Minister of Johor

List of Abbreviations

AMEM	ASEAN Ministers on Energy Meeting
APG	ASEAN Power Grid
APGCC	ASEAN Power Grid Consultative Committee
BAKAJ	Johor Water Regulatory Body
BESS	Battery Energy Storage System
bioCNG	Compressed Natural Biogas
BIPV	Building-Integrated Photovoltaics
BPENJ	Johor State Economic Planning Division
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
CEIG	China Energy International Group
CIC	CASBEE Iskandar Center
DKNJ	Johor State Sustainability Policy
DL	Distribution Licensees
DTN	National Energy Policy 2022-2040
EPC	Energy Performance Contract
EV	Electric Vehicle
FiAH	Feed-in Approval Holders
FIT	Feed-in Tariff
GBI	Green Building Index
GDP	Gross Domestic Product
GLC	Government-Linked Company
HAPUA	Heads of ASEAN Power Utilities/Authorities
HEI	Higher Education Institution
HETR	Hydrogen Economy Transition Roadmap
IEA	International Energy Agency
IP	Implementation Initiative
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
JAS	Department of Environment
Jcorp	Johor Corporation
JPK	Department of Skills Development
JPSPN	National Solid Waste Management Department
JS-SEZ	Johor-Singapore Special Economic Zone
JSC	Johor Sustainability Centre
KGEV	Kulim Green Energy Venture Sdn Bhd

KPKT	Ministry of Housing and Local Government
LCOE	Levelised Cost of Energy
LCS	Low Carbon Society
LSS	Large-Scale Solar
LTMS-PIP	Lao PDR-Thailand-Malaysia-Singapore Power Integration Project
MBJB	Johor Bahru City Council
MCMC	Malaysian Communications and Multimedia Commission
MEG	Maharani Energy Gateway Sdn Bhd
MGTC	Malaysian Green Technology And Climate Change Corporation
MHB	Majuperak Holdings Bhd
MIDA	Malaysian Investment Development Authority
MMHE	Malaysia Marine and Heavy Engineering Holdings Bhd
MPOB	Malaysian Palm Oil Board
MSPO	Malaysian Sustainable Palm Oil
NEM	Net Energy Metering
NETR	National Energy Transition Roadmap
NOVA	Net Offset Virtual Aggregation
PBT	Local Authorities
PDT	Permodalan Darul Ta'zim
PGU	Peninsular Gas Utilization
PKPJ	Johor State Housing Development Corporation
PPMJ 2030	Johor Sustainable Development Plan 2030
PTG	State Land and Mines Office
PV	Photovoltaic
RE	Renewable Energy
REC	Renewable Energy Certificate
RMK12	12th Malaysia Plan
SEDA	Sustainable Energy Development Authority
SELCO	Self-Consumption
SIRIM	Malaysian Standards and Industrial Research Institute
SJREC	Southern Johor Renewable Energy Corridor
SolaRIS	People's Incentive Scheme
ST	Energy Commission
SUK BKT	Johor State Secretary Office, Local Government Division
TCLP	Toxic Characteristic Leaching Procedure
TNB	Tenaga Nasional Berhad
TPSP	Solid Waste Disposal Site
ZEB	Zero Energy Building Program

Executive Summary

Economic growth in southern Johor has led to an increase in energy demand. With the development of the Johor-Singapore Special Economic Zone (JS-SEZ), the need for green energy has become more crucial to achieving carbon emission reduction targets. Furthermore, with the commitment to reduce energy generation from coal sources, Johor faces challenges in meeting the rising energy consumption in the state. Therefore, Renewable Energy (RE) has become the primary choice for Johor to bridge the gap and address these challenges. Currently, only about 1% of the energy used in Johor is generated from RE sources, with a recorded capacity of 199 MW in 2024. Through the Johor RE Policy 2030, which encompasses 12 key strategies and 38 initiatives, Johor aims to achieve at least 600 MW of RE capacity by 2030. This effort is expected to contribute to a reduction of up to 2.1 million tons of carbon emissions annually, attract investments of up to RM10 billion, and create 15,000 job opportunities. The key focus of this policy is the development of solar farms and floating solar projects, with identified locations for project implementation. Several proposals have also been discussed to enhance the installation of solar PV on buildings, including thermal solar systems. Other potential RE sources for implementation in Johor include bioenergy, waste-to-energy (municipal waste), mini-hydro, and hydrogen technology. To enable large-scale RE integration into Johor's energy mix, the development of a RE power grid is also recommended in eastern Johor, known as the Southern Johor Renewable Energy Corridor (SJREC). Other strategies include RE trading, smart grids and energy storage, solar PV waste management, as well as research and development in RE technology.



1.0

**Energy
Transition**

Johor, the southern economic region of Malaysia, is the third-largest economy in the country, contributing 9.5% of the national Gross Domestic Product (GDP), amounting to RM148.2 billion in 2023. Johor's population, recorded at 4.02 million in 2022, is projected to reach 4.7 million by 2040.

With the Johor Strategic Growth Roadmap in place, the state's GDP is expected to grow significantly between 2020 and 2050, increasing from RM128 billion to RM553 billion. This rapid economic growth will inevitably lead to a substantial rise in energy demand. Currently, Johor relies heavily on fossil fuel energy. Transitioning to sustainable and green



of the national GDP is contributed by Johor

RM148.2 Billion

Johor's GDP in the year 2023

2022



4.02 Million

Population



2040



4.7 Million

Population



energy sources can reduce fossil fuel-based electricity consumption and support Johor's development as a low-carbon region.

As such, the state government must establish the Renewable Energy (RE) Policy to achieve aspirations for eco-friendly and low-carbon energy consumption in Johor. While the highest solar radiation is found in northern Malaysia, Johor has potential in solar energy development. Beyond solar, other RE sources with potential in Johor include biomass, biogas, mini-hydro, and waste-to-energy. These RE initiatives will support the development of Johor-Singapore Special Economic Zones (JS-SEZ) in Johor. This RE Policy will play a crucial role in reshaping Johor's energy landscape, supporting JS-SEZ development, and contributing to the vision outlined in the Johor Sustainable Development Plan 2030: "to drive the State of Johor towards being a competitive state through sustainable and dynamic development."

2020
RM **128** Billion → 2050
RM **533** Billion



2.0

Global Energy Trends

Dependence on fossil fuels has contributed significantly to global warming, with the energy sector identified as the primary contributor to greenhouse gas emissions. Globally, many countries have initiated energy transition efforts from fossil-based energy sources to RE sources. According to statistical data from the International Renewable Energy Agency (IRENA), global installed capacity for RE has doubled from 1,700 GW in 2014 to 3,869 GW in 2023. Due to strong commitments from countries worldwide, it is projected that installed RE capacity will triple to 11,000 GW by 2030. Solar and wind energy are expected to dominate, comprising 90% of the installed capacity.

Year
2014
global installed capacity
for RE
1,700 GW

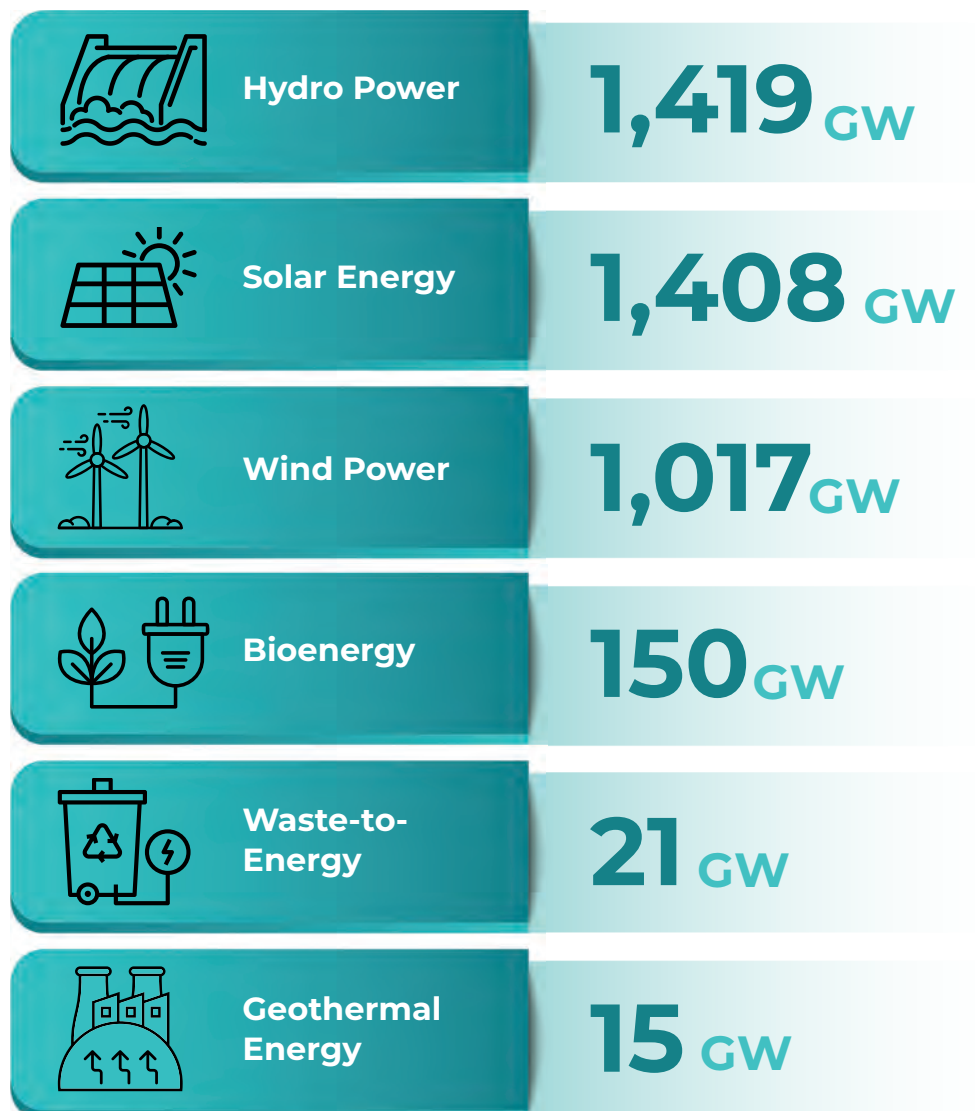
Year
2023
global installed capacity
for RE
3,869 GW
Has doubled

Year
2030
global installed capacity
for RE
11,000 GW
Will triple

2x

3x

The World Energy Outlook 2023 by the International Energy Agency (IEA) also highlights that solar and wind energy will become the primary RE sources globally. As of 2023, the installed capacities for hydro power, solar energy, wind energy, bioenergy, waste-to-energy, and geothermal energy are 1,419 GW, 1,408 GW, 1,017 GW, 150 GW, 21 GW, and 15 GW, respectively.



Key recommendations from the World Energy Outlook 2023 on RE :

The total **global power generation capacity from RE sources must increase** threefold by 2030.

RE **generation** requires enabling actions that go beyond existing regulations or **fiscal and financial incentives**.

Energy efficiency policies should include: **setting time-bound targets, establishing robust regulatory frameworks**, including building codes and energy efficiency standards for appliances, providing **fiscal and financial incentives, conducting public awareness campaigns** to educate communities about the role of energy efficiency measures, public transport and green mobility in cost-saving and collective decarbonization goals.

Public and private financial mobilization must be swiftly executed to triple RE **generation capacity** and double energy efficiency by 2030.

Power generation capacity from RE sources should be accelerated, particularly in developing countries.

Strong international collaboration is crucial to realizing all these key recommendations.

Energy efficiency improvements need to be doubled by 2030 to limit global temperature rise to 1.5°C.

Existing electricity infrastructure must be expanded and modernized to **develop a new energy system** suitable for RE.

Comprehensive and diverse policy implementation is essential to achieve these big targets.

The table below shows the countries on each continent with installed RE capacity up to the year 2023.

Table 1: Installed RE Capacity as of 2023

Continent	Country	Installed RE Capacity (MW)
Africa	South Africa	10,623
	Egypt	6,709
	Ethiopia	5,545
	Morocco	4,105
	Angola	4,091
Asia	China	1,453,701
	India	175,929
	Japan	127,328
Europe	Turkey	58,462
	Russia	56,708
	Germany	166,939
	Spain	80,136
	France	69,301
	Italy	65,157
	United Kingdom	55,561
North America	United States	387,549
	Canada	108,764
	Mexico	33,517
Oceania	Australia	54,328
	New Zealand	8,306
South America	Brazil	194,085
	Chile	21,061
	Venezuela	17,026
	Argentina	15,886
	Colombia	14,258

Source: <https://www.irena.org/Publications/2024/Mar/Renewable-capacity-statistics-2024>

2.1

Targets and Potential for Renewable Energy in ASEAN

RE is one of the key criteria for achieving a green economy in the Southeast Asian region. As global trends head towards reducing greenhouse gas emissions and achieving environmental goals, all 10 ASEAN countries have committed to reaching net-zero carbon emissions by 2050 and have set RE targets.



67%

RE target aimed by
the year

2030

Many countries have established goals to implement a 10-30% RE mix. Cambodia has a higher target, aiming for up to 67% RE mix by 2030. This high target is primarily driven by Cambodia's substantial hydro energy resources. Other countries with significant hydro development potential, such as Laos, Myanmar, Malaysia, and Thailand, have set higher RE targets of up to 30%.



**Geothermal Energy
Potential**

Next to large-scale hydro energy, solar power is identified as a promising RE source for future carbon reduction due to the increase in efficiency and the reduction in the cost of photovoltaic (PV) solar panels. Bioenergy is also seen as a primary RE option, driven by the demand for green mobility solutions through the use of biofuels or biodiesel. Countries bordering the Indian and Pacific Oceans have identified wind energy as a potential resource. Meanwhile, Indonesia, located in the Ring of Fire, has recognized geothermal energy as a promising RE source to be explored.



Ring of Fire

Table 2: RE Targets for All ASEAN Countries

Country	Target
Brunei	10% or 954 GWh of RE in the power generation mix by 2035
Cambodia	55% Hydro, 6.5% Biomass, and 3.5% Solar in the power generation mix by 2030
Indonesia	23% of RE (92 Mtoe) in the total primary energy supply (400 Mtoe) by 2025 - Installed RE capacity of 45 GW by 2025
Laos	30% RE in total energy consumption by 2025
Malaysia	32% RE in the power capacity mix by 2035
Myanmar	38% Hydro power in the total installed capacity (on- and off-grid) by 2030 9% RE in the total installed capacity by 2030
Philippines	20 GW installed capacity from RE by 2040
Singapore	- Solar energy target of at least 2 gigawatt-peak (GWp) by 2030 - Energy storage usage target of 200 MW after 2025
Thailand	30% RE in total final energy consumption by 2036 - RE targets for electricity generation by 2036 (Solar - 6,000 MW, Biomass - 5,570 MW, Wind - 3,002 MW, Large Hydro Power - 2,906.4 MW, Biogas - 600 MW, Municipal Solid Waste - 500 MW, Industrial Waste - 50 MW, Small Hydro Power 376 MW)
Vietnam	- Share of RE in total primary energy: 32.3% (62 Mtoe) by 2030 - By 2030: 21% RE in total installed capacity; 16.9% pumped-hydro storage in total installed capacity

Source: <https://asean.org/wp-content/uploads/2023/04/The-7th-ASEAN-Energy-Outlook-2022.pdf>

2.2 Energy Trade in ASEAN

A memorandum of understanding was signed among ASEAN countries in 2007 regarding the ASEAN Power Grid (APG). The agreement had a single objective, that is to promote a broad framework for the Member Countries to cooperate towards the development of a common ASEAN policy on power interconnection and trade, and ultimately towards the realisation of the APG to help ensure greater regional energy security and sustainability on the basis of mutual benefit.

The growth of APG's
interconnection capacity
reached **half** of its potential
by

2015

from

3,489 MW

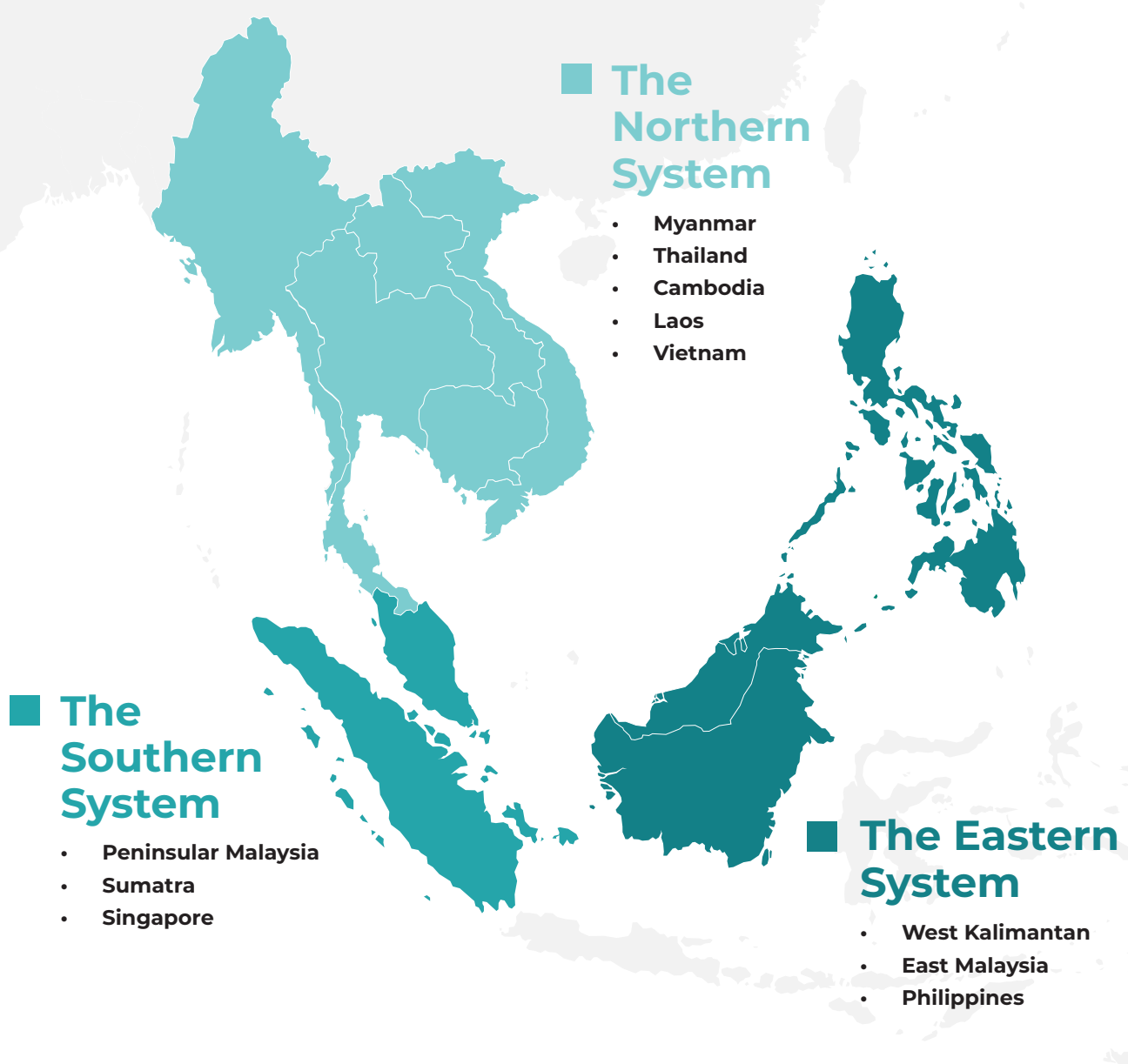
to

5,212 MW

within

1 YEAR

The APG facilitates energy trade among ASEAN countries through cross-border power trading. The growth of APG's interconnection capacity reached half of its potential by 2015, increasing from 3,489 MW to 5,212 MW within a year. At the same time, the ASEAN Power Grid Consultative Committee (APGCC) and the ASEAN Ministers on Energy Meeting (AMEM) played significant roles in enabling multilateral power trade. The Heads of ASEAN Power Utilities/Authorities (HAPUA) was established to ensure ASEAN's regional energy security and resource sharing among member countries. HAPUA plans to expand power trading across three major sub-regions: The Northern System, Southern System, and Eastern System. Its ultimate goal is to connect all regions through multilateral interconnections.



Johor, as a southern state of Malaysia, is directly involved in the APG due to its grid connection with Singapore. This creates opportunities for Johor to engage in energy trade with the country. Singapore has already begun importing RE (hydropower)

from Laos via Thailand and Malaysia (Johor) through the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP). This project is the first cross-border electricity trade involving four ASEAN countries and marks the first RE import into Singapore.



Year
2050

Singapore's high energy
demand, projected to reach

83.5 TWh

Singapore has a high energy demand, projected to reach 83.5 TWh by 2050. Although Singapore primarily relies on natural gas to meet its growing energy needs, this approach cannot be sustained to achieve its future net-zero emissions targets. With a limited RE capacity of only 42.8 TWh, Singapore will need to import green energy from neighbouring countries, such as Malaysia (Johor). For other ASEAN countries, their RE potential is sufficient to meet domestic energy demands.

Table 3: RE Potential in ASEAN

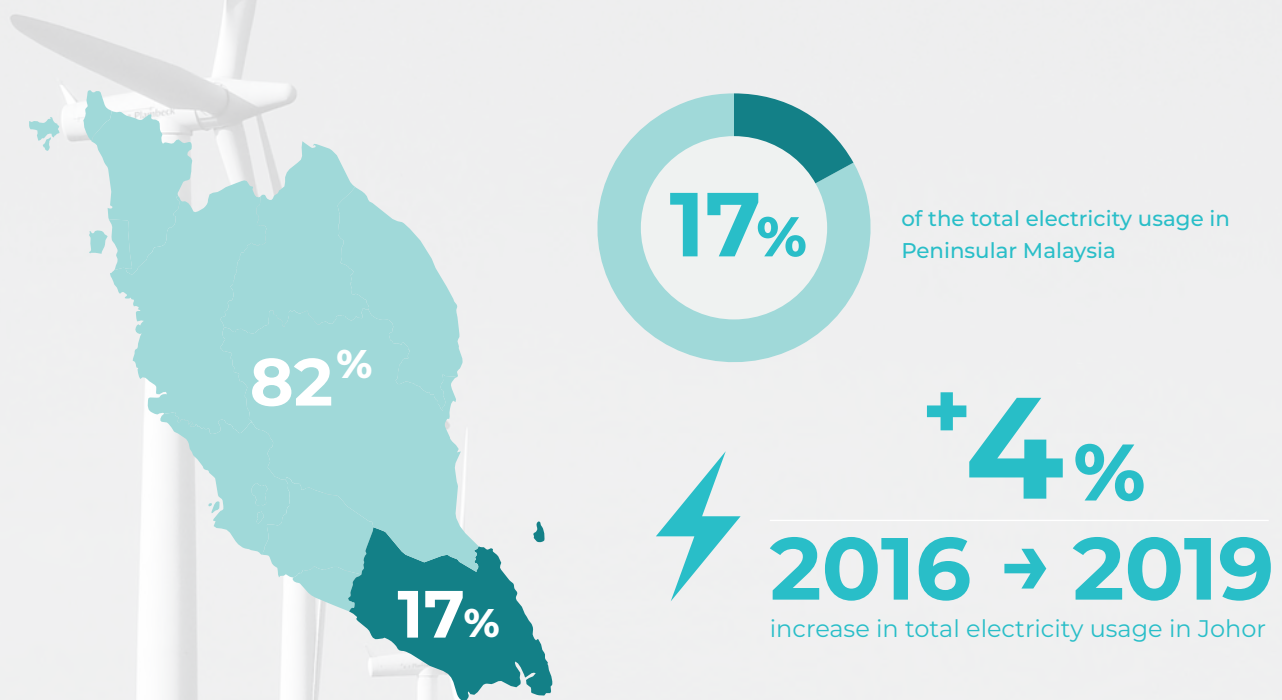
(TWh)	Brunei	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Biomass	-	11.16	101.94	8	31.55	25	7	38.39	3.47	20
Geothermal	-	-	188	-	1.81	-	15	-	-	-
Hydropower	-	79	594	99	414	315	106	-	100	120
Solar	35	7,004	16,894	2,799	4,303	16,900	4,183	4	23,078	6,235
Wind	0.05	164	144	31	-	1,145	516	-	568	739
Total RE Potential	35	7,258	17,922	2,936	4,751	18,385	4,827	43	23,750	7,114
Total Electricity Demand	6.05	70	1164	34	380	73.4	509	84	502	769

Source: Renewable Energy Trading between ASEAN Countries and road towards Net Zero Carbon Emission

3.0 Energy Outlook in Johor

It cannot be denied that energy supply is one of the most critical driving forces required to ensure the continuous growth and prosperity of Johor. Energy security is not only essential for meeting basic life needs but also serves as a vital component in driving Johor's economic development, particularly in the services and manufacturing sectors.

3.1 Energy Demand and Supply in Johor



According to statistics released by the Energy Commission (ST), Johor ranks as the second-highest state in Peninsular Malaysia in terms of electricity consumption, accounting for 17% of the total electricity usage. Additionally, electricity consumption data from 2016 to 2019 shows a year-on-year increase in Johor's electricity usage, averaging 4%. Electricity consumption in Johor is expected to continue rising in line with population growth and the rapid economic expansion facilitated by the introduction of the JS-SEZ.



Coal Sources

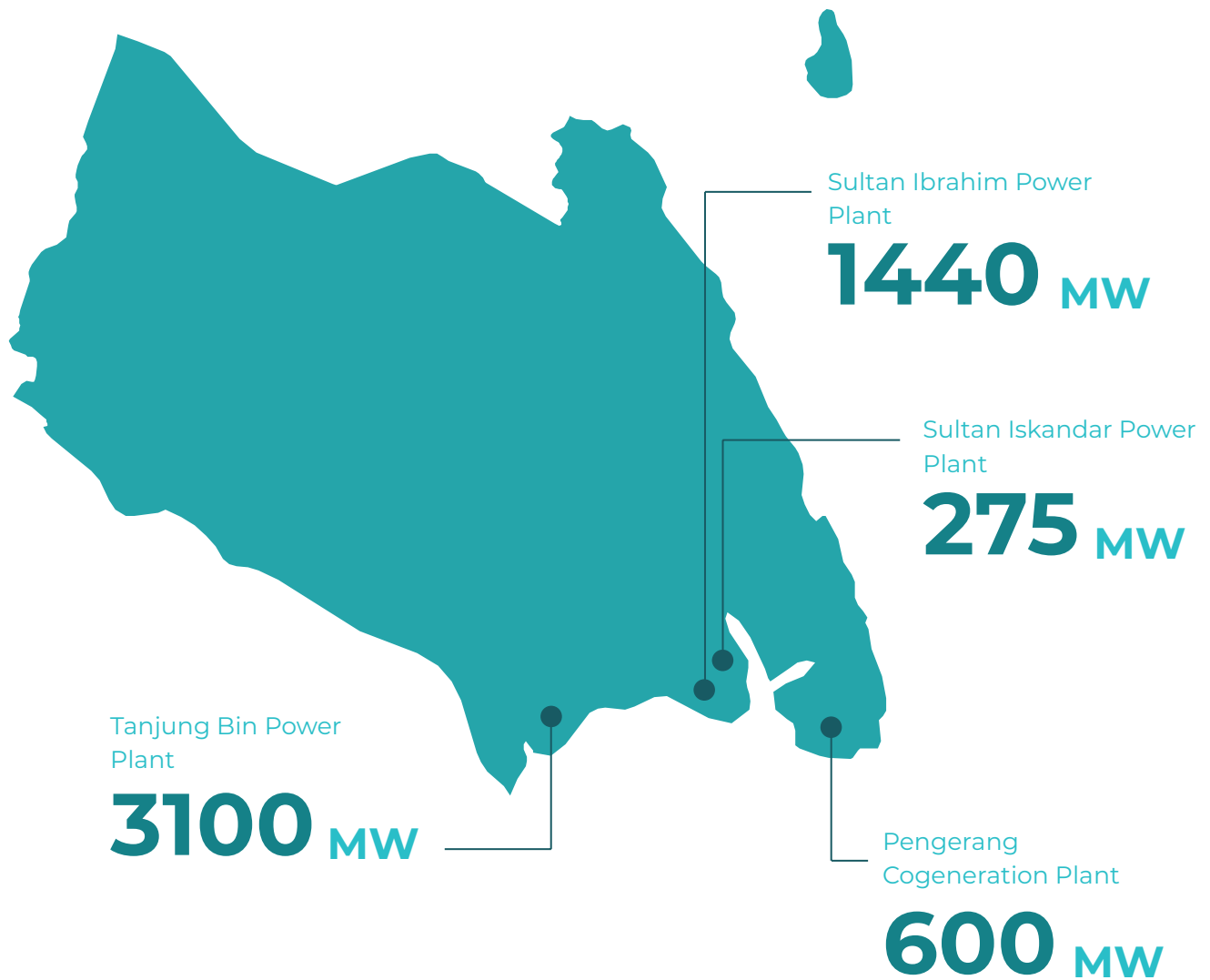


Gas Sources

From the perspective of power generation, the existing electricity supply capacity in Johor is still sufficient to meet current demand. The power generation in Johor largely relies on coal and gas as the main energy sources for electricity generation



Figure 1: Power Plant



2015

the percentage of total energy generation from RE is estimated to be less than

1%

There are four major power plants in Johor, namely the Tanjung Bin Power Plant (3100 MW), Sultan Iskandar Power Plant (275 MW), Sultan Ibrahim Power Plant (1440 MW), and Pengerang Cogeneration Plant (600 MW). In terms of mixed energy generation, according to statistics from 2015, the percentage of total energy generation from RE sources in Johor was still at a low level, estimated to be less than 1% of the total energy generation



2.1^{GW}

the gap of installed capacity
which needs to be filled with RE
sources

The decision by Malaysia to gradually phase out coal will create a gap of 2.1 GW of installed capacity, which needs to be filled with RE sources. Therefore, to ensure a stable energy supply in Johor and contribute to the reduction of greenhouse gas emissions, it is essential to explore the potential of generating energy from renewable sources. Johor has significant potential in producing alternative energy, especially due to its relatively flat topography, particularly in the northern regions of Johor. Among the sources that could be considered include energy generation from solar, biomass, biogas, and waste-to-energy.

At the present moment, the current rate of RE generation in Johor is around 199 MW. The breakdown of the current RE generation in Johor is as shown in the table below.

199_{MW}

The current rate of RE generation in Johor

Table 4: Breakdown of the current RE generation rate in Johor

Source of RE	Current Capacity
Solar	LSS - 68.9 MW ¹
	FiT – 22.7 MW ²
Biomass	58.5 MW ²
Biogas	46.9 MW ²
Waste-to-Energy (Energy generation in Seelong)	2.0 MW ³
Hydro	-
RE Total Amount	199.0 MW

Source:

1. Suruhanjaya Tenaga Malaysia Website
2. SEDA Malaysia Website
3. Sustainable Waste-to-Energy Development in Malaysia: Appraisal of Environmental, Financial, and Public Issues Related with Energy Recovery from Municipal Solid Waste.

3.2

Solar Potential in Johor

Solar energy harvesting in Malaysia can be done through solar PV, which generates electricity from solar panels, and through solar thermal systems, which generate heat energy. Among these two technologies, solar PV is the primary technology and is now being

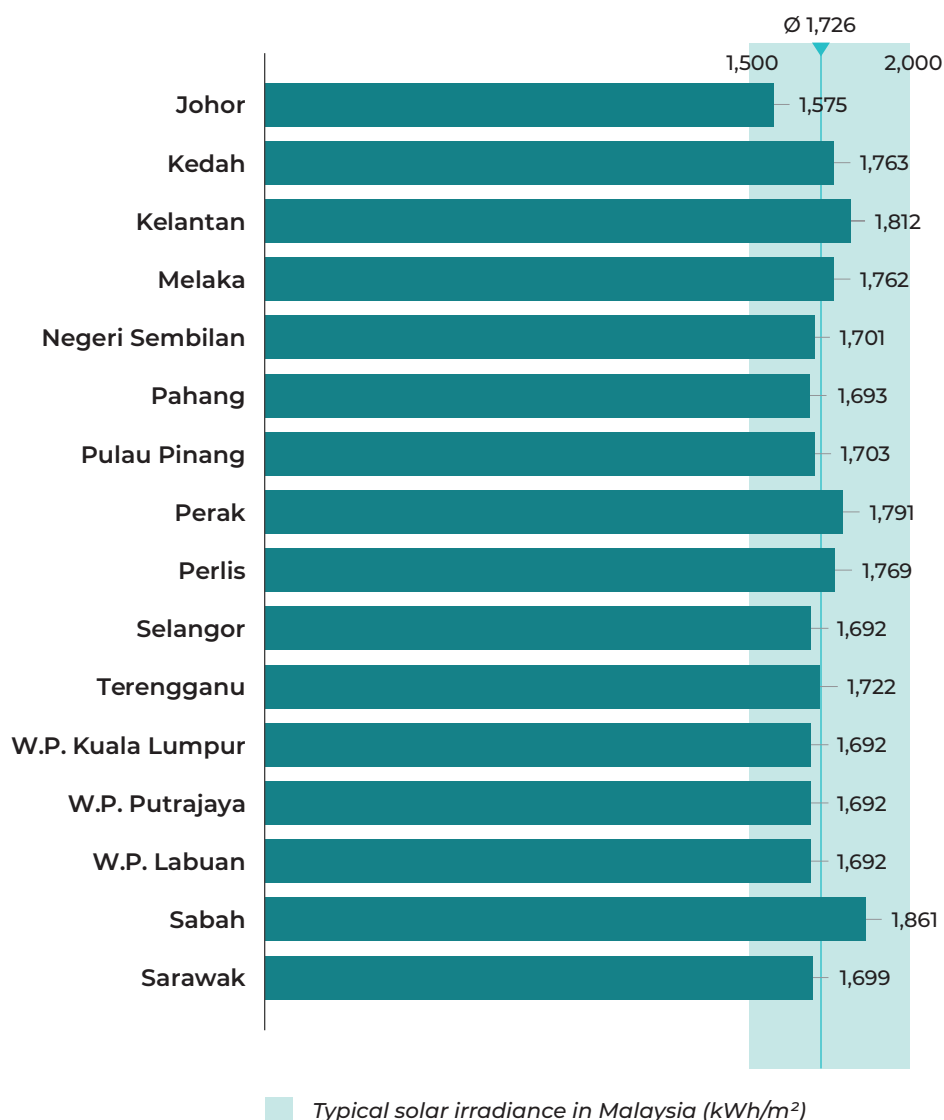
widely implemented throughout Malaysia. Solar PV can be installed on land, known as large-scale solar (LSS), on the surface of bodies of water, also known as floating solar, and on integrated buildings, particularly on building rooftops.



Figure 2: Installation of large-scale PV solar on the roof

The development of LSS in Johor is much lower compared to other states, despite the availability of land for LSS projects in Johor. The low investment in LSS is due to the lower average annual solar irradiance in Johor, which is approximately 1,575 kWh/m² per year, as shown in Figure

3. Only 68.99 MW of LSS capacity had been allocated to projects located in Johor by the second quarter (Q2) of 2022, representing 2.81% of the total LSS capacity awarded in Malaysia, including Sabah and Sarawak. Meanwhile, under the Feed-in Tariff (FiT) scheme, 22.7 MW of solar energy has been generated in Johor.

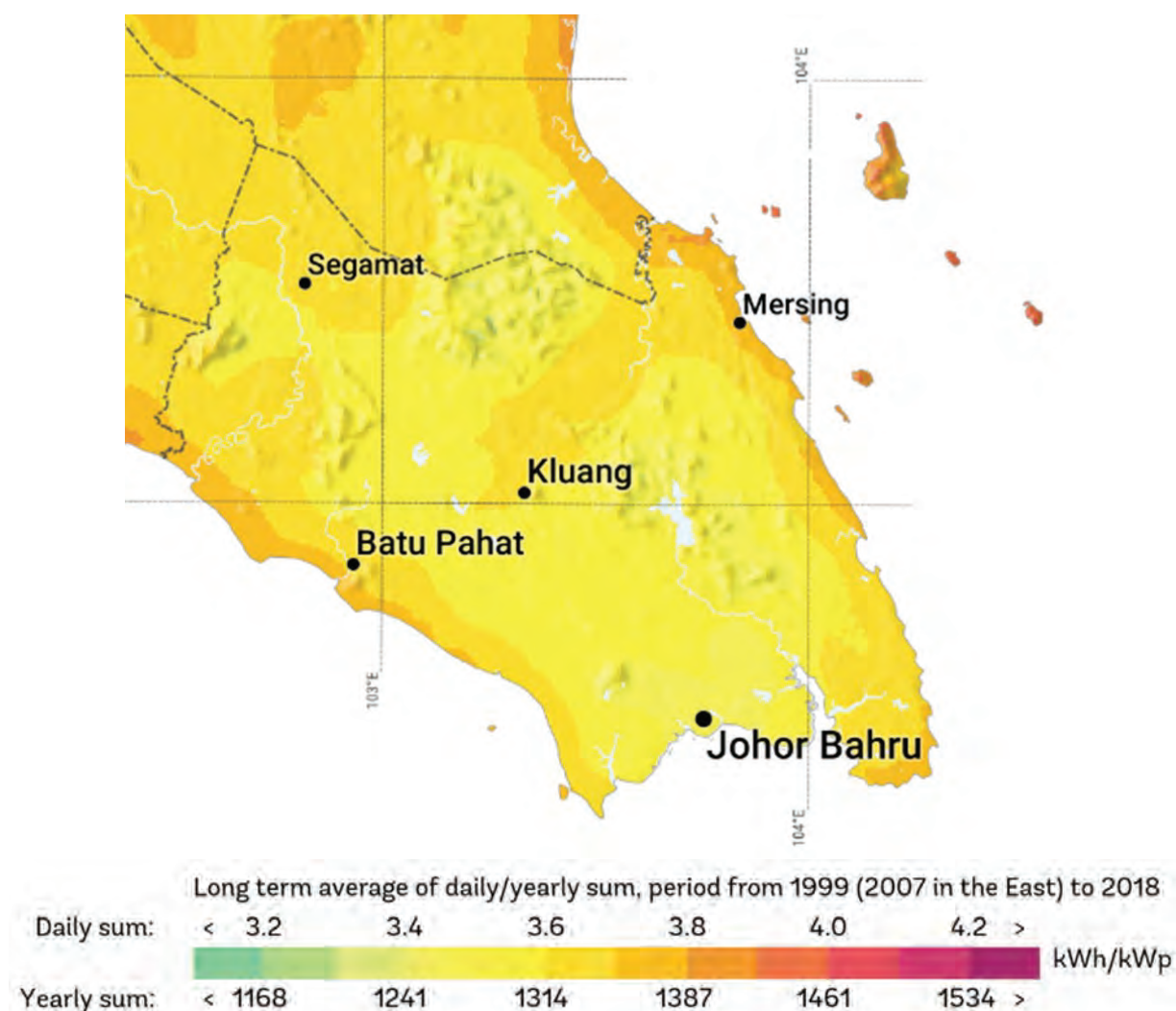


Source: https://www.seda.gov.my/reportal/wp-content/uploads/2022/01/MyRER_webVer2.pdf

Figure 3: Average annual solar irradiance in Malaysia by state

Although LSS investments in Johor may not have been profitable in the past decade due to lower solar irradiance, improvements in efficiency and reductions in the cost of solar PV panels have led investors to start recognizing Johor as a potential location for solar power generation. Many industries and commercial buildings in Johor have begun installing solar PV on rooftops for

carbon reduction and energy savings. With the vast available land in Johor, LSS projects can be developed to provide green and sustainable energy for Johor, with the potential to export solar power to neighbouring countries. Based on Figure 4, the east and west coasts of Johor receive higher solar irradiance, particularly in the areas of Mersing, Pengerang, and the Batu Pahat coast.



Source: <https://solargis.com/maps-and-gis-data/download/malaysia>

Figure 4: Average annual solar irradiance in Malaysia by state

The Johor Sustainable Development Plan 2030 (PPMJ 2030) prioritizes environmental sustainability in economic development and the well-being of the people. The Johor Green Deal framework, presented in 2023, focuses on investment to expand LSS projects in Johor by 2025.

To support the Johor State Government's efforts to intensify these LSS projects, several challenges along with proposed strategic solutions have been outlined as follows:

3.2.1 Renewable Energy Grid

The Mersing and Kota Tinggi districts (including Pengerang) each have a land area of around 2,838 km² and 2,737.63 km², respectively. If 10% (557.56 km²) of the land area in these two districts is used as sites for solar PV project development, it is estimated that around 4 GW of solar energy capacity could be generated. However, the current nodal points for injecting RE into the grid are limited in Johor.

To address this issue, the privatization of the RE grid is recommended so that the energy generated can be directly injected into the RE grid without going through the national grid.

3.2.2 Grid Instability

The concentration of solar PV projects in a particular location and the intermittent nature of solar energy mean that solar power can only be generated for 4 to 5 hours a day, depending on weather conditions. Due to this inconsistency, widespread implementation of solar energy can lead to instability in the grid.

Therefore, it is recommended that only about 50% of solar energy be considered for the energy mix. In addition, to balance the variability of solar energy and enhance grid flexibility, the expansion of Battery Energy Storage System (BESS) is necessary, even though the investment costs for BESS are currently very high. The development of a RE grid with BESS at a centralized location (BESS capacity is subjected to industrial, commercial, and residential energy demand) would address the issue of solar energy intermittency and enable LSS PV projects to be implemented in Johor. Additionally, energy trading could support BESS investments despite the high costs, as electricity prices can be sold at least three times higher than Malaysia's market price.

3.2.3 Land Use for Solar Farm Development

Land issues are one of the main constraints in the development of LSS PV, as there are areas of land with multiple owners. This hinders the acquisition of large areas of land for solar PV project development due to increased land acquisition costs. Additionally, industrial land areas are expensive to develop for solar PV projects.

To address this issue, the Johor State Government can designate agricultural land that does not have development plans for the next 20 to 30 years to be reclassified for LSS PV project development. These undeveloped lands can be categorized as reserve land and wakaf land, creating a land bank for the State of Johor to support LSS PV projects. This approach would be beneficial for the state government. Additionally, granting special permits for solar PV projects in agricultural land and closed landfill sites could further support the development of LSS PV projects.





3.2.4 Solar Farm Development Cost

Solar irradiance varies across different locations. Other than that, the existing infrastructure as well as the distance to the nearest grid also influence the operating costs of solar PV. Currently, LSS PV projects are developed through a bidding process. This could disadvantage Johor, as the solar irradiance in Johor is generally lower compared to the rest of Malaysia. Additionally, the single customer restriction Tenaga Nasional Berhad (TNB) is also a major issue for financing LSS PV projects by banks.

The rate of land tax as well as strategic and attractive development charges can serve as incentives to encourage investors to invest in Johor, even though some areas in the state may have lower solar irradiance. To address this issue, offering flexible tax rates and development charges based on factors such as land prices, proximity to the grid, solar irradiance, and intended use (whether local or for export) is seen as a way to attract investors to develop LSS projects in Johor.



3.2.5 Potential and Design of Floating Solar Systems

The only difference between floating solar installations and land-based solar is that floating solar is mounted on bodies of water, without the need for land. Floating solar is an environmentally friendly method of generating electricity, combining marine technology with RE. The electricity generated by the floating solar system can be transmitted through underwater cables. Additionally, each water body has its own unique design for the floating system. So far, there has been no detailed study conducted to explore the potential and propose a consistent, systematic, and optimal design for floating solar systems.

Therefore, it is essential to have a detailed study on the potential and design of floating solar systems, considering safety and environmental factors (such as whether they are located in the sea or on a lake). Additionally, strategic collaboration with TNB to explore the potential and to propel floating solar systems could be implemented, as demonstrated by the state-owned enterprise MajuPerak Holdings Bhd (MHB) in Perak, which developed a 100 MW floating solar project in the state.

3.2.6 Marine Waters Activities (Floating Solar)

The development of offshore floating solar projects in marine waters can interfere with maritime activities such as shipping and port operations. Additionally, the environmental impacts of floating solar systems vary depending on the type of water body.

Therefore, a detailed study of the port areas and the movement of ships in the waters of Johor is necessary to identify strategic locations for the development of floating solar projects. This is because the installation of solar PV systems in marine areas, particularly in the Straits of Johor, offers significant benefits, as it has the potential to become an energy trade resource for export.

3.2.7 Individual Ownership (Rooftop Solar)

The installation of solar PV on buildings is subject to the energy demand of those buildings. Most companies install solar PV systems through schemes like Self-Consumption (SELCO) or Energy Performance Contracts (EPC), typically on an individual basis. This makes it difficult for the government to manage solar installation projects on buildings and track solar energy generation data in Johor.

Since this data is required for planning RE projects for the Johor State Government, along with carbon reduction reporting in Johor, it is recommended to establish a digital registration framework for solar projects on buildings. The Johor Bahru City Council (MBJB) has implemented the Comprehensive Assessment System for Built Environment (CASBEE) to promote the installation of green energy in buildings as part of its criteria. This practice could be extended to other local authorities (PBT) to streamline solar energy project management and reporting across the state.

3.2.8 Solar Installation on State Government Buildings

The Johor State Government is encouraged to conduct audits on supply and demand across all state government buildings using the concepts of Virtual Net Energy Metering (NEM) or Net Offset Virtual Aggregation (NOVA) as outlined by SEDA Malaysia. For example, buildings with excess solar energy on their rooftops can share this energy virtually with other buildings in need of solar-generated electricity. However, the NEM virtual scheme is limited to a duration of 10 years.

Therefore, the Johor State Government could allocate special funding to encourage the concept of virtual energy trading. This would allow buildings with excess solar energy to share it with other buildings that are lacking solar energy, even after the 10-year period of Virtual NEM expires.





3.2.9 Disposal and Management of Solar PV Waste

The disposal and management of solar PV waste must be handled meticulously to ensure environmental sustainability. Solar PV systems may contain hazardous elements, such as heavy metals, which can harm the environment. The European Union, which classifies solar PV waste as electronic waste, has adopted measures to prevent the use of these hazardous elements during the manufacturing process. Meanwhile, in the United States, generators of solar PV waste are required to conduct the Toxic Characteristic Leaching Procedure (TCLP) to determine whether the waste falls into the hazardous category.

In Malaysia, solar PV waste is classified as electronic waste, which falls under the scheduled waste category (SW 110). This classification may burden users as managing scheduled waste involves high costs. However, these costs can be reduced since some components of solar PV systems are non-hazardous and can be categorized as controlled solid waste. Additionally, these components have the potential to be recycled, providing returns to users. To date, no guidelines have been developed to guide users on effectively separating and managing their solar PV waste.

Another issue related to managing solar PV waste is the high cost of recycling due to the complex design of solar PV systems, which complicates the recycling process. Furthermore, no facilities currently exist in Johor to handle solar PV waste. Existing e-waste recycling facilities may not be suitable for managing the more complex solar PV waste.

Therefore, the Johor State Government should develop specific guidelines for managing solar PV waste to assist users in segregating and managing their waste effectively. Additionally, the government should promote the use of solar PV systems designed for easier recycling. The Johor State Government should also encourage investment in solar PV recycling plants through various approaches, such as income tax exemptions and land allocations. Developing such recycling facilities will streamline the recycling process for solar PV waste in Johor, thereby reducing the amount of solar PV waste disposed of in landfills.



3.3

Biomass and Biogas Potential

Bioenergy refers to RE derived from organic materials, including plants, agricultural waste, and organic residues. This process involves converting biological materials into heat, electricity, or fuel. In Johor, a significant portion of bioenergy is sourced from biomass and biogas through palm oil resources.



670,862

Hectares

palm oil plantations in Johor in the year 2023 approximately

16,341,663

Tons

Biomass produced every year

3.2_{GW}

The estimated energy capacity that can be generated from biomass and biogas in Johor

58.5_{MW}

Biomass energy output

46.9_{MW}

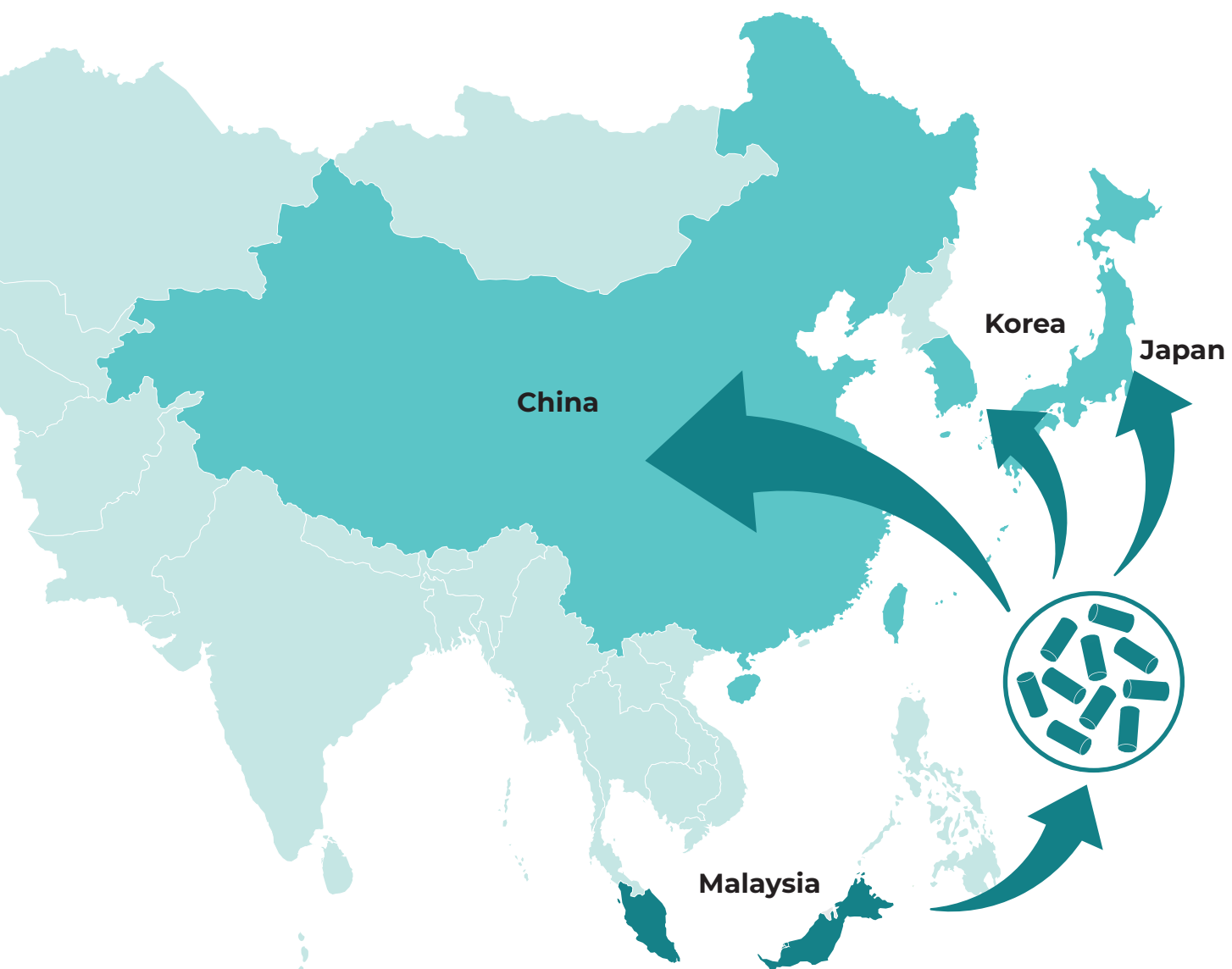
Biogas energy output

According to the Malaysian Palm Oil Board (MPOB), Johor had approximately 670,862 hectares of palm oil plantations in 2023, producing around 16,341,663 tons of biomass annually. The estimated energy capacity that

can be generated from biomass and biogas in Johor is 3.2 GW. Currently, the energy output from biomass and biogas in the state is 58.5 MW and 46.9 MW, respectively. This abundance positions palm oil biomass and biogas as high-potential RE sources.

Johor's commitment to bioenergy aligns with the National Biomass Roadmap 2023–2030, supported by Malaysia's Ministry of Plantation and Commodities. This strategic framework, in line with the 12th Malaysia Plan (RMK12), emphasizes the role of the biomass industry in generating export value for biomass-based products. The overarching goal is to contribute to greenhouse gas emissions reduction while applying a circular economy concept. Given the high potential of biomass, a significant amount of oil palm biomass is exported as pellets to China, Japan, and South Korea.

Oil Palm is processed into pellets for export



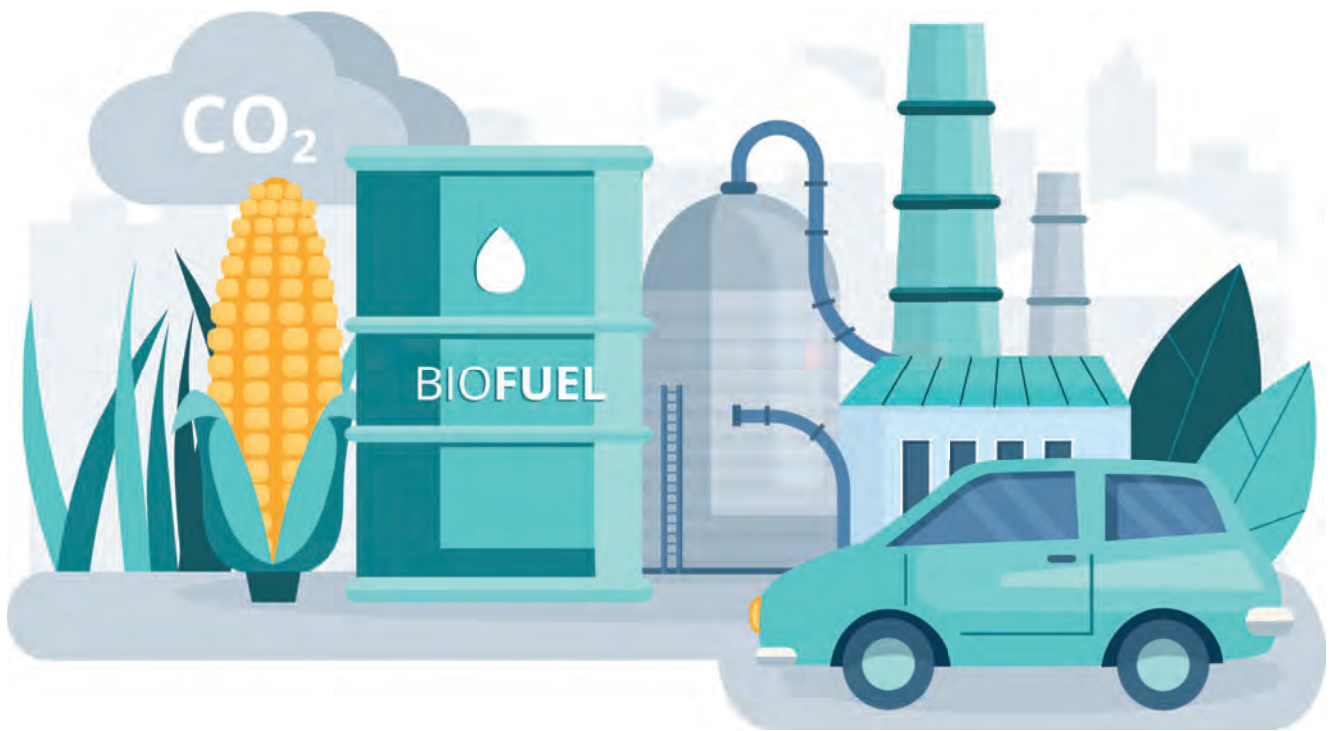
The primary challenges in implementing biomass and biogas energy include:

3.3.1 Scattered Locations of Palm Oil Mills

Palm oil mills are typically built near palm oil plantations. With a total area of 670,862 hectares of palm oil plantations and 72 palm oil mills in Johor, the mills are often located far apart and scattered. Biomass waste from these mills, such as empty fruit bunches, palm kernel shells, mesocarp fibres, and empty fruit fibres, can be utilized to generate energy. Therefore, the development of biomass collection centres is essential to establish a more systematic biomass collection system. These centres would also provide smaller palm oil mills with opportunities to generate additional income.



Figure 5: *Biogas Power Station*



3.3.2 Unregulated Supply Chain Costs and Biomass Pricing

Malaysia has become a leading destination for biomass investments across the supply chain, from upstream to downstream, including manufacturers, traders, and the supporting ecosystem. The biomass supply chain encompasses processing, transportation, and the delivery and distribution of electricity generated from biomass and biogas to transmission main intakes. One of the main challenges in implementing biomass and biogas energy is that biomass processing (pre-processing) requires high energy. Besides that, the inconsistent quality of biomass is a major challenge in biomass resource

management. The properties and characteristics of biomass, such as moisture content, density, and nutrient composition are inconsistent. Factors such as weather, raw material sources, processing methods, and storage conditions affect biomass quality. The key challenge operators face is maintaining consistent biomass quality for use in energy generation or other applications. Inconsistent quality can lead to operational issues, including unstable performance and unexpected costs.

Thus, operators must take steps to monitor and control biomass quality closely, adapting management and handling processes to daily changes in biomass characteristics. The transportation costs of biomass sources and the costs of distributing electricity generated from biomass and biogas also involve high expenses. This is because most biomass sources (e.g., waste from palm oil mills) are located in remote areas, far from main electricity transmission main intakes. The high infrastructure costs for electricity transmission and distribution must be borne by biomass and biogas-based power producers. Due to the high costs and the lack of regulation over biomass and biogas pricing, biomass producers often export biomass abroad at attractive

prices. However, while exporting biomass pellets may generate higher economic returns without requiring government incentives, it does not contribute to diversifying RE sources.

To address the cost and pricing regulation issues, incentives should be provided to energy producers using biomass and biogas. One possible incentive is tax reductions for green technologies. To encourage the implementation of biomass and biogas energy in Johor, the prices of biomass and biogas are regulated by the Johor State Government for Government-Linked Companies (GLCs) and plantations under the jurisdiction of Johor. These initiatives could encourage future investments in Johor.

3.3.3 Feed-in Tariff (FiT) Quota to Promote Biomass and Biogas Energy Implementation

The government introduced the FiT mechanism in Malaysia, requiring Distribution Licensees (DL) to purchase electricity generated from RE sources from FiAH at gazetted FiT rates. DLs pay for RE connected to the electricity grid over a specified period. By guaranteeing access to the grid and setting favourable per-unit prices for RE, the FiT mechanism ensures that RE becomes a solid long-term investment for companies and individuals alike. As the FiT is currently not attractive for biomass, discussion with the SEDA are necessary to review the FiT rates.

3.3.4 Biogas to Biomethane

To support the implementation of biomass and biogas energy in Johor, biogas can be upgraded to biomethane. Biomethane can be injected into the Peninsular Gas Utilisation (PGU) nodal injection points of PETRONAS Gas Berhad or compressed into Bio Compressed Natural Gas (bioCNG) for sale to consumers. Additionally, biogas can also be used to generate electricity and be supplied to the RE grid.



Figure 6: Biomethane plant

3.4

Waste-to-Energy Potential in Johor



4.02 Million

Estimated population of
Johor in 2022

1.06 kg

Waste generation rate
per individual daily

4,261 Tons

Approximate amount of solid
waste generated in Johor each
day

According to the Department of Statistics Malaysia, the population of Johor was estimated to be 4.02 million people in 2022. Based on a daily waste generation rate of 1.06 kg per individual, approximately 4,261 tons of solid waste are generated in Johor each day. The majority of this solid waste is disposed of in 8 Solid Waste Disposal Sites (TPSP) located around Johor, such as the Seelong Sanitary Landfill, Tanjung Langsat Landfill, and Pekan Nanas Landfill.



The practice of direct waste disposal without any treatment is unsustainable, as existing landfills are expected to reach capacity and will no longer be able to accommodate the increasing amount of solid waste, which is growing in line with the population. Efforts to develop new landfill sites are not easy, as they involve various processes such as selecting suitable locations, land ownership, land status, and obtaining Environmental Impact Assessment approval. This can result in existing landfills having to operate beyond their designated capacity, as seen in the Buloh Kasap Segamat Landfill.



Figure 7: *The disposal site exceeds the designated capacity.*

To address this issue, the federal government, through the Ministry of Housing and Local Government (KPKT), has targeted for each state to have at least one waste-to-energy plant. This initiative aims to reduce the amount of solid waste sent to landfills, thus extending the lifespan of existing landfills. The plants to be developed will use thermal processes that can directly treat solid waste.

The development of waste-to-energy plants not only contributes to more sustainable solid waste management but also helps in the generation of electricity. Based on the current solid waste generation rate in Johor, these waste-to-energy plants are expected to generate an electricity capacity of approximately 120 MW.



Figure 8: *Waste-to-energy plant*

To date, no large-scale waste-to-energy plants using thermal processes to directly treat solid waste have been developed in Johor. A small-scale waste-to-energy plant has been built at the Seelong Sanitary Landfill. This plant uses the gas produced from the decomposition of solid waste at the landfill as fuel to generate an electricity capacity of 2 MW. This existing plant has not been able to fully address the high volume of solid waste generated in the state. A large-scale thermal treatment plant is needed to effectively manage this waste and simultaneously generate a significant electricity capacity

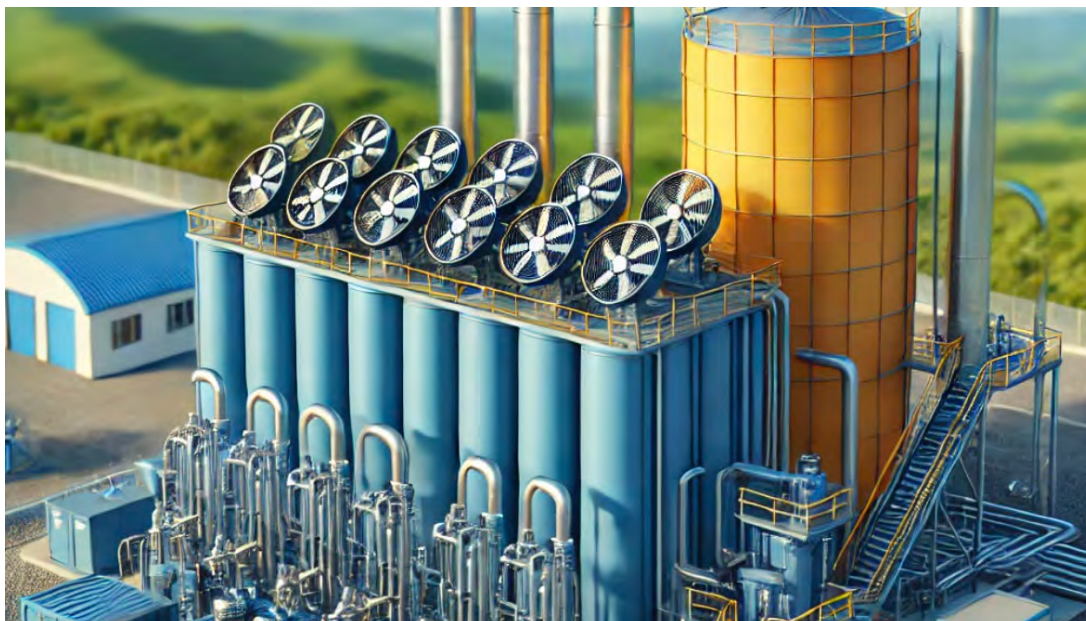


Figure 9: The biogas-based waste-to-energy plant

The development of this thermal treatment plant also provides an opportunity for full landfills to be closed and rehabilitated. Closed landfills have the potential for redevelopment. To date, 29 landfills have been safely closed, such as the Bandar Tenggara landfill and the Bukit Bakri landfill.

There are three main challenges identified in the development of thermal treatment plants, as shown in Figure 10. Meanwhile, the primary challenge in developing closed landfills is identifying and planning the appropriate type of development for these sites.



Figure 10: Challenges to the development of thermal treatment plants in Johor

To address the challenges related to the development of thermal treatment plants and the redevelopment of closed landfills in Johor, several proposed solutions will be discussed as follows:

3.4.1 Lack of Data on Local Solid Waste Characteristics

Up till now, no thermal treatment plants for solid waste have been developed in Johor. At the federal level, there are several thermal treatment plants that have been developed, such as in Pulau Tioman and Pulau Pangkor. However, these plants have faced failures due to the lack of accurate data on the thermochemical characteristics of local solid waste during the design and technology selection process. The design and technology systems that were chosen were not suitable for the characteristics of the waste being received, which, on average, has a high moisture content. A similar situation could occur in thermal treatment plants being developed in Johor if the data on the characteristics of local solid waste is not accurate.

Therefore, the Johor State Government should conduct more frequent solid waste audits at existing landfill sites to obtain accurate data on the characteristics of solid waste in each district. This is important as the characteristics of solid waste may vary during specific seasons, such as festive periods or fruit harvest seasons. Data from other districts may not be relevant due to differences in socio-economic and demographic characteristics. Additionally, the Johor State Government can improve the record-keeping system at the existing landfill weighbridge. The current system only records the total amount of solid waste collected by concessionary and private companies. Data on the quantity of waste generated from different types of sources, such as residential, commercial, and industrial waste, is not recorded. This data could provide a more accurate representation of the solid waste characteristics in Johor.

3.4.2 Issues in Waste Separation at Source

The diverse composition of solid waste complicates the incineration process in thermal treatment plants. Non-burnable components, such as glass and metal, present in the waste can reduce the efficiency of the thermal treatment process. The source separation programme, which has been enforced since 1st September 2015, has been seen as ineffective in segregating non-burnable components such as metal and glass from solid waste. On the other hand, the two categories of separation introduced in this programme—recyclable materials and non-recyclable materials—can lower the quality of waste combustion. This is because materials with good calorific value, such as plastics and paper, are separated out and sent to recycling facilities. The remaining waste components, such as food waste and diapers, typically have low calorific value and are unsuitable for energy generation.

To address this issue, the Johor State Government can follow the example set by Japan, which separates solid waste into two main categories: burnable and non-burnable materials. This separation approach is seen as an effective way to provide higher-quality fuel for the thermal treatment plants that are to be developed.

3.4.3 High Development Costs

High costs are often a major challenge in the development of thermal treatment plants. As a result, concession companies are forced to impose high tipping fees on the government. The tipping fee for thermal treatment plants ranges from around RM 100 per ton and can reach up to RM 250 per ton. This rate is significantly higher than the current tipping fee for landfills, which is approximately RM 30 to RM 40 per ton, paid by the government.

Therefore, the Johor State Government can take steps to develop local expertise and companies within the thermal treatment plant industry. The development of local talent and companies can occur through investments, funding grants, incentives, and legislation. This development is seen as a potential way to reduce the cost of developing thermal treatment plants in Johor.

3.4.4 Challenges in Identifying and Planning Suitable Development Types for Closed Landfill Sites

The soil structure at solid waste landfill sites differs from that of other areas. This is because landfill sites consist of various layers, such as solid waste layers, soil layers, and geosynthetic clay liners. The solid waste itself is composed of a variety of components, including food waste, plastics, and paper. As a result, closed landfill sites may only be suitable for certain types of development. This requires thorough research and careful planning to ensure that the redevelopment of these sites is done in a sustainable and systematic manner.

Therefore, the Johor State Government can appoint a state GLC to act as a coordinator, responsible for managing and granting exclusivity to parties capable of treating, rehabilitating, reclaiming, and developing abandoned and closed solid waste disposal sites owned by the state government and PBT in Johor.

3.5

Mini and Micro Hydropower Potential

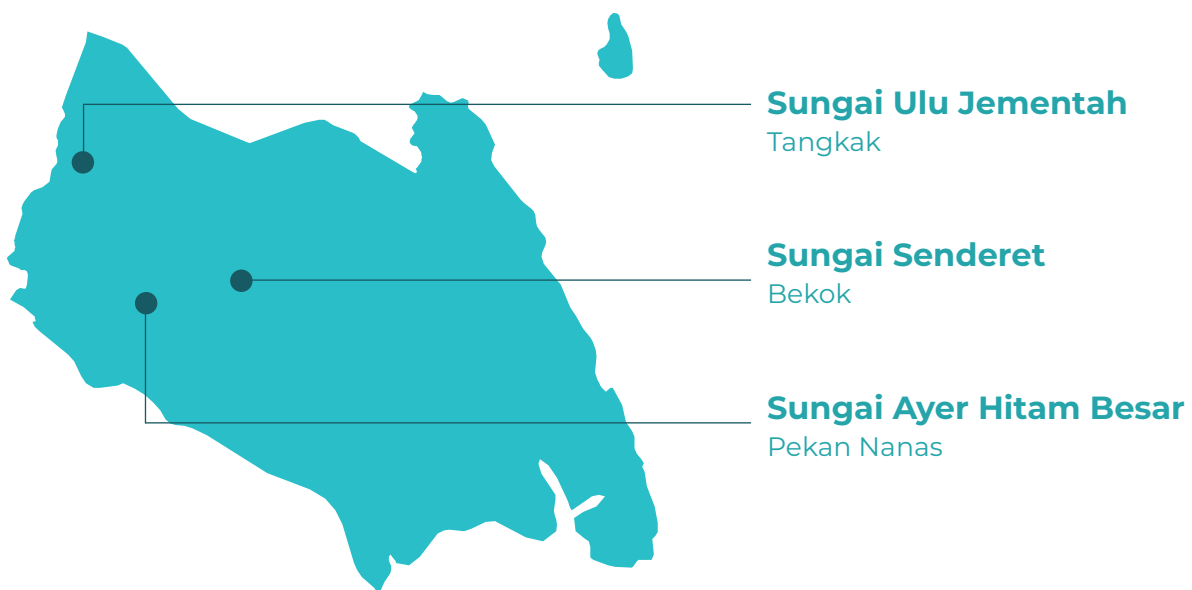
Small-scale hydro plants can be divided into two types: mini hydro and micro hydro. Mini hydro plants typically have the capacity to generate electrical power ranging from 100 kW to 1 MW, while micro hydro plants can generate between 5 kW and 100 kW.

Mini Hydro

100_{kW} - 1_{MW}

Micro Hydro

5_{kW} - 100_{kW}



1.6_{MW}

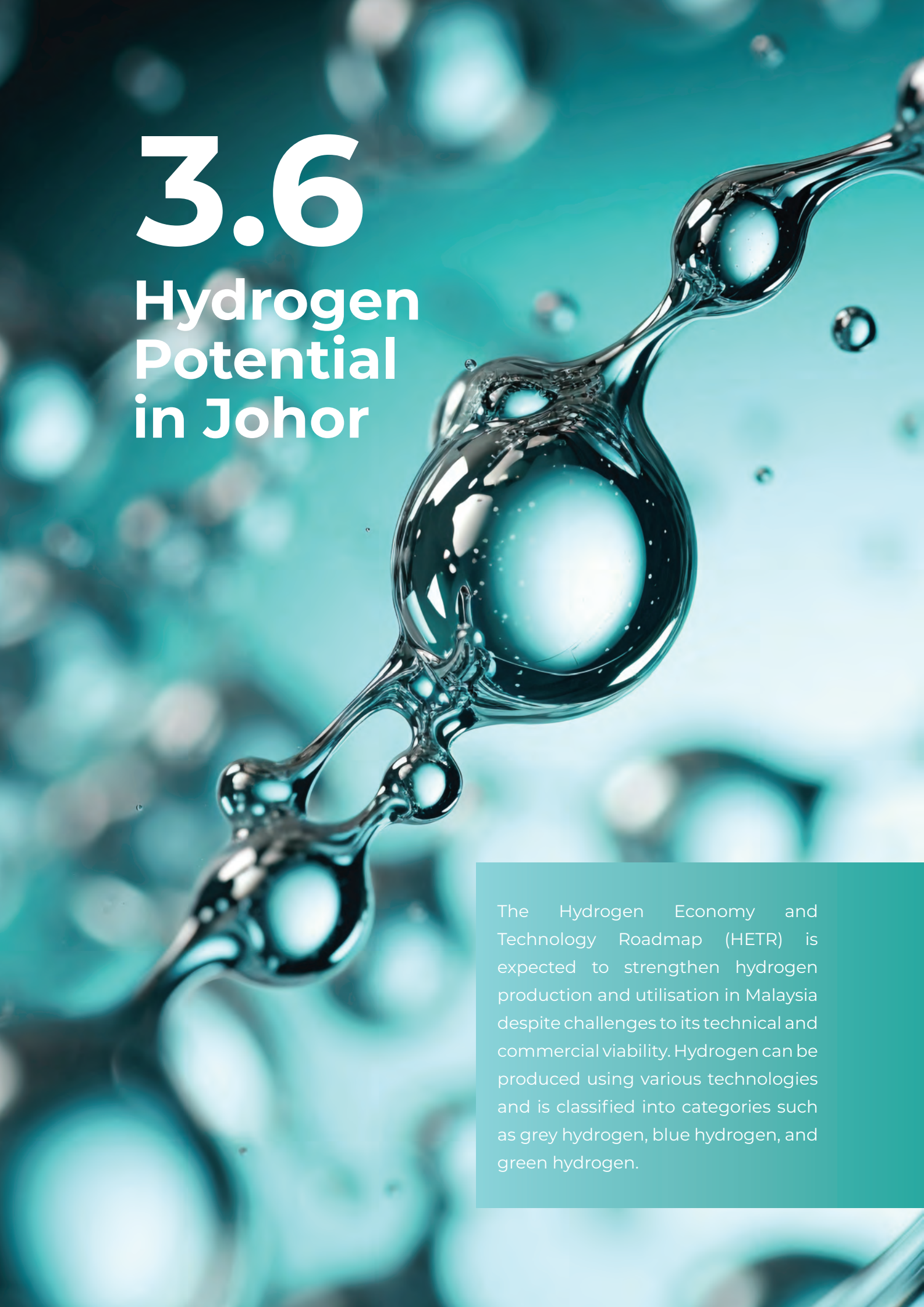
Total electrical capacity generated

There are 12 locations in Johor that have been identified as having potential for mini hydro power generation. Among them are Sungai Senderet in Bekok, Sungai Ulu Jementah in Tangkak, and Sungai Ayer Hitam Besar in Pekan Nanas. The development of mini hydro and micro hydro plants at these sites could generate a total electrical capacity of 1.6 MW (Table 5).

Table 5: Potential locations in Johor for mini hydro and micro hydro developments

No	River Name	Site Location	Catchment Area, km ²	River Flow Rate, m ³ /s	Potential electrical capacity, kW
1	Sg. Senderet	Perkampungan orang asli, Sg. Selai, Bekok	6	0.20	117.7
2	Sg. Lamyang	Perkampungan Orang Asli Sg. Kemidak, Bekok	8	0.27	190.7
3	Sg. Genal	Perkampungan Orang Asli Sg. Kemidak, Bekok	2	0.07	49.4
4	Sg. Kemarat	Perkampungan Orang Asli Sg. Kemidak, Bekok	9	0.30	247.2
5	Sg. Sechawai	Perkampungan Orang Asli Kg.Tamok, Bekok	6	0.20	94.2
6	Sg. Pencharang	Perkampungan Orang Asli Kg. Tembayan, Bekok	15	0.50	294.2
7	Sg. Anak Ayer Puteh	Ladang Tangkah, Sagil,Tangkak	3	0.07	82.4
8	Sg. Ayer Panas	Taman Rekreasi Gunung Ledang , Tangkak	6	0.14	82.4
9	Sg. Sagil	Sagil, Tangkak	3	0.07	41.2
10	Sg. Legeh	Ladang Kebun Bahru, Kebun Bahru, Tangkak	2	0.05	58.9
11	Sg. Ulu Jementah	Kg. Peng Jongkang, Jementah,Tangkak	9	0.21	123.6
12	Sg. Ayer Hitam Besar	Air Terjun Gunung Pulai, Pekan Nenas	10	0.40	306

One of the main issues in developing mini and micro hydro plants is that the potential sites for these projects are located in remote parts, far from areas with high electricity demand. Consequently, distributing the electricity generated by these mini and micro hydro plants would incur significant costs due to the need to develop new electrical grids to connect the hydro systems to the local grid network. An alternative technology for hydro energy distribution, besides developing new electrical grids, is converting generated hydro energy into hydrogen, allowing its distribution via land transportation.

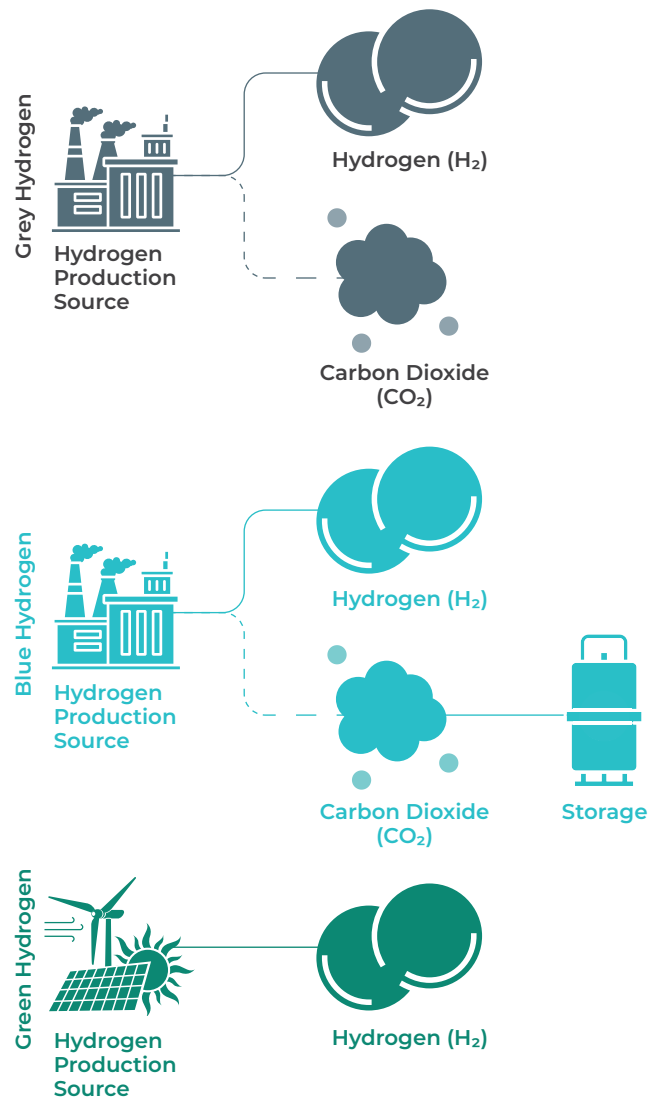


3.6

Hydrogen Potential in Johor

The Hydrogen Economy and Technology Roadmap (HETR) is expected to strengthen hydrogen production and utilisation in Malaysia despite challenges to its technical and commercial viability. Hydrogen can be produced using various technologies and is classified into categories such as grey hydrogen, blue hydrogen, and green hydrogen.

Grey hydrogen is produced through the combustion of fossil fuels, releasing carbon dioxide (CO₂). Blue hydrogen shares the same production source as grey hydrogen, but the CO₂ emitted during the production process is captured and stored. Green hydrogen, on the other hand, is produced from RE sources such as solar and hydro. It does not emit CO₂ and is more sustainable than other technologies. However, the potential for green hydrogen production depends on the availability of solar and hydro energy, particularly in Johor.



Currently, Johor Corporation (JCorp) and Sojitz Corporation are conducting a three-year feasibility study, initiated at the end of 2022, on the use of hydrogen and ammonia as part of decarbonisation initiatives in Johor. Recently, Maharani Energy Gateway Sdn Bhd (MEG) and China Energy International Group (CEIG) Sdn Bhd collaborated in building a green hydrogen and ammonia plant in Muar, Johor, requiring an investment of approximately RM 9.5 billion.

However, five key challenges have been identified, as illustrated in Figure 11. To address these challenges in Johor, several potential solutions have been discussed below:

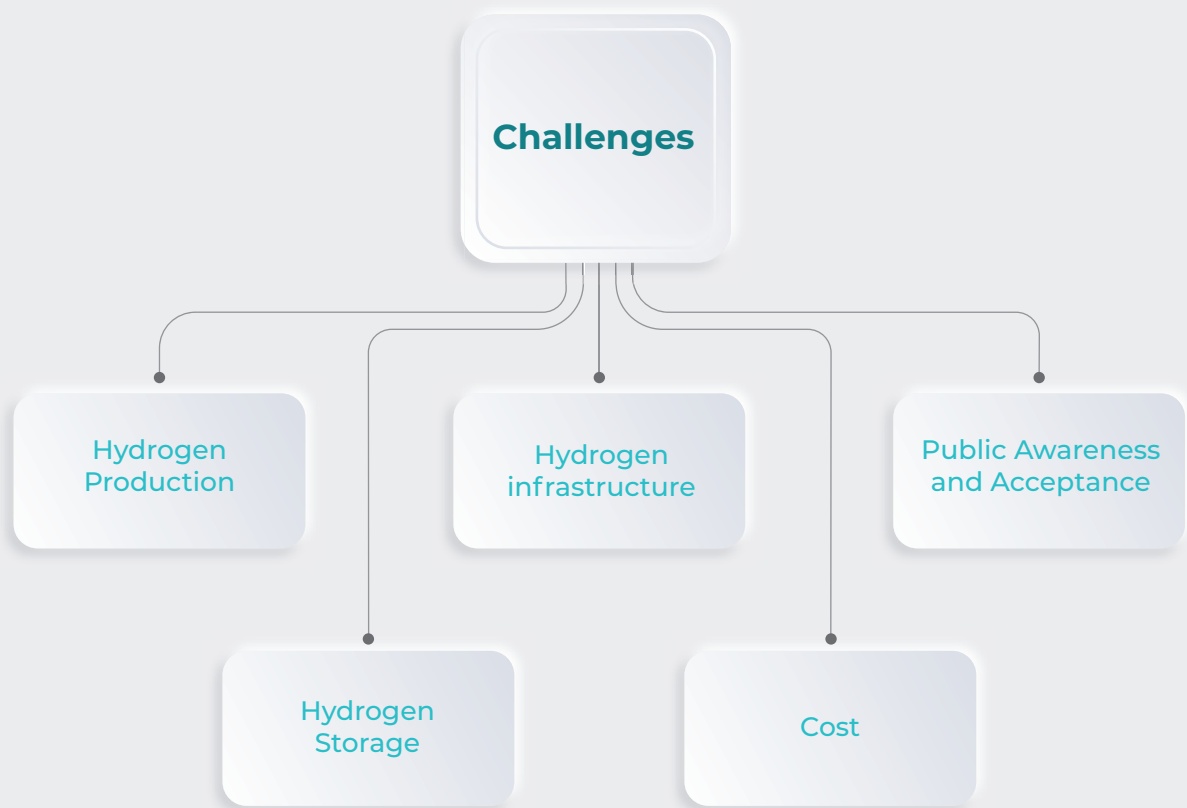


Figure 11: Hydrogen Technology Challenges in Johor

3.6.1 Hydrogen Production

Green hydrogen produced from solar energy systems faces limitations due to competition with electricity generation from solar. Solar electricity production is highly efficient and more cost-effective compared to hydrogen production.

To address this issue, the Johor State Government can spearhead hydrogen production by integrating mini hydro with solar systems, and identifying suitable areas for pilot projects. One suggestion is to place solar and mini hydro integration in rural parts, as the distribution of hydrogen storage is easier, allowing it to meet demands in various areas.

3.6.2 Hydrogen Storage

Storing hydrogen is challenging because hydrogen molecules are naturally small and in a gaseous form. Hydrogen also has a low energy density by volume compared to natural gas, which means it requires larger storage spaces.



Through satellite laboratories in collaboration with research institutions in Johor, the state could lead this initiative by pioneering hydrogen storage technologies in forms other than gaseous hydrogen, such as compressed hydrogen, liquid hydrogen, ammonia, and solid hydrogen. These alternatives can reduce the storage space required for hydrogen and facilitate its distribution, thus fulfilling the demands of the industrial, commercial, and export sectors.



3.6.3 Hydrogen Infrastructure

Currently, there is no commercial-scale infrastructure for the production, distribution, and use of hydrogen in Johor, unlike fossil fuels such as coal, petrol, and natural gas.

To encourage investment in hydrogen infrastructure development, including production facilities, distribution pipelines, and hydrogen refuelling stations, it is essential to build such facilities. The Johor State Government could follow the example of the Scottish government by providing matching grants for every hydrogen infrastructure investment in Johor. Furthermore, there are various hydrogen technologies at institutions that could be scaled up commercially if sufficient funding is provided by the Johor State Government.

3.6.4 Hydrogen Costs

In Malaysia, most hydrogen produced today is grey hydrogen, made from fossil fuel using Steam Methane Reforming technology that releases CO₂. Therefore, hydrogen production through this method does not contribute to reducing carbon emissions, unlike green hydrogen. While green hydrogen production is more environmentally friendly, the cost of electrolysis technology, which uses solar or hydro energy as a power source, is expensive.

To address this issue, the implementation of advanced technology with a “Build Some, Buy Some” approach, as outlined in the HETR, aims to produce hydrogen at a competitive cost, supported by local ecosystems and expertise. Johor can lead this initiative by establishing “satellite laboratories” in collaboration with Higher Education Institutions (HEI) in Johor to develop commercial electrolysis technology using the “Build Some, Buy Some” approach, thereby reducing technology costs.

3.6.5 Public Awareness and Acceptance

Hydrogen technology is relatively new in Malaysia, especially in Johor. The local community is not yet widely exposed to hydrogen technology. The lack of exposure will create concerns, particularly in terms of safety.

To raise awareness of hydrogen technology, efforts can be made to reach all levels of society in Johor. The government can collaborate with schools and HEI in Johor to provide early exposure to hydrogen technology for the public. Additionally, the development of small-scale hydrogen technologies as pilot projects can help build confidence among the community and investors in hydrogen technology.

4.0

Existing Laws, Policies, and Incentives Related to Energy

The direction of Malaysia's energy sector is set by current laws and policies related to energy. These laws and policies serve as a reference for stakeholders, particularly in the energy sector, to carry out their projects. Energy sector laws are also crucial in ensuring that all parties fulfil their responsibilities as stipulated by law.

1974

Petroleum Development Act (1974)

- To vest the **entire ownership in and the exclusive rights** for the exploration and exploitation of petroleum resource in PETRONAS.
- PETRONAS shall be subject to the control and **direction of the Prime Minister**
- The **National Petroleum Advisory Council** is set up to advise the Prime Minister on national policy, interests and matters pertaining to petroleum, petroleum industries, energy resources and their utilisation.

Electricity Supply Act (1990)

- To provide for the **regulation of the electricity supply industry**
- Supply of electricity at **reasonable prices and licensing of electrical installation** and to promote safe and efficient systems for electricity-related operations.

1990

1993

Gas Supply Act (1993)

- To provide for the **licensing of natural gas** supply to consumers at reasonable prices, with continuous supply and good quality.
- Ensure the **safe and efficient** operation of natural gas pipelines, installations and appliances.

Energy Commission Act (2001)

- Establishment of the Energy Commission.
- Authorise the Energy Commission to **regulate energy supply activities** including the enforcement of energy supply laws.

2001

2011

Renewable Energy Act (2001)

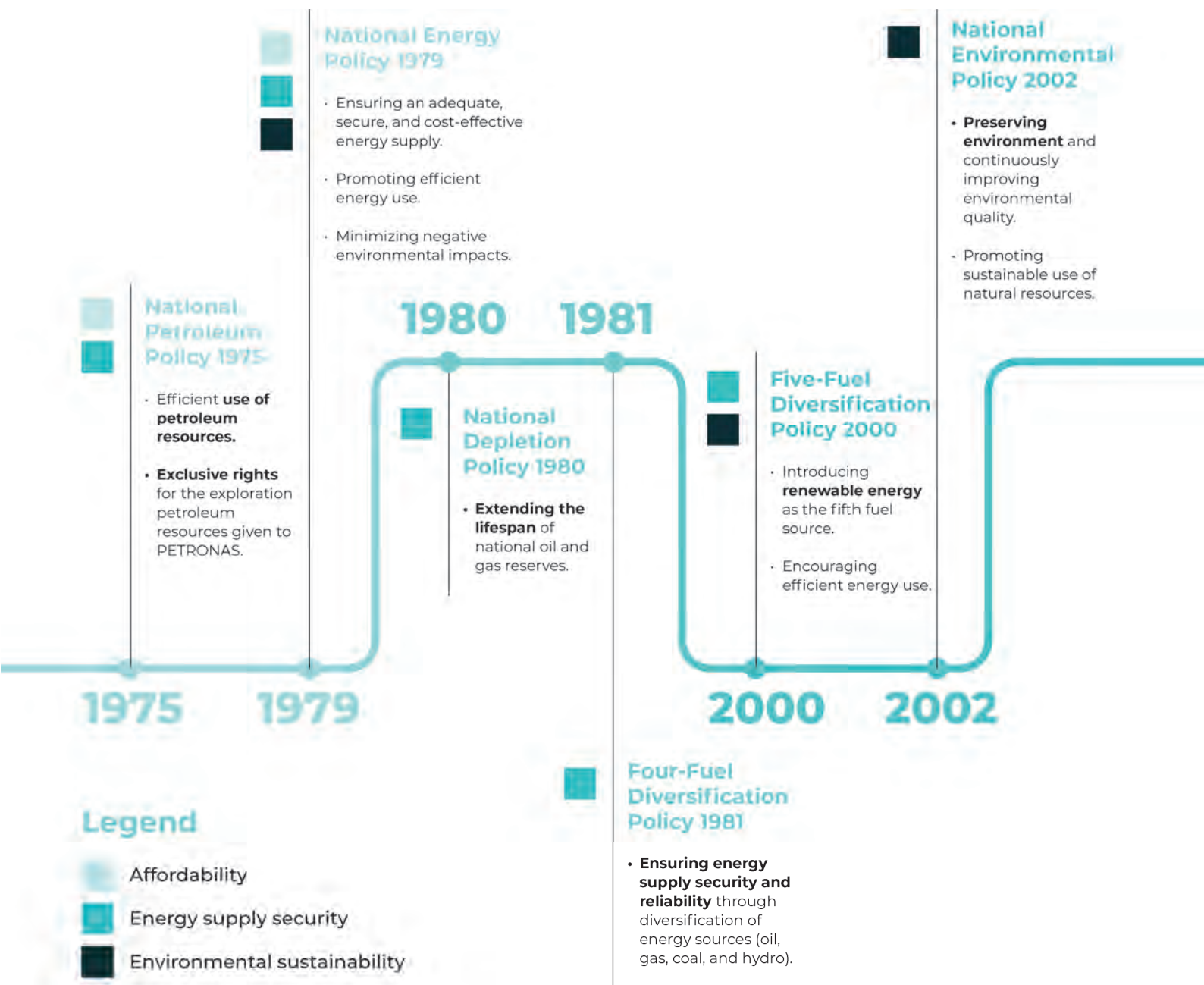
- To provide for the **establishment of a FiT system** to increase electricity generation from renewable sources.

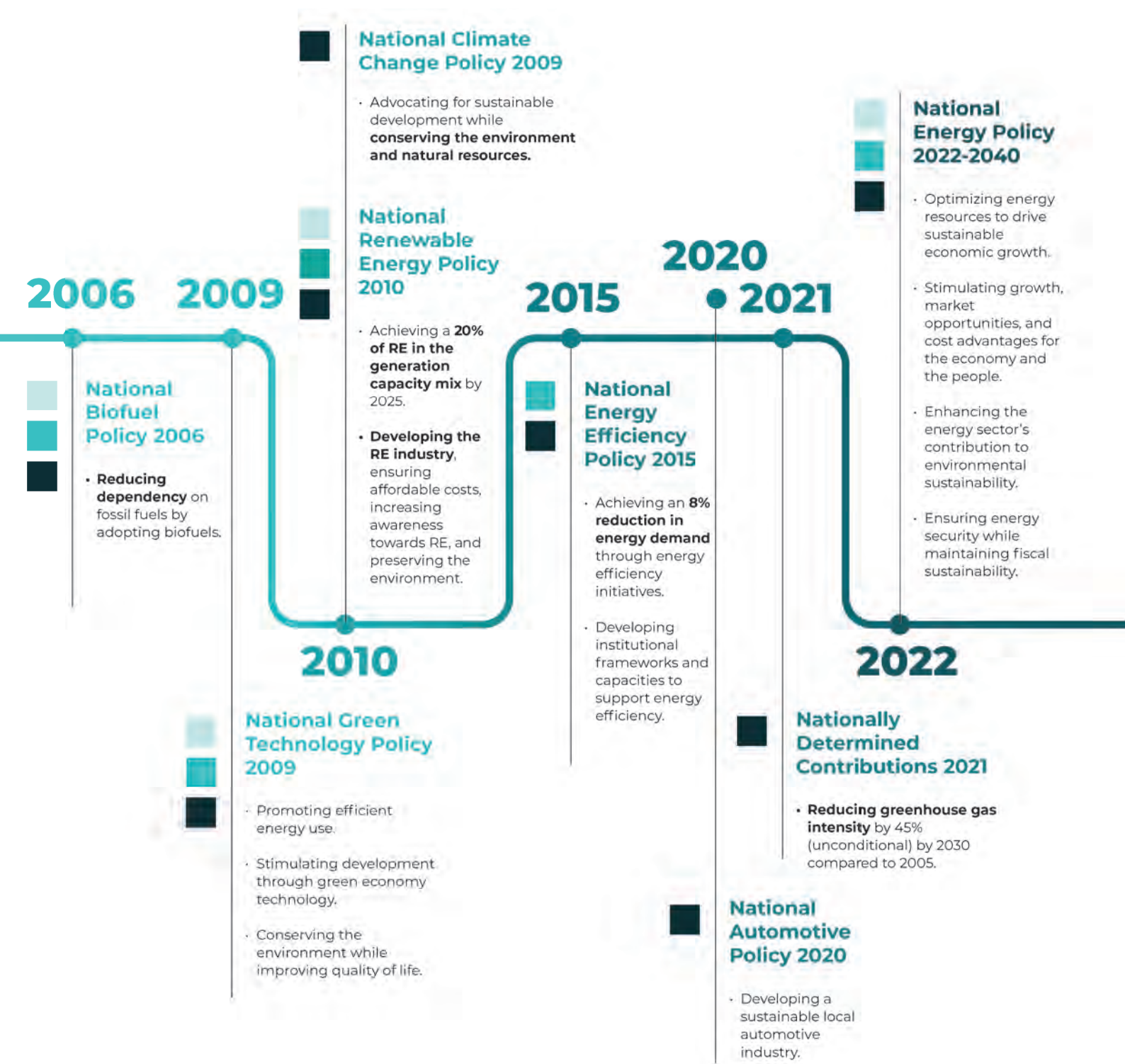
Sustainable Energy Development Authority Act (2011)

- To provide for the **establishment of the SEDA**.
- SEDA is responsible for **sustainable energy laws and to promote the use of sustainable energy**.

Source: National Energy Policy 2022-2040

Figure 12: Energy-related acts in Malaysia



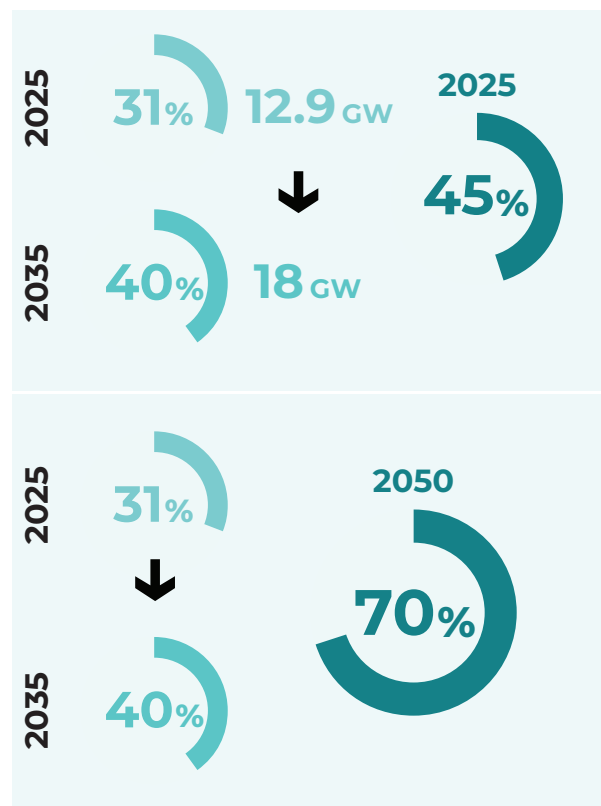


Source: Updated from National Energy Policy 2022-2040

Figure 13: Policies introduced in Malaysia related to the energy sector

To support the policies mentioned, several roadmaps have been developed over the past five years.

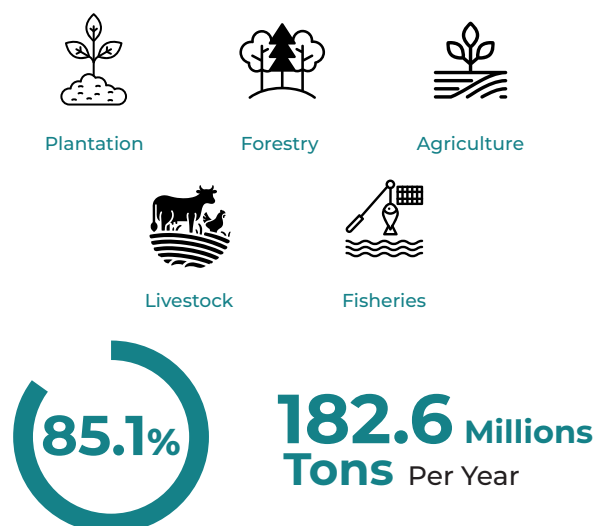
1 Malaysia Renewable Energy Roadmap (2021) aims to increase the shares of RE in Malaysia to 31% (12.9 GW) by 2025 and 40% (18.0 GW) by 2035, while also reducing greenhouse gas intensity by 45% (unconditionally) by 2030 compared to 2005.



2 National Energy Transition Roadmap (NETR) 2030 aims to gradually increase the shares of RE in Malaysia to 31% by 2025, 40% by 2035, and achieve net zero emissions (70%) by 2050.

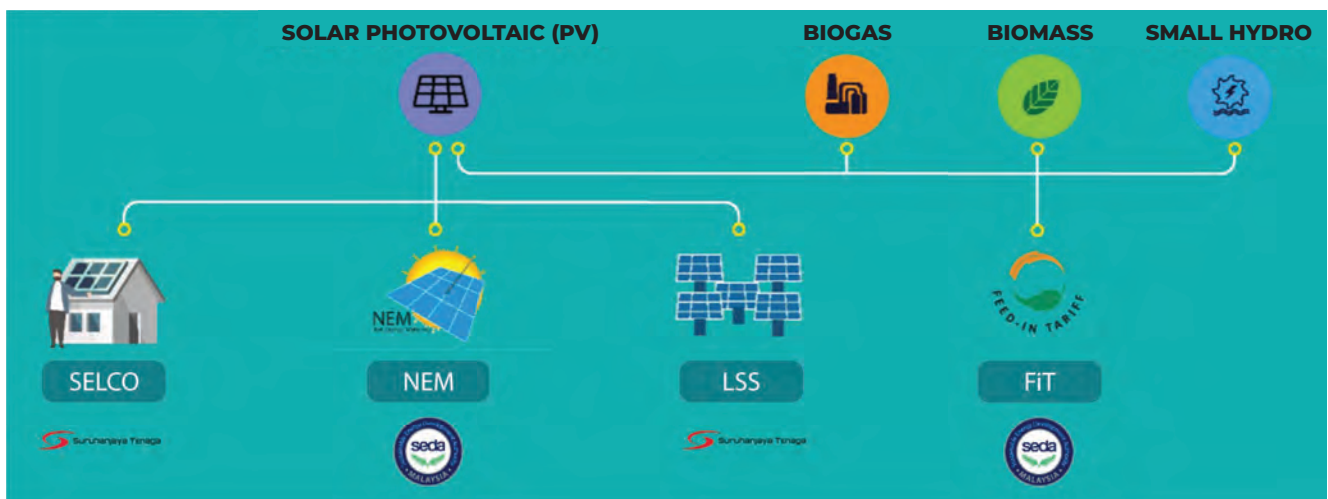
3 Hydrogen Economy and Technology Roadmap (HETR) focuses on promoting the use of hydrogen for energy storage and as a fuel in combined cycle gas turbines. It also emphasizes investing in hydrogen technology to address domestic use, energy security, international energy trade sustainability, and decarbonisation.

4 National Biomass Action Plan 2023-2030 outlines Malaysia's focus on biomass resources widely available in the plantation, forestry, agriculture, livestock, and fisheries sectors. Biomass potential from these sectors is estimated at 182.6 million tons per year, with a significant portion (85.1%) derived from the palm oil biomass industry.



In line with the Malaysian Government's efforts to reduce greenhouse gas emissions, the Low Carbon Society (LCS) Blueprint for Iskandar Malaysia 2025 was developed in Johor in 2012. The LCS Blueprint emphasizes several RE sources, including solar, biomass, biogas, waste, and hydrogen. Several documents, including (1) Johor Sustainable Development Plan (PPMNJ) 2019-2030, (2) Johor State Sustainability Policy (DKNJ) 2017-2021 and (3) Johor State Structure Plan 2030, were also developed. These documents further highlight the importance of RE in achieving sustainable development.

In addition to the energy policies mentioned above, incentives are also crucial to enabling the realization of the introduced policies. Among the incentives and programs implemented by the government to drive the energy sector in Malaysia are as follows:



Source: Official SEDA Malaysia Portal

Figure 14: List of incentives and programs available in Malaysia related to RE

SELCO

Self-Consumption (SELCO) applies when electricity is generated for personal use, and any excess is not allowed to be exported to the grid. The government encourages individuals, commercial users, and industries to install solar PV systems for their own use, aiming to hedge against rising electricity costs.

NEM

The government introduced the Net Energy Metering (NEM) Scheme in November 2016, with a quota allocation of 500 MW until 2020, to encourage the uptake of RE in Malaysia. The concept of NEM is that the energy generated from the installation of solar PV systems will be used first for the consumer's own needs, and any excess will be exported to TNB at the prevailing displaced cost.

LSS

Large-Scale Solar (LSS) is a competitive bidding programme aimed at reducing the Levelised Cost of Energy (LCOE) for the development of LSS PV plants. The ST is the implementing agency for this scheme.

FiT

The Feed-in Tariff (FiT) in Malaysia requires DLs to purchase electricity generated from RE sources from FiAH and sets the FiT rates. The DLs will pay for RE supplied to the electricity grid for a specified period. By guaranteeing access to the grid and setting a favourable price for each unit of RE, the FiT mechanism ensures that RE becomes a viable and sound long-term investment for industrial companies and individuals.

5.0

Vision and Objectives of the Johor Renewable Energy Policy

Based on the collected data, it is clear that Johor has significant potential as a RE producer, thus driving the economic growth in Johor. To achieve this vision, the Johor RE Policy 2030 will be established. This policy is developed in line with existing federal government policies and focuses on new strategies required for the sustainable development of RE in Johor. The policy covers the following aspects:

Aligning current RE development with federal government policies and action plans

Ensuring the energy sector is ready to meet growing energy demands, reduce fossil fuel dependency, and address climate change

Strategically planning and utilising renewable resources in Johor for energy generation

Providing coordination across various stakeholders, including government, economic sectors, energy-related industries, and research entities, in RE development

Ensuring RE development in Johor is aligned with national and global energy transition trends

The vision, objectives, and 12 key strategies that will be emphasized in this policy are depicted in the diagram below.

JOHOR RENEWABLE ENERGY POLICY 2030

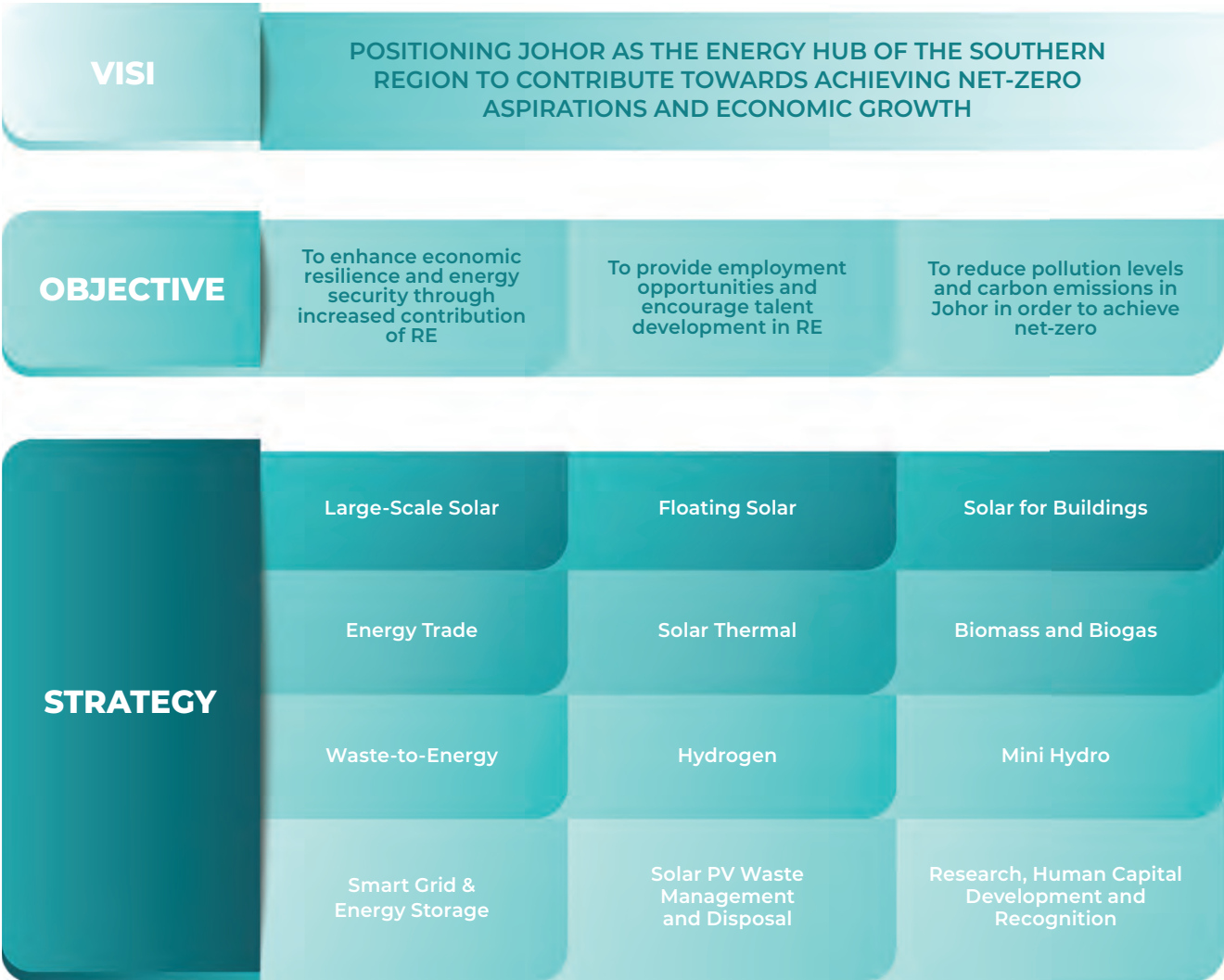


Figure 15: Vision, Objectives and Strategies of the Johor RE Policy 2030

There are 12 key strategies and 38 implementation initiatives identified. From these 12 key strategies, three have been designated as enablers to support the implementation of the other strategies. The three identified enabler strategies are Strategy 10: Smart Grid and Energy Storage, Strategy 11: Solar PV Waste Management and Disposal, dan Strategy 12: Research, Human Capital Development, and Recognition.

Based on the strategies and implementation initiatives outlined above, the Johor RE Policy 2030 is expected to drive economic growth in Johor, create job opportunities, and reduce carbon emissions, thereby fulfilling the three pillars of sustainability.



600 MW
Renewable energy

199 MW

Existing RE

250 MW

Solar RE

151 MW

Other RE sources



2,100 kton CO₂
Carbon reduction per year



15,000
Job opportunities



RM 10 Billion
Investment value

6.0 Implementation Timeline

The implementation timeline for the Johor RE Policy 2030 action plan is divided into three phases: short-term (quick wins), medium-term, and long-term. The detailed timelines and corresponding years of implementation are outlined below.

Table 6: Implementation timeline of Johor RE Policy 2030 action plan

	Time Frame	Year of Implementation
Short-term (Quick Win)	1 - 2 years	2025 - 2026
Medium-term	3 - 4 years	2025 - 2028
Long-term	5 - 6 years	2025 - 2030

7.0 Quick Win Implementation Initiatives

There are 17 short-term (quick win) implementation initiatives (IP) that can be executed within the next one to two years in Johor. These quick win IP are listed below:

Table 7: Quick win implementation initiatives list

Strategy	Implementation Initiatives (Quick Win)
S1: Large-Scale Solar	IP 1: Establish Southern Johor Renewable Energy Corridor (SJREC) for solar energy generation zone IP 2: Promote the development of LSS PV projects across the State of Johor IP 3: Develop a platform to streamline application and monitoring processes for LSS projects IP 4: Establish a land bank and special banking rates for RE development
S2: Floating Solar	IP 1: Develop a framework for constructing floating solar PV projects IP 2: Establish zones for floating solar PV development
S3: Solar for Buildings	IP 1: Install solar PV systems for Zero Energy Building (ZEB) programmes under Green Building Certification for Building-Integrated PV (BIPV) IP 2: Use government buildings in Johor as pilot projects for solar PV installations IP 3: Promote various concepts for solar installations on buildings

S6: Biomass and Biogas	IP 1: Create a biomass ecosystem in Johor to enhance the local economic value of biomass compared to export markets
S7: Waste-to-Energy	IP 1: Implement waste segregation at the source programme based on burnable and non-burnable components
S8: Hydrogen	IP 1: Conduct detailed studies on the potential for hydrogen generation and demand in Johor
S11: Solar PV Waste Management and Disposal	IP 1: Develop solar PV installation frame designs optimised for recycling
S12: Research, Human Capital Development, and Recognition	IP 1: Empower HEI in Johor as RE research and consultancy centres IP 2: Strengthen training centres to produce highly skilled human capital to support RE development in Johor IP 3: Establish a Johor Green Energy Recognition programme IP 4: Launch public awareness campaigns to educate the community on the role and importance of RE

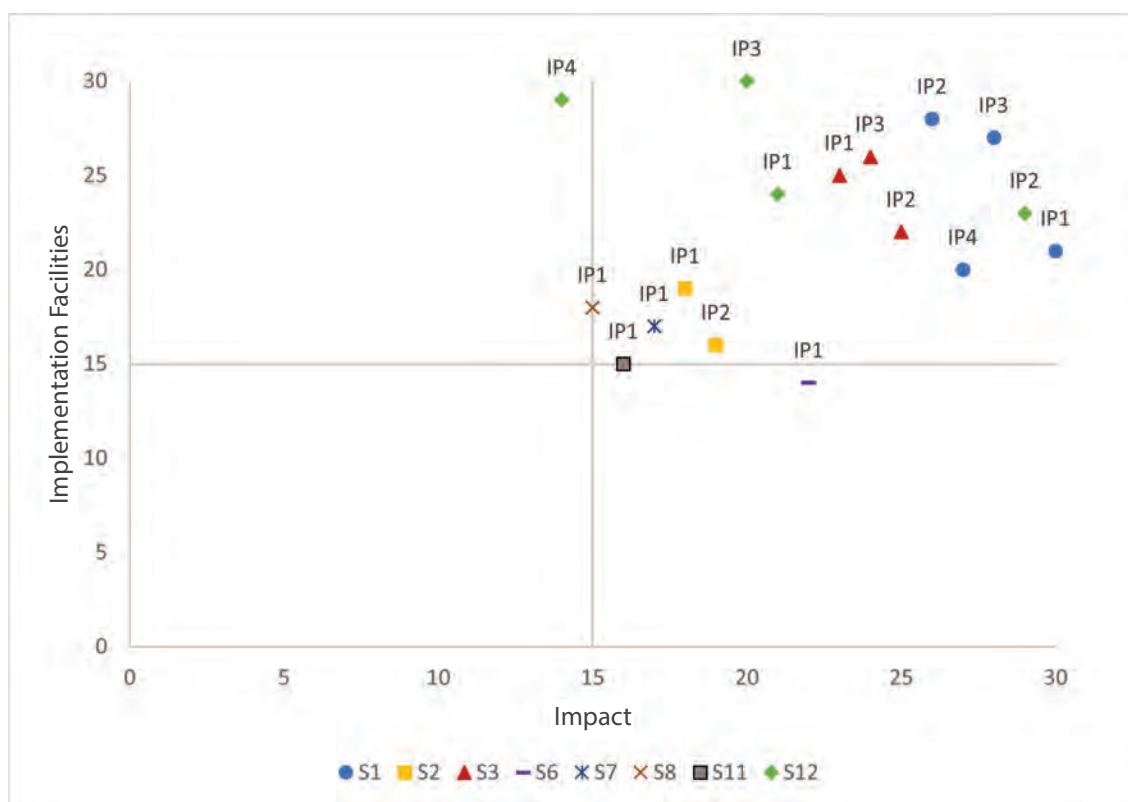
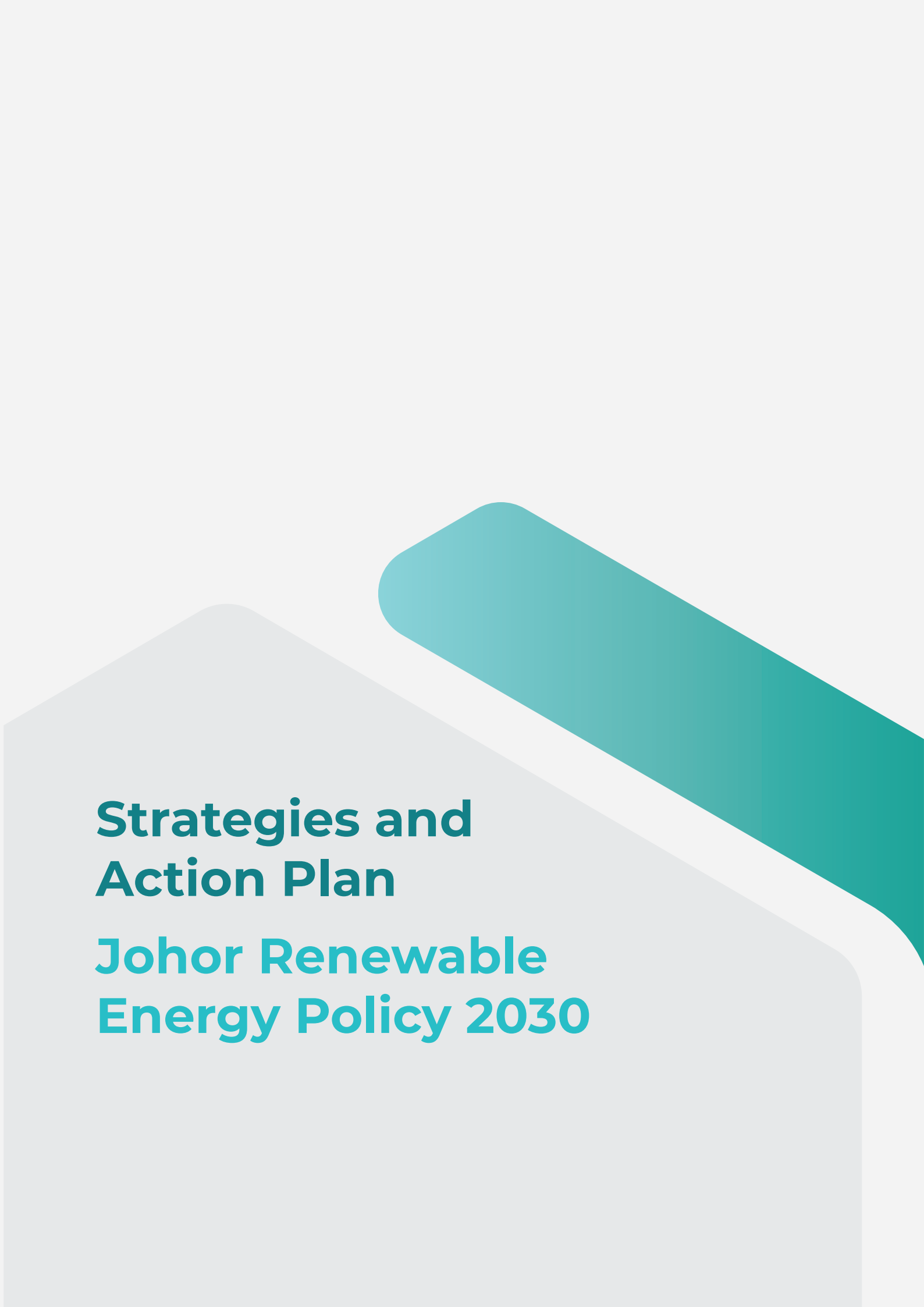


Figure 16: Priority Assessment Chart for Quick Win Initiatives

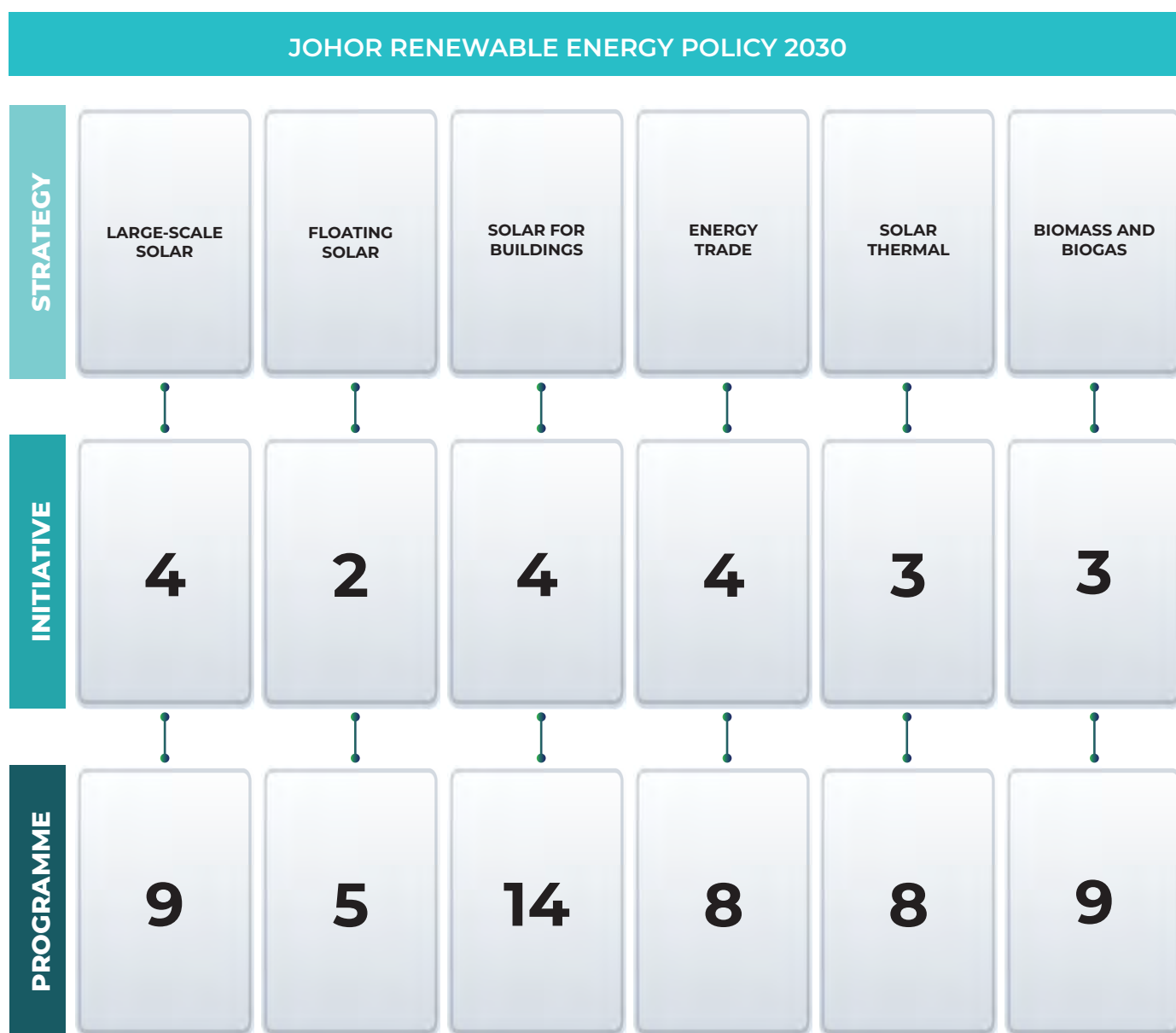


Strategies and Action Plan

Johor Renewable Energy Policy 2030

8.0 Strategies and Action Plans for Renewable Energy in Johor

The Johor Renewable Energy Policy 2030 comprises **12 strategies** with **38 implementation initiatives**. These initiatives are supported by **99 programmes** to achieve the policy's vision, as shown in Figure 17.



JOHOR RENEWABLE ENERGY POLICY 2030

STRATEGY	WASTE-TO-ENERGY	HYDROGEN	MINI HYDRO	SMART GRID & ENERGY STORAGE	SOLAR PV WASTE MANAGEMENT AND DISPOSAL	RESEARCH, HUMAN CAPITAL DEVELOPMENT AND RECOGNITION
INITIATIVE	4	4	1	2	3	4
PROGRAMME	8	14	3	4	4	13

Figure 17: Summary of the Johor Renewable Energy Policy 2030

STRATEGY 1

Large-Scale Solar

OBJECTIVE

Enhancing the development of LSS farms in Johor through the establishment of a RE grid and land-use adjustments, streamlining land-use application procedures, recalculating special solar permit fees and other related charges for LSS projects, and providing a platform to facilitate the application and monitoring of LSS projects in Johor.

Scale	Estimated Capacity	Estimated Site Area (Acres)
Small	1 – 5 MW	< 25
Medium	6 – 30 MW	25 – 150
Large	Exceeds 31 MW	> 150

IMPLEMENTATION INITIATIVES

1. Establish Southern Johor Renewable Energy Corridor (SJREC) for solar energy generation zone.
2. Promote the development of LSS PV projects across the State of Johor.
3. Develop a platform to streamline the application and monitoring processes for LSS projects.
4. Establish a land bank and special banking rates for RE development.

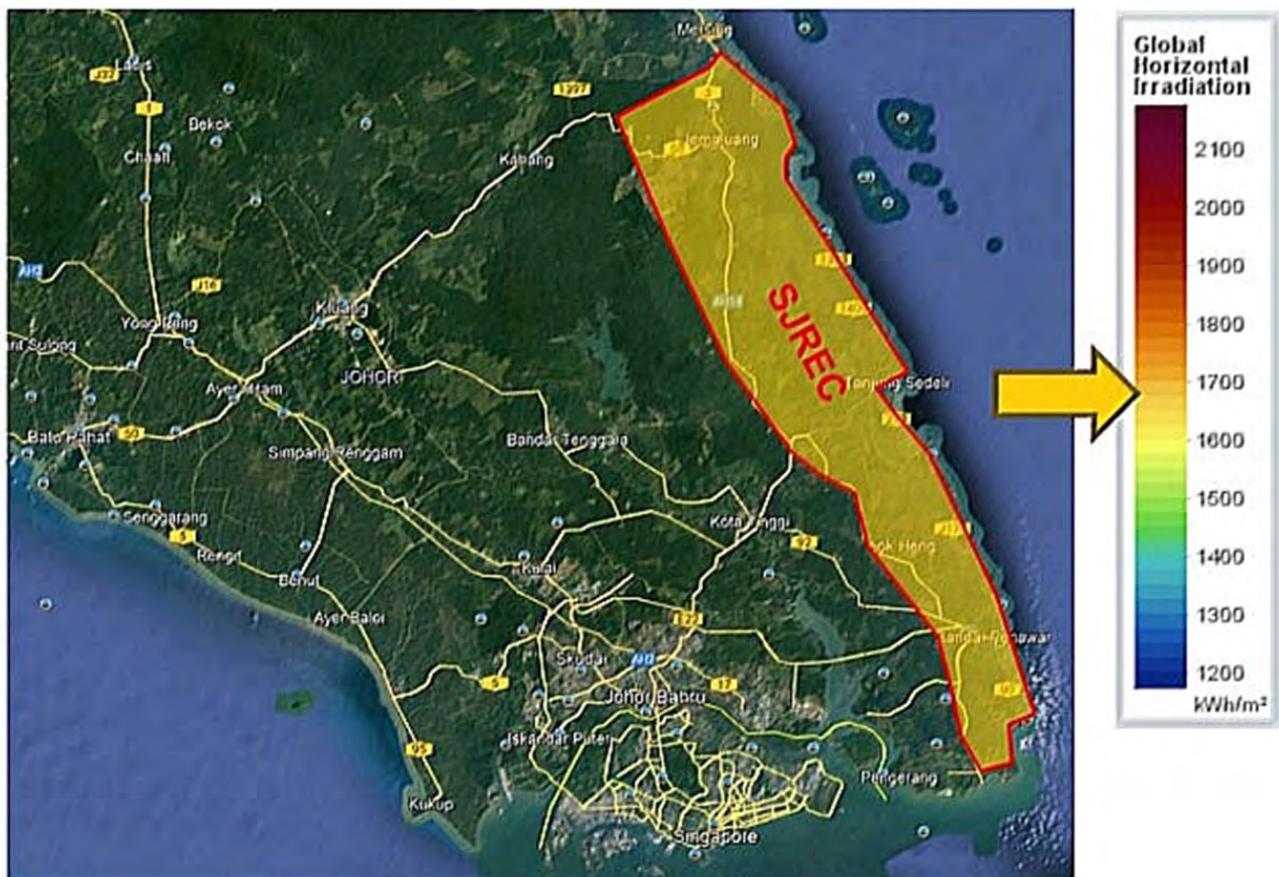


IP 1:

ESTABLISH SJREC FOR SOLAR ENERGY GENERATION ZONE

To ensure that solar PV projects are developed in an organised manner, a RE solar generation zone should be established in Johor. With this zone, potential areas (i.e., areas with high solar irradiance) can be identified. Additionally, this zone will also guarantee energy connectivity between the solar power generation areas and the existing grid, or with the RE grid in the future.

Based on solar irradiation intensity, the eastern coast of Johor has been identified as suitable for the development of solar PV projects due to their high solar irradiation ($\sim 1,700$ kWh/m²) compared to other areas. The zone identified as the SJREC, includes the districts of Mersing and Kota Tinggi, including Pengerang. By establishing SJREC, the planning of RE infrastructure, including the RE grid, can be done more strategically to enhance the contribution of RE sources to Johor's energy mix.



Proposed area for Southern Johor Renewable Energy Corridor (SJREC)

An example of a suitable area within the zone for LSS projects is the area covering Sg. Lebam/Felda Kledang/Punggai. This area also receives relatively high solar irradiation in Johor, estimated at around 3.7 kWh/kWp. The area, located at Tanjung Surat and the eastern coast of Kota Tinggi, has 4 plots of land with a total area of 4,600 acres and the potential to install solar panels with a capacity of 2 - 3 GW. Additionally, this location is considered strategically ideal for LSS development due to its proximity to the existing grid.



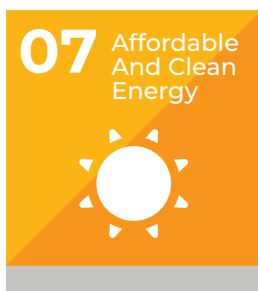
An example of a potential area within SJREC – Sg. Lebam/Felda Kledang/Punggai

SJREC will prioritize the development of LSS projects, as LSS projects are not encouraged to be developed in urban areas. This is because LSS projects require large tracts of land, and developing them in urban areas would waste valuable land that could be used more strategically for economic development. Furthermore, SJREC can support the growth of JS-SEZ in Johor by supplying RE. This can be achieved through the proposed development of a RE grid within the SJREC zone, which will be connected to the existing grid in the JS-SEZ. Supplying RE to the JS-SEZ will also benefit industries in Johor by helping them reduce carbon emissions through direct use of RE or through Renewable Energy Certificate (REC) using the RE generated in SJREC. This initiative will help attract both international and local investors who prioritize sustainability and environmental conservation.

PROGRAMME

- Conducting a detailed study and propose strategic locations within SJREC for the development of LSS PV projects.
-

SDG



IP 2:

PROMOTE THE DEVELOPMENT OF LSS PV PROJECTS ACROSS THE STATE OF JOHOR

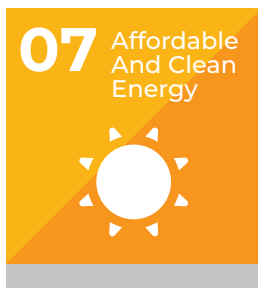
Solar PV in Johor still holds significant untapped potential. Therefore, to further stimulate the LSS industry in the state, efforts to promote this sector must be intensified. Areas with high solar intensity outside the SJREC zone include districts such as Segamat, Muar, Batu Pahat, and Pontian. The criteria for installing LSS PV align with LSS standards and the planning and installation guidelines for solar in Johor. These solar projects could cover installations in agricultural areas (based on the agrivoltaics concept) and rural regions. However, the development of LSS projects in designated food security zones is strictly prohibited.



PROGRAMME

- Engaging in discussions with TNB to increase the number of nodal points for solar energy injection into the existing electrical grid.
- Providing incentives for interested parties to develop LSS PV projects across Johor.
- Making information about solar development plans in Johor available on the state government's website.
- Implementing LSS PV projects in suitable areas across Johor.

SDG



IP 3:

DEVELOP A PLATFORM TO STREAMLINE THE APPLICATION AND MONITORING PROCESSES FOR LSS PROJECTS

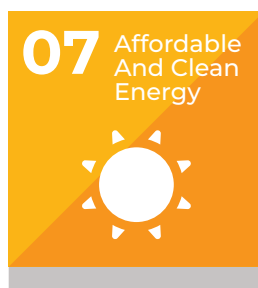
The application process for solar project development requires multiple levels of approval, including land approval, energy generation approval, and planning permission. Additionally, this process involves various parties and government agencies. Therefore, to make the application process more systematic and time-efficient, an integrated platform needs to be developed. This platform will assist developers in submitting applications according to established procedures. Subsequently, the application will be directly forwarded to the relevant bodies involved in the project approval process.

Furthermore, the platform will facilitate the monitoring of RE generation in Johor. Project developers will use this platform to record RE generation data. As an initial step, the platform can be launched for LSS project applications and later upgraded to include applications for other RE sources such as biomass, waste-to-energy, and mini hydro projects.

PROGRAMME

- Developing a dedicated website accessible to any interested parties for applying to develop LSS projects.

SDG



IP 4:

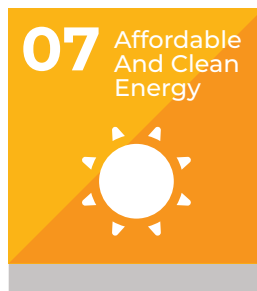
ESTABLISH A LAND BANK AND SPECIAL BANKING RATES FOR RE DEVELOPMENT

LSS development in the southern region is less economically viable compared to the northern region of Peninsular Malaysia due to 10-15% lower solar irradiation. Additionally, solar feasibility studies increase the cost of LSS development. To enhance the competitiveness of solar PV investments in Johor, financial support should be provided. Although Malaysia has an LSS program, a federal government-led competitive bidding initiative, the Johor State Government can assist by identifying land that will remain undeveloped for 21 years and offering lower development fees for these projects to encourage more competitive bidding for LSS projects. The state government could also provide special funding for solar energy feasibility studies. These studies should not only assess solar irradiation but also analyse how location and terrain affect the feasibility and profitability of RE projects. Other factors to consider include RE potential, development costs, grid injection costs to the nearest grid, and energy supply and demand analyses. These studies can help mitigate project risks, thereby increasing confidence among banks to offer special interest rates. Land banks, matching funds, and the provision of special interest rates by banks can collectively help reduce LSS investment costs in Johor.

PROGRAMME

- 📄 Preparing a land bank inventory by identifying plots of land that will remain undeveloped for the next 21 years for LSS project development.
- 📄 Establishing a special fund to support feasibility studies for RE development.
- 📄 Coordinating with Bank Negara to facilitate the provision of special banking interest rates for LSS project development.

SDG



STRATEGY 2

Floating Solar

OBJECTIVE

Establish a floating solar PV development zone in suitable locations with minimal environmental impact, guided by relevant acts, regulations, and guidelines. This strategic initiative aims to promote the use of innovative and sustainable solar energy sources, contributing to the diversification of the country's energy mix and ensuring the effectiveness and sustainability of large-scale floating solar PV projects.

IMPLEMENTATION INITIATIVES

1. Develop a framework for the constructing floating solar PV projects.
2. Establish zones for floating solar PV development.



IP 1:

DEVELOP A FRAMEWORK FOR CONSTRUCTING FLOATING SOLAR PV PROJECTS

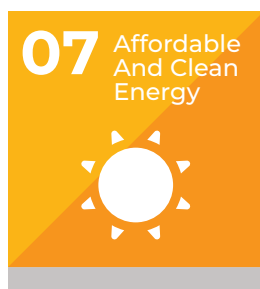
The development of floating solar raises concerns from various parties. From an environmental perspective, the installation of floating solar could impact the marine life beneath the floating solar structures. Technically, compared to conventional PV solar systems, floating solar needs to be installed with the appropriate floating and anchoring systems. Floating solar also affects fishing activities, fishermen, shipping, and Orang Asli communities. Therefore, to initiate floating solar projects in Johor, a proper framework that considers environmental, technical, and specific land use factors is required.



PROGRAMME

- Conducting environmental and technical impact studies for floating solar developments in water catchment areas in collaboration with the Department of Environment (JAS).
- Executing social and economic impact studies that consider the effects on fishing activities, fishermen, shipping, and indigenous communities that may be affected by this project.

SDG



IP 2: ESTABLISH ZONES FOR FLOATING SOLAR PV DEVELOPMENT

There are various types of water surfaces with potential for floating solar projects. These include areas such as abandoned mining pools, lakes, catchment areas (rivers/reservoirs), and the sea. Reservoirs are particularly promising due to their calm water surfaces. Some reservoirs in Johor include the Upper Layang Reservoir, Lower Layang Reservoir, Sembrong Reservoir, and Bekok Reservoir. A full list of reservoirs in Johor, along with their water surface areas and estimated solar capacity, is provided in the table below. The use of water supply reservoirs for floating solar projects must obtain approval from the JAS.

List of potential reservoirs in Johor for floating solar development

No	Reservoir Name	Responsible Agency	Catchment Area (HA)	Surface Area (km ²)	Estimated Solar Capacity (MW) ¹
1	Lower Layang Reservoir, Johor Bahru	BAKAJ	2,650	16.00	256.07
2	Upper Layang Reservoir, Johor Bahru	BAKAJ	3,200	20.00	320.09
3	Gunung Pulai 1 Reservoir, Johor Bahru	BAKAJ	2,873	0.08	1.28
4	Gunung Pulai 2 Reservoir, Johor Bahru	BAKAJ		0.53	8.48
5	Gunung Pulai 3 Reservoir, Johor Bahru	BAKAJ		0.02	0.32
6	Pontian Reservoir, Ulu Choh	BAKAJ		1.94	31.05
7	Lebam Reservoir, Kota Tinggi	BAKAJ	1,897	1.70	27.21
8	Congok Reservoir, Mersing	BAKAJ	1,550	0.64	10.24
9	Kahang Reservoir, Kluang	BAKAJ	2,766	5.60	89.63
10	Juaseh Reservoir, Segamat	BAKAJ	2,946	2.10	33.61
11	Gunung Ledang Reservoir, Muar	BAKAJ	1,030	0.14	2.24
12	Bekok Reservoir (Segamat, Kluang, Batu Pahat)	JPS	35,402	12.00	192.05
13	Sembrong Reservoir (Kluang, Batu Pahat)	JPS	13,644	15.00	240.07
14	Machap Reservoir, Kluang	JPS	8,530	9.09	145.48
15	Labong Reservoir, Mersing	JPS	1,444	6.07	97.15

¹ Capacity is calculated using an estimate of 10% of the water surface area for solar panel installation

Source: BAKAJ

The installation of floating solar panels in marine environments is subject to tidal conditions. Areas with strong waves are unsuitable for floating solar installations. The Straits of Johor is a potential location for large-scale floating solar systems due to its relatively calm waters. Furthermore, installations in marine areas are limited to a maximum distance of three nautical miles from the shore. This limitation aims to minimize the impact on fishing and coastal activities and reduce effects on sensitive marine habitats. This approach aligns with the provisions of the Territorial Sea Act 2012 (Act 750), which establishes the three-nautical-mile boundary as a guideline.

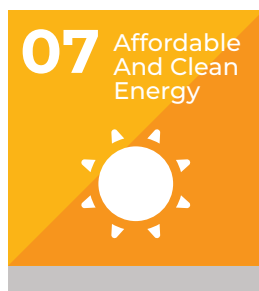


Floating solar

PROGRAMME

- Identifying suitable areas for floating solar installations, such as disused mines, lakes, water catchment areas (rivers/reservoirs), and coastal waters.
- Establishing procedures to obtain approvals and licenses from relevant authorities for the development of floating solar projects.
- Implementing floating solar projects in identified locations, including disused mines, lakes, water catchment areas (rivers/reservoirs), and coastal waters.

SDG



STRATEGY 3

Solar For Buildings

OBJECTIVE

Optimising the potential of solar energy in Johor by implementing and integrating effective, sustainable, and environmentally friendly PV systems on buildings, with the aim of increasing RE use, reducing carbon footprints, and supporting the state's economic growth through innovation, green technology, and sustainable development.

IMPLEMENTATION INITIATIVES

1. Install Solar PV systems for Zero Energy Building (ZEB) Programmes under the Green Building Certification for BIPV.
2. Use government buildings in Johor as pilot projects for solar PV installations.
3. Promote various concepts for solar PV installation on buildings.
4. Expand the use of solar-powered electric vehicle (EV) chargers.



IP 1:

INSTALL SOLAR PV SYSTEMS FOR ZEB PROGRAMMES UNDER THE GREEN BUILDING CERTIFICATION FOR BIPV

ZEB Programmes focus on developing buildings that achieve zero or positive energy balance, where the energy generated on-site meets or exceeds the energy consumed by the building. This involves integrating RE technologies such as BIPV into the design and construction of new buildings. Incorporating BIPV installations as part of green building certification criteria also promotes green building certifications like the Green Building Index (GBI), CASBEE Iskandar, or GreenRE standards. Establishing a special application pathway for green building certification is necessary to prioritize and expedite applications for certifications, permits, and compliance inspections. By implementing this system, stakeholders can navigate the approval process efficiently, encouraging the adoption of environmentally friendly construction practices in the commercial and industrial sectors.

Example:

A commercial building achieving a higher Green Building rating due to the integration of a BIPV system, demonstrating a strong commitment to sustainability and energy efficiency.

Example:

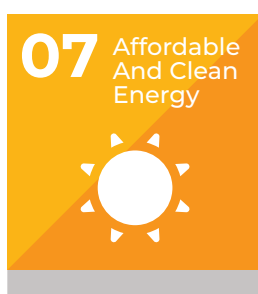
The integration of BIPV windows and facades in a commercial building contributes to the building's overall energy self-sufficiency.



PROGRAMME

- Implementing a Green Lane initiative for each PBT to expedite the approval process for the installation of solar PV systems for green buildings by commercial/industrial sectors.
- Incorporating green building elements, particularly related to the installation of BIPV systems, into the progress/development plans of each PBT.

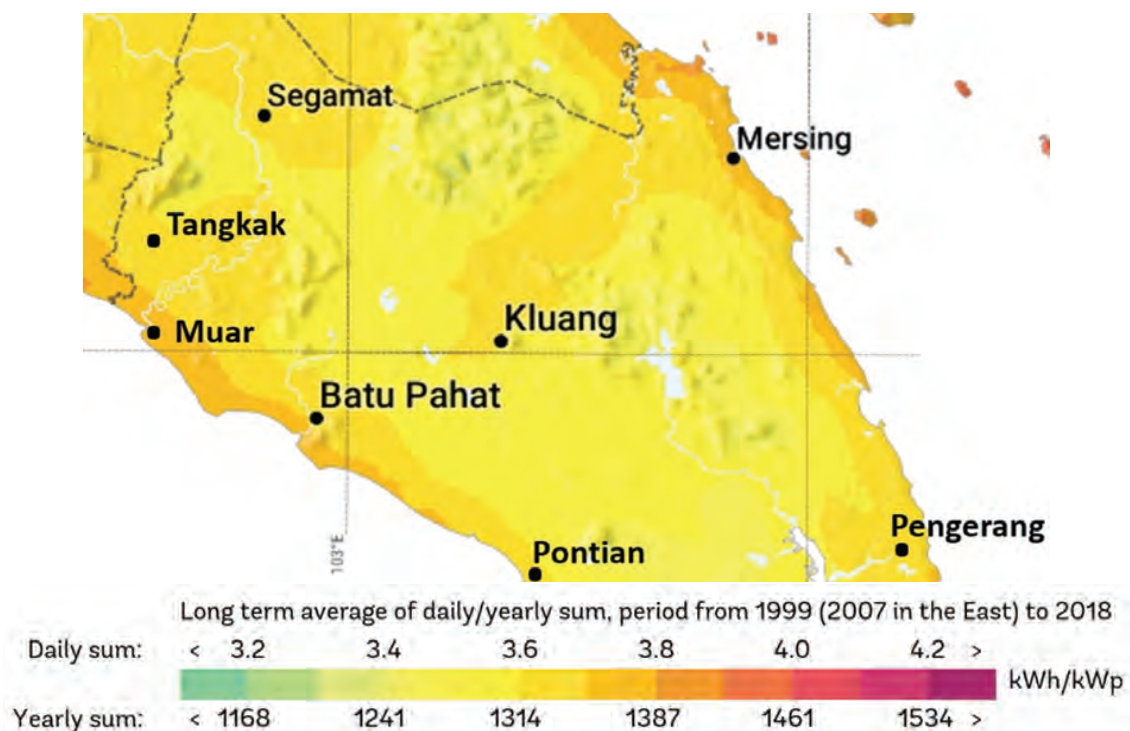
SDG



IP 2:

USE GOVERNMENT BUILDINGS IN JOHOR AS PILOT PROJECTS FOR SOLAR PV INSTALLATIONS

Conduct site studies for government buildings in Pontian, Segamat, Mersing, Kota Tinggi, and Pengerang to identify the potential for solar PV system installation. Additionally, to initiate the acquisition and installation of solar PV systems on government buildings in these areas, leveraging the advantages of high solar intensity.

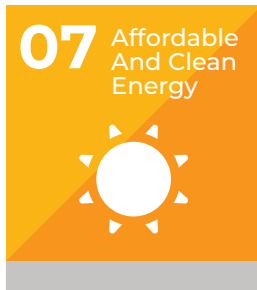


Source: <https://solargis.com/maps-and-gis-data/download/malaysia>

Potential areas for the implementation of pilot solar PV projects integrated into government buildings

PROGRAMME

- Conducting a detailed study on the locations of government buildings in areas with solar radiation exceeding 3.6 kWh/kWp.
- Initiating the procurement and development process for solar PV systems for selected government buildings based on the results of the location study.
- Installing an energy monitoring system to regularly assess the performance of the installed solar PV systems.



IP 3:

PROMOTE VARIOUS CONCEPTS FOR SOLAR PV INSTALLATIONS ON BUILDINGS

Financial assistance to encourage the installation of solar panels in buildings varies and is based on different concepts. For rooftop solar development, the initial cost of solar PV installation must be considered. Therefore, suitable concepts for installing solar PV in residential areas include community solar projects and incorporating solar PV installation costs into house prices. Meanwhile, for industrial and commercial buildings, the solar leasing concept can be implemented.

Community solar projects can be carried out particularly in residential areas with a Joint Management Committee. Funds tied to the committee can be used for solar PV installation, where the energy generated by solar PV can be utilized for facilities (such as streetlights, prayer halls, gyms, swimming pools, and multipurpose halls) in the residential area. This provides mutual benefits to all residents within the community.

Solar leasing for buildings opens opportunities for sustainable investments offering economic and environmental benefits. In this model, investors provide capital for the installation of solar systems and then receive returns on their investment through lease payments from building owners or developers. This allows users to benefit from solar energy without upfront installation costs, while involving third-party ownership and maintenance of the solar PV system.

Apart from the discussed concepts, existing schemes that building owners can apply for include NEM 3.0 and SolaRIS. There are three types of NEM:

NEM Rakyat

The Solar for Rakyat Incentive Scheme (SolaRIS) is expected to boost the adoption of solar energy generation among citizens under the Net Energy Metering (NEM) Programme. Among other benefits, it will provide a rebate of RM1,000/kWac up to a maximum of RM4,000/kWac for new users. This specific incentive program promotes the installation of solar PV systems in domestic homes as a quick win measure to optimize rooftop spaces for RE generation.

NEM GoMEN

Specifically for ministries and government entities, with a quota of 100 MW.

NOVA Programme

Net Offset Virtual Aggregation (NOVA) for commercial, industrial, agricultural, and mining buildings with a quota of 1100 MW.

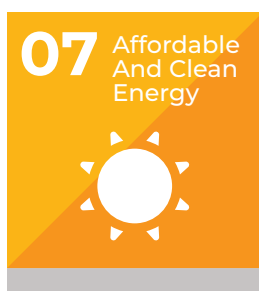
Other incentives that can be considered include:

- **Promotional incentives** (green incentives/subsidies for installing green/solar energy systems, green practices, and related programs/campaigns/training involving processes, procurement, and compliance in solar energy usage for buildings) for the first 3–5 years for international industries establishing branches in Johor or local industries constructing premises with BIPV applications in new buildings in Johor's commercial/industrial areas.
- **Extended incentives.** Introducing special tax rates or tax rebates/deductions (e.g., assessment taxes) for taxes under state or PBT jurisdiction, applicable to industries/companies/commercial operators practicing green initiatives, as a replacement for promotional incentives after the initial 3–5 years.

PROGRAMME

- Conducting campaigns for residential communities to highlight the mutual benefits of community solar projects using tied funds managed by Joint Management Committees.
- Conducting campaigns to educate industrial and commercial building owners about the benefits of rooftop leasing for BIPV installations.
- Introducing additional incentives for solar leasing initiatives and community solar projects.
- Reviewing the proposal to include Solar RE Guidelines as part of the conditions in planning permission evaluations.
- Recommending housing developers to install solar PV systems in new residential areas.

SDG



IP 4:

EXPAND THE USE OF SOLAR-POWERED EV CHARGERS

The existing EV charging stations still rely on electricity from the National Grid, which is mostly generated from fossil-based energy. Integrating solar PV technology into charging stations can help reduce carbon emissions for EVs in Johor. The solar PV can be installed in parking lots, at gas stations with charging stations, or on the rooftops of buildings providing EV charging services.

In addition, to support the NETR, the expansion of EV charging stations across the country, including Johor, is essential. Charging stations equipped with solar PV can ensure a smooth transition towards achieving the core of green mobility as outlined in the NETR.

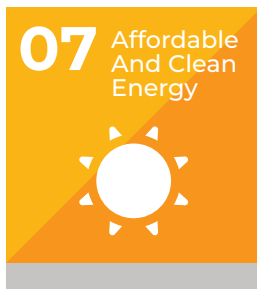


Solar-Powered EV Charger

PROGRAMME

- 📄 Conducting a detailed study on strategic locations for converting existing EV charging stations to solar-powered smart chargers.
- 📄 Developing guidelines for integrated solar EV charging to ensure organized and consistent implementation.
- 📄 Creating a business ecosystem for solar-powered smart EV charging products.
- 📄 Introducing incentives for the development of new solar-powered smart chargers.

SDG



STRATEGY 4

Energy Trade

OBJECTIVE

Empower the trade of RE through the provision of a digital trading platform, development of a RE power grid, development of natural gas and hydrogen pipeline grids, and the introduction of Renewable Energy Certificate (REC).

IMPLEMENTATION INITIATIVES

1. Develop a RE power grid as an enabler for RE trade.
2. Develop natural gas grids and hydrogen pipelines for energy from bio sources and green hydrogen for trade purposes.
3. Establish REC for RE grids and natural gas grids.
4. Provide a digital trading platform.



IP 1:

DEVELOP A RENEWABLE ENERGY POWER GRID AS AN ENABLER FOR RE TRADE

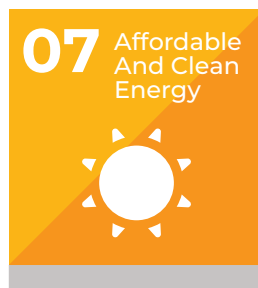
Currently, the nodal points for injecting solar energy into the grid in Johor are limited, and the large-scale integration of RE into the national grid is not feasible. The development of a new RE grid can resolve the existing nodal point issues and allow for the generation and use of more RE in Johor. This, in turn, can attract more investment in RE and enable energy trading between Johor and other countries. The development of this RE grid is estimated to cost between RM 9.42 million and RM 14.14 million for each new cable to be installed.

* This initiative is also linked to Initiatives 1 and 2 for the LSS Strategy.

PROGRAMME

- Conducting a detailed market study in target countries to understand energy usage patterns, regulatory frameworks, and the potential demand for RE markets.
- Developing a strategic RE grid to facilitate the trade of RE to other countries.

SDG



IP 2:

DEVELOP NATURAL GAS GRIDS AND HYDROGEN PIPELINES FOR ENERGY FROM BIO SOURCES AND GREEN HYDROGEN FOR TRADE PURPOSES

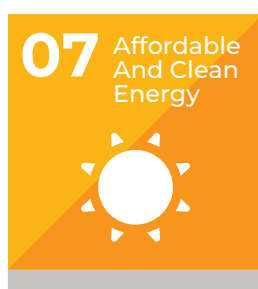
So far, the natural gas grid and hydrogen pipeline for the transmission of bioenergy such as biomethane and green hydrogen have not been developed for the purpose of cross-border RE trade. Therefore, to enhance energy trade, a natural gas grid and hydrogen pipeline need to be established to ensure the effective implementation of cross-border energy trading.



PROGRAMME

- Conducting a detailed market study in target countries to understand energy consumption patterns, regulatory frameworks, and potential demand for RE markets.
- Developing a natural gas grid and hydrogen pipeline for the transmission of biomethane and green hydrogen across borders.

SDG



IP 3:

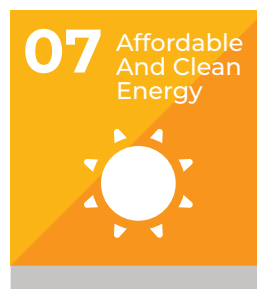
ESTABLISH REC FOR RE GRIDS AND NATURAL GAS GRIDS

So far, there has been no REC from bio-based energy sources (such as bioenergy and green hydrogen) produced from sources under the regulation of the Johor State Government. This certificate will be offered to industries/agencies interested in reducing greenhouse gas emissions, thereby promoting the use of energy from renewable sources. This initiative will also help attract both international and local investors who prioritize sustainability and environmental preservation.

PROGRAMME

- 📄 Developing REC from bio-based energy sources produced from regulated sources under the Johor State Government.
- 📄 Determining the price of REC managed by the RE grid operator at SJREC and the natural gas grid operator with BURSA Malaysia.

SDG



IP 4:

PROVIDE A DIGITAL TRADING PLATFORM

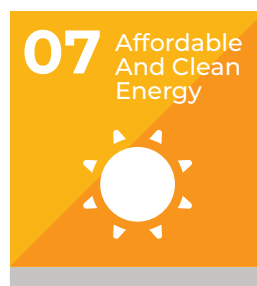
Pricing and trading of RE are subject to various factors, especially in zones with multiple suppliers and buyers. Therefore, a transparent and detailed digital trading platform needs to be developed for the RE grids that will be established. This digital platform will facilitate economic growth in RE trading in Johor. Price negotiations in the market, at competitive rates compared to the retail tariffs (TNB), and real-time transactions between RE producers and solar energy consumers can be carried out more efficiently.



PROGRAMME

- Developing a digital platform to facilitate energy trading using the RE grid.
- Utilising data analytics to optimize the trading platform for the efficiency and effectiveness of RE buying and selling, ensuring grid stability.

SDG



STRATEGY 5

Solar Thermal

OBJECTIVE

Increase the use of solar thermal technology across various sectors, including industry, commercial buildings, hospitals, and housing in Johor, by implementing various approaches such as awareness programs, feasibility studies, and incentives for building owners.

IMPLEMENTATION INITIATIVES

1. Balance the competitiveness of solar thermal technology to be on par with solar PV through incentives.
2. Expand the use of solar thermal systems in commercial/industrial/government buildings with high thermal energy demand.
3. Increase the use of solar water heaters in new residential buildings.



IP 1:

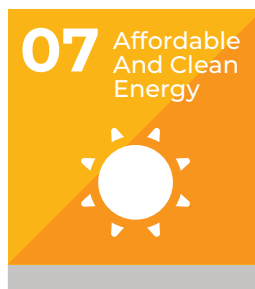
BALANCE THE COMPETITIVENESS OF SOLAR THERMAL TECHNOLOGY TO BE ON PAR WITH SOLAR PV THROUGH INCENTIVES

So far, there have been no incentives provided by either the federal or state governments concerning the implementation of solar thermal technology. Therefore, to enhance the competitiveness of this technology, an adjustment needs to be made so that the incentives provided for the implementation of solar thermal technology are on par with those for solar PV technology.

PROGRAMME

- 📄 Conducting studies on suitable incentive methods for solar thermal technology.
- 📄 Providing incentives to building owners who switch to solar thermal systems to generate thermal energy at their premises.

SDG



IP 2:

EXPAND THE USE OF SOLAR THERMAL SYSTEMS IN COMMERCIAL/ INDUSTRIAL/GOVERNMENT BUILDINGS WITH HIGH THERMAL ENERGY DEMAND

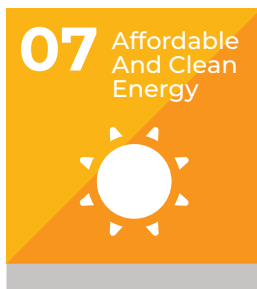
Solar thermal is a technology that harnesses solar energy for generating thermal energy for use in industries, residential buildings, and commercial properties. The energy efficiency produced by solar thermal technology is significantly higher compared to solar PV technology. Therefore, widespread adoption of solar thermal technology can optimize the generation and use of RE, subsequently helping to reduce greenhouse gas emissions. However, not all buildings in Johor have a demand for thermal energy. Certain areas, such as hospital buildings, hotels, and manufacturing industries, can be prioritized in efforts to expand the use of this system.



PROGRAMME

- Organising campaigns to introduce solar thermal technology, its functions, and the benefits of using solar thermal systems.
- Conducting feasibility studies on potential buildings (such as hospitals) for the installation of solar thermal systems.
- Implementing the phased installation of solar thermal systems in buildings (such as government hospitals).
- Promoting the use of solar thermal technology in industries.

SDG



IP 3:

INCREASE THE USE OF SOLAR WATER HEATERS IN NEW RESIDENTIAL BUILDINGS

Solar thermal technology can be used primarily for the development of new residential areas designed with an eco-friendly housing concept. Solar thermal technology can provide hot water for household use while reducing carbon footprints and electricity consumption.

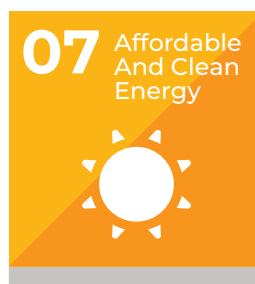


An example of solar thermal panel installation on a house rooftop

PROGRAMME

- Advising property developers to install solar thermal systems in new residential areas.
- Providing incentives to property developers who integrate solar thermal systems into new housing projects.

SDG



STRATEGY 6

Biomass and Biogas

OBJECTIVE

Increase the use of biomass and biogas in Johor by creating a biomass ecosystem in the state, developing biomass collection centres, providing incentives, and converting biogas to biomethane.

IMPLEMENTATION INITIATIVES

1. Create a biomass ecosystem in Johor to enhance the local economic value of biomass use compared to export markets.
2. Develop biomass collection centres for plantations under the Johor State Government.
3. Convert biomass and biogas into biomethane to be directly fed into the natural gas grid.



IP 1:

CREATE A BIOMASS ECOSYSTEM IN TO ENHANCE THE LOCAL ECONOMIC VALUE OF BIOMASS COMPARED TO EXPORT MARKETS

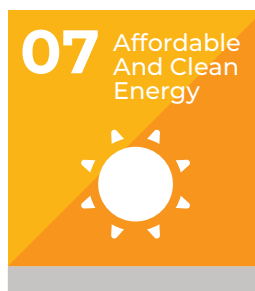
The supply chain costs and the price of biomass are not regulated at the federal or state government levels. Foreign countries offer higher purchase prices for palm kernel shells and mesocarp fibre, and accept the Malaysian Sustainable Palm Oil (MSPO) certification. As a result, most biomass sources are sold overseas, causing us to lose a potential source for RE. Additionally, small/private manufacturers lack the capital to support the use of biomass for energy production. Therefore, a biomass ecosystem needs to be established in the State of Johor to enhance the economic potential of biomass for local use.



PROGRAMME

- Conducting detailed studies to identify several strategic areas around the State of Johor for the development of biomass collection centres.
- Carrying out a comprehensive study on the potential for biomass generation and demand in Johor, and establish a regulatory body to develop and manage the biomass and biogas economy for plantations under the supervision of the Johor State Government.
- Developing more attractive incentives, such as the FIT offered by SEDA Malaysia, for biomass producers from plantations under the jurisdiction of Johor, in line with rising capital and operational costs.
- Developing an online platform for mapping and tracking the supply and demand or a biomass trading application in the State of Johor.

SDG



IP 2:

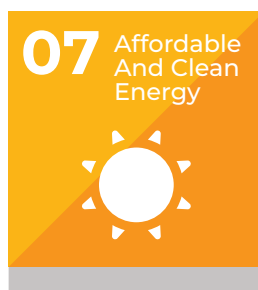
DEVELOP BIOMASS COLLECTION CENTRES FOR PLANTATIONS UNDER THE STATE GOVERNMENT OF JOHOR

Small/private manufacturers have a limited quantity of biomass, making it uneconomical to produce energy. To address this issue, small/private manufacturers are encouraged to sell to biomass collection centres. This aligns with the National Biomass Action Plan 2023-2030, which aims to develop three biomass collection and processing centres in the State of Johor, as Johor is one of the states with a high availability of biomass raw materials. The location of these biomass collection centres should be strategic, taking into account biomass sources and the existing electricity grid for delivery. The selection of suitable locations must also include environmental impact assessments, consultations with local communities, and compliance with safety and quality standards set by the authorities.

PROGRAMME

- Holding engagement sessions with Johor State Government agencies, palm oil companies, and companies with the potential to develop biomass collection centres.
- Establishing procedures and licensing for the collection and distribution of biomass from the relevant authorities.

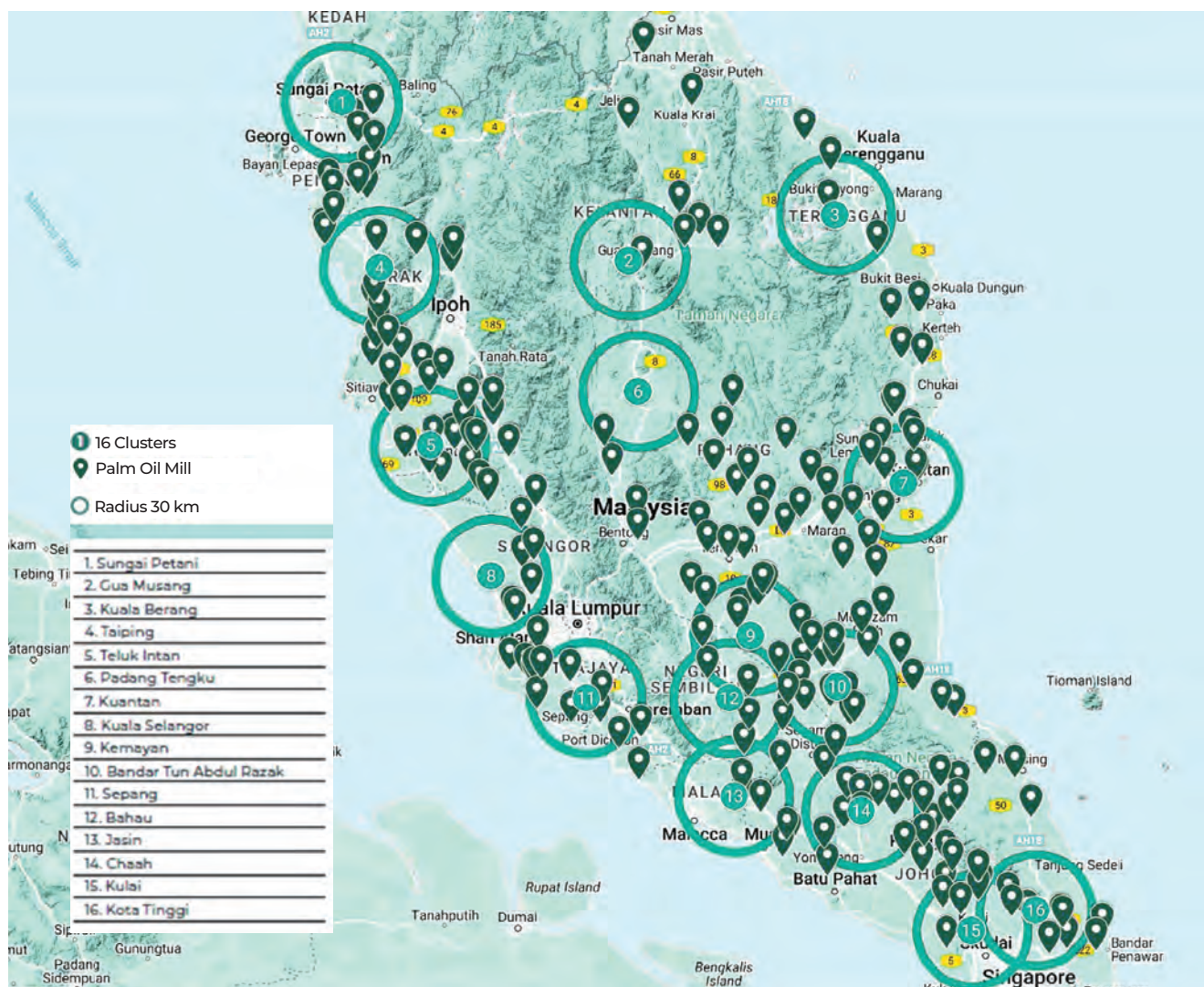
SDG



IP 3:

CONVERT BIOMASS AND BIOGAS INTO BIOMETHANE TO BE DIRECTLY FED INTO THE NATURAL GAS GRID

Biogas can be upgraded to biomethane and fed into the natural gas grid. To encourage biomethane generation from biogas sources produced by plantations under the supervision of the Johor State Government, attractive incentives such as FIT should be offered. Therefore, several action details are proposed to accelerate the delivery of biomethane from generated biogas to the natural gas grid, which can be used by industries as an alternative energy source for boilers and other processes. This biomethane can also be traded to other countries through the natural gas grid.



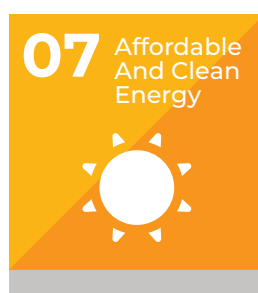
Source: National Biomass Action Plan 2023-2030

Oil Palm Biomass Clusters in Peninsular Malaysia for Grid-Connected Biomass Plants

PROGRAMME

- Identifying the injection nodal points in the PGU natural gas network.
- Conducting a detailed study considering the distance between palm oil mills and the PGU injection nodal points, as well as the costs of biomethane production and transportation.
- Implementing a natural energy grid development project for the delivery of biomethane to the PGU.

SDG



STRATEGY 7

Waste-to-Energy

OBJECTIVE

To enhance the development of waste-to-energy plants in the State of Johor through strengthening solid waste audit studies, implementing effective waste segregation programs at the source, empowering local experts, and appointing responsible agencies for the development of closed solid waste landfill sites.

IMPLEMENTATION INITIATIVES

1. Implement waste segregation at the source programme based on burnable and non-burnable components.
2. Create a data sharing platform and allocate funding for solid waste audits.
3. Appoint responsible parties for the development of closed solid waste landfill sites.
4. Empower local experts in waste-to-energy technology.



Proposed location for waste-to-energy plant development in Johor

IP 1:

IMPLEMENT WASTE SEGREGATION AT THE SOURCE PROGRAMME BASED ON BURNABLE AND NON-BURNABLE COMPONENTS

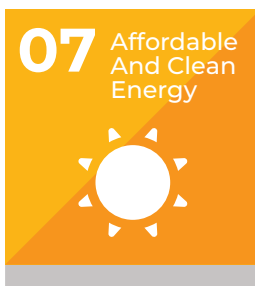
The current waste segregation programme implemented by the government is based on recyclable and non-recyclable components. This segregation approach is seen as unhelpful for the operation of waste-to-energy plants, as solid waste that is of high quality for fuel, such as plastic, is being separated for recycling. Therefore, the state government can implement a waste segregation program at the source based on burnable and non-burnable components to support the operation of waste-to-energy plants.



PROGRAMME

- Holding engagement sessions with the National Solid Waste Management Department (JPSPN) to facilitate the process of changing the segregation categories at the source.
- Developing guidelines for the community on the types of waste that fall under the burnable components category, while raising awareness about this segregation programme.

SDG



IP 2:

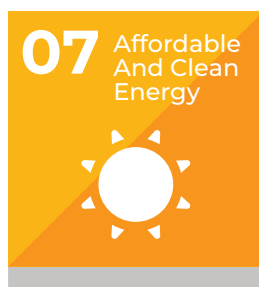
CREATE A DATA SHARING PLATFORM AND ALLOCATE FUNDING FOR SOLID WASTE AUDITS

To ensure more accurate data acquisition regarding the characteristics of solid waste in Johor, a data-sharing platform should be developed to allow all parties involved in the solid waste audit studies to share research findings, including solid waste data and study methods. At the same time, funding should be allocated to cover the high audit costs. This will enable more solid waste data to be collected through a more standardised auditing method, providing a more accurate overview of the characteristics of solid waste in Johor. This will help toward the development of more sustainable waste-to-energy plants.

PROGRAMME

- Standardising the methods and identifying the frequency of audits on the composition and characteristics of solid waste in Johor.
- Developing a data-sharing platform to provide opportunities for all involved parties to share study findings.
- Allocating funding for solid waste audits.

SDG



IP 3:

APPOINT RESPONSIBLE PARTIES FOR THE DEVELOPMENT OF CLOSED SOLID WASTE LANDFILL SITES

To date, there are 29 closed solid waste landfill sites in Johor. These sites have the potential for development. However, the development of these sites requires careful planning and studies. The Johor State Government needs to appoint an agency responsible for managing the development of these sites to ensure that it can proceed in a more organised manner.

Closed Landfill Sites in Johor

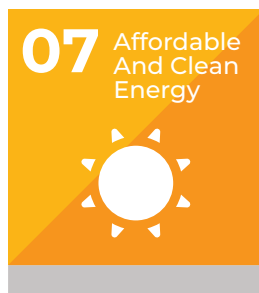
No	Closed Landfill Site	Operational Years
1	Jalan Tahana Landfill Site	1970-1999
2	Ulu Tiram Landfill Site	1997-2004
3	Lima Kedai Landfill Site	1992-1989
4	Kempas Landfill Site	1988-1995
5	Taman Mega Ria Landfill Site	1988-1995
6	Kpg Kelichap Landfill Site	1997-2004
7	Bandar Kota Tinggi Landfill Site	TM-1990
8	Sri Pantai Landfill Site	1990-2013
9	Rimba Terjun Landfill Site	1980-2003
10	Sanglang Landfill Site	1986-2003
11	Segamat Baru Landfill Site	TM-2000
12	Jementah Landfill Site	TM-2002
13	Jalan Air Hitam Landfill Site	1986-1997
14	Jalan Kubur Cina Landfill Site	1984-1990
15	Jalan Labis Landfill Site	1990-2007
16	Kampung Sri Wangi Landfill Site	2007-2008
17	Pasir Gudang Baru Landfill Site	1989-2002
18	Sabak Awor Landfill Site	1967-1982
19	Tanjung Agas Landfill Site	1983-1984
20	Tanjung Ketapang Landfill Site	1984-1986
21	Chohong Landfill Site	1980-2003
22	Sengkang Landfill Site	1970-2003
23	Jalan Temayor Landfill Site	2003-2009
24	Sungai Rengit Landfill Site	2001-2016
25	Endau Landfill Site	1996-2016
26	Bekoh Landfill Site (Md Tangkak)	2002-2019
27	Ladang Cep 1 Landfill Site (Md Simpang Renggam)	1995-2019
28	Bandar Tenggara Landfill Site (Md Kota Tinggi)	1995-2019
29	Bukit Bakri Landfill Site (Mp Muar)	1986-2021

Source: Solid Waste Management Facility Inventory, JPSPN

PROGRAMME

- Coordinating and identifying parties capable of treating, rehabilitating, reclaiming, and developing abandoned solid waste landfill sites and those that have been safely closed.
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SDG



IP 4:

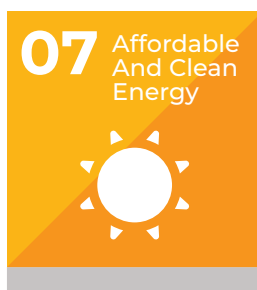
EMPOWER LOCAL EXPERTS IN WASTE-TO-ENERGY TECHNOLOGY

The development of waste-to-energy plants requires significant investment. One of the contributing factors is the high dependence on foreign expertise for the establishment of waste-to-energy plants. The state government can reduce these costs by empowering local experts in waste-to-energy technology through investments in local companies with the potential to become key players in the waste-to-energy industry.

PROGRAMME

- Identifying local experts and companies involved in the waste-to-energy plant industry.
- Implementing waste-to-energy projects.

SDG



STRATEGY 8

Hydrogen

OBJECTIVE

Developing a hydrogen economy ecosystem in Johor involves establishing hydrogen infrastructure, including hydrogen production systems and distribution networks using trucks and pipelines to deliver to end-users. The development of hydrogen production systems at lower costs will leverage local expertise, and hydrogen plants will be built using a 'public-private partnership' model between the Johor State Government and private companies.

IMPLEMENTATION INITIATIVES

1. Conduct detailed studies on the potential for hydrogen generation and demand in Johor.
2. Establish a regulatory body to develop and manage the hydrogen economy in Johor.
3. Provide matching grants and facilitate investment processes for hydrogen infrastructure in Johor.
4. Develop pilot projects based on hydrogen technology.



H₂
HYDROGEN

IP 1:

CONDUCT DETAILED STUDIES ON THE POTENTIAL FOR HYDROGEN GENERATION AND DEMAND IN JOHOR

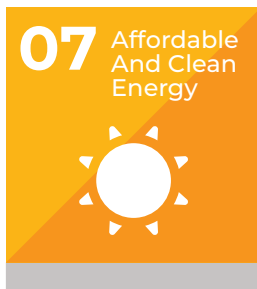
Hydrogen can be produced from various sources. For hydrogen production from RE, suitable locations must be identified to maximise the RE that can be converted into hydrogen. The areas and the level of energy demand for hydrogen also need to be studied to ensure proximity to production sites, thereby reducing costs and ensuring a continuous supply. The water resources to be used must also be assessed to ensure a continuous water supply for hydrogen production.



PROGRAMME

- Conducting a gap analysis to identify surplus RE potential that can be converted into hydrogen through electrolysis technology.
- Assessing the availability of water resources for hydrogen production via electrolysis while ensuring that existing water supply needs are not affected.
- Evaluating the availability of biomass resources to ensure a sufficient and continuous supply for hydrogen production.
- Identifying the potential uses of hydrogen in Johor.

SDG



IP 2:

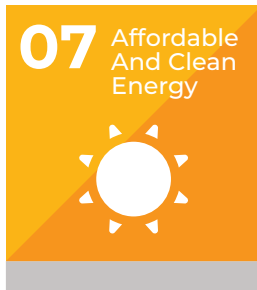
ESTABLISH A REGULATORY BODY TO DEVELOP AND MANAGE THE HYDROGEN ECONOMY IN JOHOR

A hydrogen regulatory body in Johor is crucial and will serve as a reference centre for both domestic and international investors. This body will study and outline financial incentives to attract investors in developing the hydrogen economy in Johor. It will also develop hydrogen production guidelines and regulate hydrogen infrastructure in Johor.

PROGRAMME

- Planning, coordinating, and overseeing the development of hydrogen infrastructure according to development plans, policies, and guidelines.
- Developing the Johor Hydrogen Economy Plan to drive the establishment of a green hydrogen supply chain.
- Positioning Johor as a global innovation hub for hydrogen technology, collaborating with international partners, and expanding hydrogen production bases.
- Establishing a regulatory body as a secretariat to coordinate the reporting of development and the implementation of hydrogen activities in Johor.

SDG



IP 3:

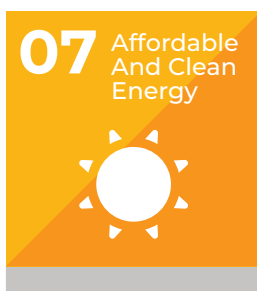
PROVIDE MATCHING GRANTS AND FACILITATE INVESTMENT PROCESSES FOR HYDROGEN INFRASTRUCTURE IN JOHOR

There are other states, such as Sarawak, that are competing with Johor in attracting hydrogen investments. Therefore, the Johor State Government needs to provide an incentive to compete with these states, such as offering matching grants and simplifying the investment process.

PROGRAMME

- Provide allocation for matching grants to hydrogen-based investments.
- Develop processes and evaluation criteria for Johor's hydrogen investments matching grants.

SDG



IP 4:

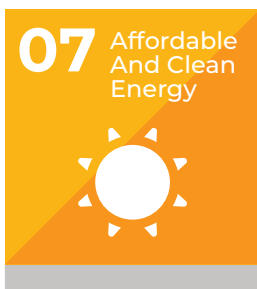
DEVELOP PILOT PROJECTS BASED ON HYDROGEN TECHNOLOGY

Developing pilot projects based on hydrogen technology is a crucial strategic step to raise community awareness about hydrogen energy and instil confidence among investors in Johor's commitment to advancing hydrogen technology. Through collaboration between the public and private sectors, these projects will not only drive sustained economic growth but also accelerate the development of hydrogen technology for broader global applications.

PROGRAMME

- ☐ Foster partnerships among the government, universities, and private companies to develop pilot hydrogen technology project using a Build Some, Buy Some approach.
- ☐ Establish satellite laboratories in collaboration with universities in Johor to create commercial technologies for hydrogen production and storage in compressed, liquid, ammonia, and solid forms.
- ☐ Implement demonstration projects to showcase the effectiveness of hydrogen technology in public transportation, power generation, and energy storage.
- ☐ Increase public awareness about the importance and benefits of hydrogen technology through educational programmes, awareness campaigns, and exposure programmes.

SDG



STRATEGY 9

Mini Hydro

OBJECTIVE

Strengthening the development of hybrid mini hydro and solar systems in the State of Johor for hydrogen production through comprehensive feasibility studies and the construction of infrastructure to facilitate the hydrogen transportation process.



IMPLEMENTATION INITIATIVES

1. Conduct a feasibility study for mini hydro systems in hydrogen production.

IP 1:

CONDUCT A FEASIBILITY STUDY FOR MINI HYDRO SYSTEMS IN HYDROGEN PRODUCTION

One of the main issues in developing mini hydro plants is that potential sites for development are often located in remote areas, far from places with high electricity demand. As a result, connecting the developed hydro system to the local electricity grid incurs high costs. At the same time, the small capacity of mini hydro plants increases the cost per unit of energy, based on the principle of economies of scale.

To address this issue, the state government could utilise the mini hydro system for hydrogen production. This system is seen as practical because hydrogen can be stored and transported from rural areas to urban or industrial areas. The mini hydro system can be integrated with other RE systems, such as solar, to increase production capacity. To realize this, the state government can conduct a feasibility study of this system, considering technical, regulatory, and financial aspects. The study should also consider an effective hydrogen transportation system from rural areas to urban or industrial areas.



Potential areas for the development of mini hydro generation in Johor



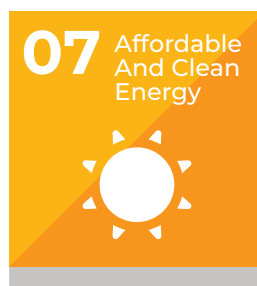
PROGRAMME

- 📄 Identifying suitable locations in Johor for the development of mini hydro and solar hybrid systems for local use or hydrogen production.

- 📄 Organising engagement sessions with stakeholders in the mini hydro, solar, and hydrogen industries to discuss issues, challenges, and costs of developing mini-hydro and solar hybrid systems.

- 📄 Conducting feasibility studies on mini hydro and solar hybrid systems for local use or hydrogen production.

SDG



STRATEGY 10

Smart Grid and Energy Storage

OBJECTIVE

Promote self-generated energy by introducing microgrid systems, smart grids, and energy storage from solar sources to reduce dependency on fossil fuel-based electricity and decrease greenhouse gas emissions.

IMPLEMENTATION INITIATIVES

1. Upgrade existing energy grid to a smart grid system.
2. Establish a trading ecosystem for smart grid system, microgrid system, and solar-based energy storage.



IP 1: UPGRADE EXISTING ENERGY GRID TO A SMART GRID SYSTEM

Given the significant increase in energy demand due to economic growth in Johor, alongside the need for energy performance reporting, particularly for carbon reporting and grid requirements, the current grid system must be upgraded to meet future changes. A smart grid system can aid in energy reporting, improve electricity distribution, and enable high penetration of RE, including the implementation of energy storage solutions.

With a smart grid system, users can reduce electricity consumption from the main grid through a SELCO mechanism. The SELCO mechanism allows users to utilise all electricity generated by their solar systems for personal use but prohibits the transfer of excess electricity to the grid network.

PROGRAMME

- 📄 Analysing the capability and capacity of the existing energy grid.
- 📄 Implementing gradual upgrades, such as installing smart grid equipment and devices.
- 📄 Promoting the SELCO concept for electricity generation within microgrids.

SDG



IP 2:

ESTABLISH A TRADING ECOSYSTEM FOR SMART GRID SYSTEM, MICROGRID SYSTEM, AND SOLAR-BASED ENERGY STORAGE

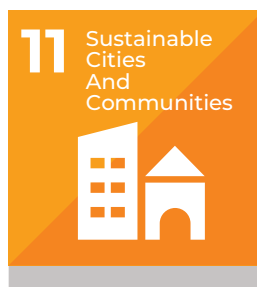
The smart microgrid system integrated with energy storage is a key initiative to enhance the implementation of RE. Additionally, energy storage is a core technology for peak load management and stabilizing variable RE. This system can be built in new or existing development zones with the aim of improving energy sustainability and optimising energy usage.

A major constraint in implementing these systems is the high upfront cost. To alleviate this financial burden, a mechanism known as the EPC can be adopted. This mechanism is a profit-sharing agreement where an energy service company bears the costs of installation, maintenance, and procurement related to smart grids, microgrids, and energy storage systems. Building owners then repay the costs based on the savings generated from these systems until the agreement term ends.

PROGRAMME

- 📄 Adopting the EPC mechanism for smart grid, microgrid, and energy storage system trade.

SDG



STRATEGY 11

Solar PV Waste Management and Disposal

OBJECTIVE

Strengthening the management of solar PV waste removal and disposal through the promotion of solar PV installations with designs suitable for recycling, the development of guidelines for solar PV waste management, and the development of recycling plants for solar PV waste.

IMPLEMENTATION INITIATIVES

1. Develop a framework for solar PV installation designs optimised for recycling.
2. Develop guidelines for solar PV waste management.
3. Develop facilities and management for solar PV waste recycling.



IP 1:

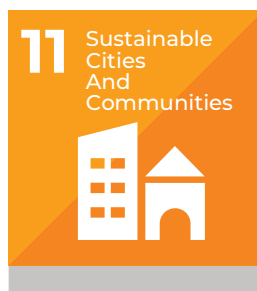
DEVELOP SOLAR PV INSTALLATION FRAME DESIGNS OPTIMISED FOR RECYCLING

The current cost of recycling solar PV waste is high due to the complex design of solar PV, which makes the recycling process difficult. This cost can be reduced if the produced solar PV has a design that is suitable for recycling. Guidelines for the criteria of solar PV with this design need to be developed to facilitate the manufacturing industry in producing this type of solar PV. This will also enable consumers who wish to purchase this type of solar PV to make the right choice. This type of solar PV may be more expensive due to higher manufacturing costs. Therefore, providing incentives for the use of this type of solar PV can help reduce the burden on consumers in adopting solar PV more sustainably.

PROGRAMME

- Developing guidelines for the criteria of solar PV that have a design suitable for recycling.
- Allocating incentives for the use of solar PV that meets the outlined criteria.

SDG



IP 2:

DEVELOP GUIDELINES FOR SOLAR PV WASTE MANAGEMENT

In Malaysia, solar PV waste is classified as electronic waste, which falls under the scheduled waste list (SW 110). This classification could burden consumers, as managing scheduled waste involves high costs. These costs can be reduced since some components in solar PV are non-hazardous and can be categorized as controlled solid waste. Moreover, these components have the potential to be recycled and provide returns to consumers. To date, no guidelines have been developed to guide consumers in effectively, sustainably, and cost-efficiently segregating and managing their solar PV waste.

PROGRAMME

📄 Developing guidelines for solar PV waste management for end users.

SDG



IP 3:

DEVELOP FACILITIES AND MANAGEMENT FOR SOLAR PV WASTE RECYCLING

Solar PV waste contains elements that can be recycled. However, to date, there are no facilities for handling solar PV waste in Johor. Therefore, the development of recycling facilities and management for solar PV waste is needed to handle the waste more effectively and systematically, while simultaneously reducing the amount of solar PV waste disposed of in landfills.



PROGRAMME

- Encouraging investment in solar PV recycling plants in Johor through income tax reductions or exemptions.

SDG



STRATEGY 12

Research, Human Capital Development, and Recognition

OBJECTIVE

To foster the development of human capital, research, and recognition in green technology, by empowering HEI in Johor to drive local innovation and produce highly skilled human capital.

IMPLEMENTATION INITIATIVES

1. Empower HEI in Johor as RE research and consultancy centres.
2. Strengthen training centres to produce highly skilled human capital to support RE development in Johor.
3. Establish a Johor Green Energy Recognition programme.
4. Launch public awareness campaigns to educate the community on the role and importance of RE.

IP 1: EMPOWER HEI IN JOHOR AS RE RESEARCH AND CONSULTANCY CENTRES

The transition from a conventional fossil-based energy system to a green and RE system requires the development of technology and commercialisation. In addition to solar PV, technologies such as solar thermal, hydrogen systems, energy storage, smart grids, and microgrids are still costly. Through research and development, the efficiency of these technologies can continue to improve, and the cost of technology can be reduced. This would make these technologies more competitive in the market. By empowering HEI, Johor can transit into a sustainable state. This will provide access to leading RE and the latest energy technology systems, as well as local technical experts.



PROGRAMME

- ▢ Providing innovation and research support in the form of grants or incentives.
- ▢ Conducting research and development related to RE-based technologies.
- ▢ Strengthening research related to the recycling process of solar PV waste.

**IP 2:****STRENGTHEN TRAINING CENTRES TO PRODUCE HIGHLY SKILLED HUMAN CAPITAL TO SUPPORT RE DEVELOPMENT IN JOHOR**

Johor's transition into a state that generates high RE will create many job opportunities, and a large number of local experts will be needed to support the growth of the technology. Therefore, the empowerment of training centres and local facilities is essential to ensure that this human capital gap can be filled by local expertise and the people of Johor.



PROGRAMME

- 📄 Conducting training and capacity-building programmes for the local community.
- 📄 Collaborating with HEI in Johor for the development of technology, human capital, skills, and advanced knowledge related to RE.
- 📄 Strengthening the modules offered by the Yayasan Pelajaran Johor to support the development of RE.
- 📄 Leveraging current and future hydrogen projects for skill training for the people of Johor to support the expansion of the new industry and hydrogen economy.

SDG



IP 3:

ESTABLISH A JOHOR GREEN ENERGY RECOGNITION PROGRAMME

Johor not only requires a well-designed business platform for RE growth but also recognition. Through recognition, many investors can be encouraged to consider investing in high-impact and innovative RE projects.

PROGRAMME

- Awarding rewards or recognition to acknowledge contributors/investors/creators/designers/users of solar-based technology to encourage the growth of green energy in Johor.
- Assisting those recognised in advancing RE-based technology for knowledge transfer among educational institutions, industries, and users.

SDG



IP 4:

LAUNCH PUBLIC AWARENESS CAMPAIGNS TO EDUCATE THE COMMUNITY ABOUT THE ROLE AND IMPORTANCE OF RE

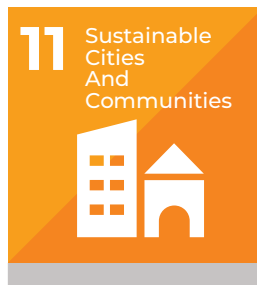
A community that is knowledgeable about RE and related technologies will better appreciate the efforts being undertaken and show greater interest in participating in these initiatives. This, in turn, has the potential to enhance the workforce and increase the number of users of RE-based technology.

To raise community awareness about the importance of RE and to encourage their involvement in supporting its development, several programmes can be promoted at both school and community levels. At the school level, programmes may include formal learning in classrooms as well as extracurricular activities such as educational trips to RE generation sites and innovation competitions centred on RE-based technology. At the community level, programmes could involve RE awareness workshops, short video contests highlighting the importance of RE, and design and innovation competitions for RE-based technology.

PROGRAMME

- Introducing new technologies based on RE and providing explanations about the advantages of these technologies.
- Promoting the latest RE projects implemented in Johor and explaining their benefits and significance through various channels such as mass media and social media.
- Having more awareness programmes at school level to provide early exposure to students on the importance of RE.
- Organising programmes themed around RE with the local community.

SDG





Conclusion

Johor Renewable Energy Policy 2030

9.0 Conclusion

The Johor RE Policy 2030 outlines a comprehensive and strategic direction for the RE sector, encompassing solar energy, biomass, biogas, mini hydro power, waste-to-energy, and hydrogen. This RE policy has the potential to drive economic growth in Johor, particularly through energy trade. The Johor State Government can position itself as a leading player in the regional energy market, thereby attracting both domestic and international investors. This economic development will, in turn, accelerate the advancement of RE infrastructure and technology in Johor. Additionally, the policy aims to cultivate a skilled local workforce in the RE industry while creating more job opportunities for the people of Johor.

The Johor RE Policy 2030 aligns with existing national policies such as the National Energy Policy 2022-2040 (NEP) and the NETR. This policy enables Johor to effectively address challenges while contributing to the nation's Low Carbon Aspiration by 2040. The continuity of this RE policy will extend until 2040, with ongoing improvements to ensure it remains relevant to the changing circumstances of the time. Therefore, it is crucial for all stakeholders, including government agencies, industry players, and local communities, to be actively involved and collaborate in ensuring the successful achievement of the vision and mission outlined in this policy.



Action Plan

**Johor Renewable
Energy Policy 2030**

10.0 Action Plan Schedule

The Johor 2030 RE Action Plan encompasses 12 main strategies, 38 implementation initiatives, and 99 programmes. Details regarding the lead agencies, supporting agencies, timeline, and implementation years for each programme planned in this action plan are as follows in the table below.

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S1 Large-Scale Solar	IP1 Establish SJREC for solar energy generation zone.	P1 Conducting a detailed study and propose strategic locations within SJREC for the development of LSS PV projects.	BPENJ	PTG, JSC, PBT, PLANMalaysia Johor, GLC	/			
	IP2 Promote the development of LSS PV projects across the State of Johor.	P1 Engaging in discussions with TNB to increase the number of nodal points for solar energy injection into the existing electrical grid.	BPENJ	TNB, ST	/			
		P2 Providing incentives for interested parties to develop LSS PV projects across Johor.	BPENJ	PBT, JSC	/			
		P3 Making information about solar development plans in Johor available on the state government's website.	BPENJ	PBT, JSC	/			
		P4 Implementing LSS PV projects in suitable areas across Johor.	BPENJ	PBT, JSC TNB, ST				

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S1 Large-Scale Solar	IP3 Develop a platform to streamline application and monitoring processes for LSS Projects.	P1 Developing a dedicated website accessible to any interested parties for applying to develop LSS projects.	ICT Johor	BPENJ, JSC	/			
		P1 Preparing a land bank inventory by identifying plots of land that will remain undeveloped for the next 21 years for LSS project development.	PTG	BPENJ, JSC	/			
		P2 Establishing a special fund to support feasibility studies for RE development.	BPENJ	JSC, PTG, PBT	/			
		P3 Coordinating with Bank Negara to facilitate the provision of special banking interest rates for LSS project development.	JSC	MGTC, Bank Negara	/			
S2 Floating Solar	IP1 Develop a framework for constructing floating solar PV projects.	P1 Conducting environmental and technical impact studies for solar developments in water catchment areas in collaboration with the JAS.	BPENJ	JSC, JAS, HEI	/			
		P2 Executing social and economic impact studies that consider the effects on fishing activities, fishermen, shipping, and indigenous communities that may be affected by this project.	BPENJ	JSC, BAKAJ, Marine Department of Malaysia, JAS, HEI	/			

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S2 Floating Solar	IP2 Establish zones for floating solar PV development.	P1 Identifying suitable areas for floating solar installations, such as disused mines, lakes, water catchment areas (rivers/reservoirs), and coastal waters.	BAKAJ	PTC, BAKAJ, PBT, Marine Department of Malaysia, JPS	/			
		P2 Establishing procedures to obtain approvals and licenses from relevant authorities for the development of floating solar projects.	BPENJ	PTC, BAKAJ, PBT, Marine Department of Malaysia, JPS	/			
		P3 Implementing floating solar projects in identified locations, including disused mines, lakes, water catchment areas (rivers/reservoirs), and coastal waters.	BPENJ	BAKAJ, PBT	/			
S3 Solar for Buildings	IP1 Install solar PV systems for ZEB programmes under Green BIPV.	P1 Implementing a Green Lane initiative for each PBT to expedite the approval process for the installation of solar PV systems for green buildings by commercial/ industrial sectors.	SUK Local Government Division (SUK BKT)	JSC, Accreditation Panel (GBI), CASBEE Iskandar Centre (CIC), GreenRE, REHDA and others in collaboration with the Sustainable Energy Development Authority (SEDA)	/			
		P2 Incorporating green building elements, particularly related to the installation of BIPV systems, into the progress/development plans of each PBT.	SUK BKT	PBT	/			
	IP2 Use government buildings in Johor as pilot projects for solar PV installations.	P1 Conducting a detailed study on the locations of government buildings in areas with solar radiation exceeding 3.6 kWh/kWp.	Management Services Division (BKP)	SUK BKT, PBT, TNB, SEDA	/			

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S3 Solar for Buildings	IP3 Promote various concepts for solar installations on buildings.	P2 Initiating the procurement and development process for solar PV systems for selected government buildings based on the results of the location study.	BKP	SUK BKT, PBT, TNB, SEDA	/			
		P3 Installing an energy monitoring system to regularly assess the performance of the installed solar PV systems.	BKP	SUK BKT, PBT, TNB, SEDA	/			
		P1 Conducting campaigns for residential communities to highlight the mutual benefits of community solar projects using tied funds managed by Joint Management Committees.	JSC	BPENJ,	/			
		P2 Conducting campaigns to educate industrial and commercial building owners about the benefits of rooftop leasing for BIPV installations.	JSC	BPENJ, PBT	/			
		P3 Introducing additional incentives for solar leasing initiatives and community solar projects.	BPENJ	PBT, JSC	/			
	P4 Reviewing the proposal to include Solar RE Guidelines as part of the conditions in planning permission evaluations.	PLANMalaysia Johor	SUK BKT, PBT	/				
	P5 Recommending housing developers to install solar PV systems in new residential areas.	PBT	BPENJ, PKPJ	/				

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S3 Solar for Buildings	IP4 Expand the use of solar-powered EV chargers.	P1 Conducting a detailed study on strategic locations for converting existing EV charging stations to solar-powered smart chargers.	JSC	BPENJ, PTG, PBT, PLANMalaysia Johor, HEI		/		
		P2 Developing guidelines for integrated solar EV charging to ensure organized and consistent implementation.	PLAN Malaysia johor	BPENJ, PBT		/		
		P3 Creating a business ecosystem for solar-powered smart EV charging products.	JSC	Invest Johor		/		
		P4 Introducing incentives for the development of new solar-powered smart chargers.	BPENJ	JSC		/		
S4 Energy Trade	IP1 Develop a RE power grid as an enabler for RE trade.	P1 Conducting a detailed market study in target countries to understand energy usage patterns, regulatory frameworks, and the potential demand for RE markets	BPENJ	JSC, HEI	/			
		P2 Developing a strategic RE grid to facilitate the trade of RE to other countries.	Grid Leader	GLC, TNB, Independent Power Producer (IPP)			/	
	IP2 Develop natural gas grids and hydrogen pipelines for energy from bio sources and green hydrogen for trade purposes.	P1 Conducting a detailed market study in target countries to understand energy consumption patterns, regulatory frameworks, and potential demand for RE markets.	BPENJ	JSC, HEI	/			
		P2 Developing a natural gas grid and hydrogen pipeline for the transmission of biomethane and green hydrogen across borders.	Grid Leader	GLC, TNB, IPP			/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation				Cost (RM)
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)		
					2025-2026	2025-2028	2025-2030		
S4 Energy Trade	IP3 Establish REC for RE grids and natural gas grids.	P1 Developing REC from bio-based energy sources produced from regulated sources under the Johor State Government	Grid Leader	JSC, BURSA Malaysia		/			
		P2 Determining the price of REC managed by the RE grid operator at SJREC and the natural gas grid operator with BURSA Malaysia.	Grid Leader	BPENJ, GLC, JSC, BURSA Malaysia, TNB, ST			/		
	IP4 Provide a digital trading platform.	P1 Developing a digital platform to facilitate energy trading using the RE grid.	GLC	JSC, TNB, SKMM, IPP, Consulting Body			/		
		P2 Utilising data analytics to optimize the trading platform for the efficiency and effectiveness of RE buying and selling, ensuring grid stability.	GLC	JSC, TNB, SKMM, IPP, Consulting Body			/		
S5 Solar Thermal	IP1 Balance the competitiveness of solar thermal technology to be on par with solar PV through incentives.	P1 Conducting studies on suitable incentive methods for solar thermal technology.	BPENJ	JSC, HEI	/				
		P2 Providing incentives to building owners who switch to solar thermal systems to generate thermal energy at their premises.	BPENJ	JSC, Accreditation Panel (GBI), CIC, GreenRE, REHDA, SEDA		/			

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S5 Solar Thermal	IP2 Expand the use of solar thermal systems in commercial/ industrial/ government buildings with high thermal energy demand.	P1 Organising campaigns to introduce solar thermal technology, its functions, and the benefits of using solar thermal systems.	JSC	BPENJ, HEI, SIRIM	/			
		P2 Conducting feasibility studies on potential buildings (such as hospitals) for the installation of solar thermal systems.	BPENJ	JSC, PBT, HEI, SIRIM, ST, SEDA	/			
		P3 Implementing the phased installation of solar thermal systems in buildings (such as government hospitals).	GLC	SUK BKT, JSC, PBT, SIRIM, ST, SEDA		/		
		P4 Promoting the use of solar thermal technology in industries.	SIRIM	JSC, PBT, ST, SEDA		/		
	IP3 Increase the use of solar water heaters in new residential buildings.	P1 Advising property developers to install solar thermal systems in new residential areas	PKPJ	BPENJ, REHDA			/	
		P2 Providing incentives to property developers who integrate solar thermal systems into new housing projects.	PKPJ	PBT			/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S6 Biomass and Biogas	IP1 Create a biomass ecosystem in Johor to enhance the local economic value of biomass compared to export markets.	P1 Conducting detailed studies to identify several strategic areas around the State of Johor for the development of biomass collection centres.	BPENJ	JSC, GLC, HEI	/			
		P2 Carrying out a comprehensive study on the potential for biomass generation and demand in Johor, and establish a regulatory body to develop and manage the biomass and biogas economy for plantations under the supervision of the Johor State Government.	BPENJ	JSC, GLC, HEI	/			
		P3 Developing more attractive incentives, such as the FIT offered by SEDA Malaysia, for biomass producers from plantations under the jurisdiction of Johor, in line with rising capital and operational costs.	BPENJ	JSC, GLC		/		
		P4 Developing an online platform for mapping and tracking the supply and demand or a biomass trading application in the State of Johor.	BPENJ	JSC, GLC			/	
	IP2 Develop biomass collection centres for plantations under the Johor State Government.	P1 Holding engagement sessions with Johor State Government agencies, palm oil companies, and companies with the potential to develop biomass collection centres.	BPENJ	JSC, GLC		/		
		P2 Establishing procedures and licensing for the collection and distribution of biomass from the relevant authorities.	BPENJ	JSC, GLC			/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S6 Biomass and Biogas	IP3 Convert biomass and biogas into biomethane to be directly fed into the natural gas grid.	P1 Identifying the injection nodal points in the PGU natural gas network.	BPENJ	JAS	/			
		P2 Conducting a detailed study considering the distance between palm oil mills and the PGU injection nodal points, as well as the costs of biomethane production and transportation.	BPENJ	JAS, HEI		/		
		P3 Implementing a natural energy grid development project for the delivery of biomethane to the PGU.	GLC	JAS			/	
S7 Waste-to-Energy	IP1 Implement waste segregation at the source programme based on burnable and non-burnable components.	P1 Holding engagement sessions with the National Solid Waste Management Department (JPSPN) to facilitate the process of changing the segregation categories at the source.	SUK BKT	JPSPN, SWCorp	/			
		P2 Developing guidelines for the community on the types of waste that fall under the burnable components' category, while raising awareness about this segregation programme.	SUK BKT	JPSPN, SWCorp	/			
	IP2 Create a data sharing platform and allocate funding for solid waste audits.	P1 Standardising the methods and identifying the frequency of audits on the composition and characteristics of solid waste in Johor.	SUK BKT	SWCorp, HEI	/			
		P2 Developing a data-sharing platform to provide opportunities for all involved parties to share study findings.	SUK BKT	SWCorp, HEI	/			
		P3 Allocating funding for solid waste audits.	BPENJ	SUK BKT, SWCorp		/		

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S7 Waste-to-Energy	IP3 Appoint responsible parties for the development of closed solid waste landfill sites.	P1 Coordinating and identifying parties capable of treating, rehabilitating, reclaiming, and developing abandoned solid waste landfill sites and those that have been safely closed.	SUK BKT	BPENJ, GLC		/		
	IP4 Empower local experts in waste-to-energy technology.	P1 Identifying local experts and companies involved in the waste-to-energy plant industry.	SUK BKT	BPENJ		/		
		P2 Implementing waste-to-energy projects	Industrial Players	BPENJ, Invest Johor			/	
S8 Hydrogen	IP1 Conduct detailed studies on the potential for hydrogen generation and demand in Johor.	P1 Conducting a gap analysis to identify surplus RE potential that can be converted into hydrogen through electrolysis technology.	BPENJ	HEI	/			
		P2 Assessing the availability of water resources for hydrogen production via electrolysis while ensuring that existing water supply needs are not affected.	BPENJ	BAKAJ, HEI	/			
		P3 Evaluating the availability of biomass resources to ensure a sufficient and continuous supply for hydrogen production.	BPENJ	HEI	/			
		P4 Identifying the potential uses of hydrogen in Johor.	BPENJ	HEI	/			

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S8 Hydrogen	IP2 Establish a regulatory body to develop and manage the hydrogen economy in Johor	P1 Planning, coordinating, and overseeing the development of hydrogen infrastructure according to development plans, policies, and guidelines.	BPENJ	JSC, PBT, HEI		/		
		P2 Developing the Johor Hydrogen Economy Plan to drive the establishment of a green hydrogen supply chain	BPENJ	JSC, PBT, HEI		/		
		P3 Positioning Johor as a global innovation hub for hydrogen technology, collaborating with international partners, and expanding hydrogen production bases.	BPENJ	JSC, PBT, HEI		/		
		P4 Establishing a regulatory body as a secretariat to coordinate the reporting of development and the implementation of hydrogen activities in Johor.	BPENJ	JSC, PBT, HEI		/		
	IP3 Provide matching grants and facilitate investment processes for hydrogen infrastructure in Johor	P1 Provide allocation for matching grants to hydrogen-based investments	BPENJ	Invest Johor, MIDA		/		
		P2 Develop processes and evaluation criteria for Johor's hydrogen investments matching grants.	BPENJ	Invest Johor, MIDA		/		

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S8 Hydrogen	IP4 Develop pilot projects based on hydrogen technology.	P1 Foster partnerships among the government, universities, and private companies to develop pilot hydrogen technology project using a Build Some, Buy Some approach.	BPENJ	GLC, HEI, Industry			/	
		P2 Establish satellite laboratories in collaboration with universities in Johor to create commercial technologies for hydrogen production and storage in compressed, liquid, ammonia, and solid forms.	HEI	GLC, Industry			/	
		P3 Implement demonstration projects to showcase the effectiveness of hydrogen technology in public transportation, power generation, and energy storage.	BPENJ	GLC, HEI, Industry			/	
		P4 Increase public awareness about the importance and benefits of hydrogen technology through educational programmes, awareness campaigns, and exposure programmes.	BPENJ	GLC, HEI, Industry			/	
S9 Mini Hydro	IP1 Conduct a feasibility study for mini hydro systems in hydrogen production.	P1 Identifying suitable locations in Johor for the development of mini hydro and solar hybrid systems for local use or hydrogen production.	BPENJ	BAKAJ, JPS			/	
		P2 Organising engagement sessions with stakeholders in the mini hydro, solar, and hydrogen industries to discuss issues, challenges, and costs of developing mini hydro and solar hybrid systems.	BPENJ	BAKAJ, JPS, HEI, MGTC, Industry			/	
		P3 Conducting feasibility studies on mini hydro and solar hybrid systems for local use or hydrogen production.	BPENJ	JSC, HEI			/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S10 Smart Grid and Energy Storage	IP1 Upgrade existing energy grid to a smart grid system.	P1 Analysing the capability and capacity of the existing energy grid.	BPENJ	TNB	/			
		P2 Implementing gradual upgrades, such as installing smart grid equipment and devices.	Pemain Industry	TNB	/			
		P3 Promoting the SELCO concept for electricity generation within microgrids.	JSC	TNB	/			
	IP2 Establish a trading ecosystem for smart grid system, microgrid system, and solar-based energy storage.	P1 Adopting the EPC mechanism for smart grid, microgrid, and energy storage system trade.	BPENJ	TNB, SEDA, ST	/			
S11 Solar PV Waste Management and Disposal	IP1 Develop solar PV installation frame designs optimised for recycling.	P1 Developing guidelines for the criteria of solar PV that have a design suitable for recycling.	PLAN Malaysia Johor	HEI, JPSPN, JAS, SWCorp, MGTC, SEDA	/			
		P2 Allocating incentives for the use of solar PV that meets the outlined criteria.	BPENJ	JPSPN, JAS, SWCorp, MGTC, SEDA	/			
	IP2 Develop guidelines for solar PV waste management.	P1 Developing guidelines for solar PV waste management for end users.	PLAN Malaysia Johor	JAS, SWCorp, SEDA	/			
	IP3 Develop facilities and management for solar PV waste recycling.	P1 Encouraging investment in solar PV recycling plants in Johor through income tax reductions or exemptions.	Invest Johor	BPENJ, LHDN	/			

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S12 Research, Human Capital Development, and Recognition	IP1 Empower HEI in Johor as RE research and consultancy centres.	P1 Providing innovation and research support in the form of grants or incentives.	Johor Human Capital Strategy Unit	BPENJ, HEI	/			
		P2 Conducting research and development related to RE-based technologies.	HEI	JSC	/			
		P3 Strengthening research related to the recycling process of solar PV waste.	HEI	JSC	/			
		P1 Conducting training and capacity-building programmes for the local community.	Johor Human Capital Strategy Unit	Yayasan Pelajaran Johor, HEI, JPK	/			
	IP2 Strengthen training centres to produce highly skilled human capital to support RE development in Johor.	P2 Collaborating with HEI in Johor for the development of technology, human capital, skills, and advanced knowledge related to RE.	Johor Human Capital Strategy Unit	Yayasan Pelajaran Johor, HEI, JPK	/			
		P3 Strengthening the modules offered by the Yayasan Pelajaran Johor to support the development of RE.	Yayasan Pelajaran Johor	Johor Human Capital Strategy Unit, HEI, JPK	/			
		P4 Leveraging current and future hydrogen projects for skill training for the people of Johor to support the expansion of the new industry and hydrogen economy.	Johor Human Capital Strategy Unit	HEI, JPK			/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation			
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)	Cost (RM)
					2025-2026	2025-2028	2025-2030	
S12 Research, Human Capital Development, and Recognition	IP3 Establish a Johor Green Energy Recognition programme	P1 Awarding rewards or recognition to acknowledge contributors/ investors/creators/designers/ users of solar-based technology to encourage the growth of green energy in Johor	JSC	BPENJ, MGTC	/			
		P2 Assisting those recognised in advancing RE-based technology for knowledge transfer among educational institutions, industries, and users	JSC	BPENJ, MGTC	/			
	IP4 Launch public awareness campaigns to educate the community on the role and importance of RE.	P1 Introducing new technologies based on RE and providing explanations about the advantages of these technologies	JSC	BPENJ, HEI	/			
		P2 Promoting the latest RE projects implemented in Johor and explaining their benefits and significance through various channels such as mass media and social media	JSC	BPENJ, HEI	/			
		P3 Having more awareness programmes at school level to provide early exposure to students on the importance of RE	JSC	BPENJ, Johor State Education Department	/			
		P4 Organising programmes themed around RE with the local community	JSC	BPENJ, HEI	/			

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